2010 OZARK SUMMIT

Living On Karst:

Sustainable Management of Ozark Ecosystems

October 19-21, 2010

U.S. Fish & Wildlife Service · Arkansas Game & Fish Commission · USGS science for a changing world · Land Legacy · The Nature Conservancy · Oklahoma · Northeastern State University

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OZARK SUMMIT SPONSORS

Ozark Summit Agenda

MONDAY, OCTOBER 18

6:00 - 8:00 PM	**Informal Social**	

TUESDAY, OCTOBER 19

7:30 - 8:30 AM	**Registration**	
7:45 - 8:15 AM	**Facilitator / Moderator**	*Cypress Room*
8:30 - 9:00 AM	**Opening Ceremony**	*Cherokee Nation, Ballroom*
9:00 - 9:10 AM	**General Remarks**	*Summit Coordinators*
9:10 - 9:30 AM	**Opening Remarks**	*FWS Region 2*
9:30 - 10:30 AM	**Freedom to Roam**	*Gary Tabor*
10:30 - 10:45 AM	**Break**	
10:45 - 11:30 AM	**Landscape Conservation Cooperative / Climate Change**	*FWS Appalachian LCC Coordinator, Jean Brennan*
11:30 - 12:15 PM	**Landscape Conservation Cooperative**	*FWS Gulf Coastal Plains & Ozarks LCC Coordinator, Bill Uihlein*
12:15 - 1:00 PM	**Lunch**	*NSU Cafeteria & Eateries Onsite*
1:00 - 1:50 PM	**World Café**	*Summit Coordinators, Ballroom*
1:50 - 2:00 PM	**Move to Talks**	
2:00 - 3:40 PM	**Scientific Presentations**	
3:40 - 3:50 PM	**Reconvene in Ballroom**	
3:50 - 4:15 PM	**LCC Q & A**	*LCC Panel*
4:15 - 4:50 PM	**LCC Topic Development**	*Summit Coordinators*
4:50 - 5:00 PM	**Day 1 Wrap-up / Remarks**	*Summit Coordinators*

WEDNESDAY, OCTOBER 20

8:00 - 8:10 AM	**Day 2 Greetings**	*Summit Coordinators*
8:10 - 8:40 AM	**Ethnobotany**	*Chickasaw Nation, Steven Bond*
8:40 - 9:25 AM	**Healthy Forests Reserve Program**	*Natural Resrouces Conservation Service, Suzanne Collier*
9:25 - 9:30 AM	**General Remarks**	*Summit Coordinators*
9:30 - 10:45 AM	**Poster Session**	
10:45 - 12:00 PM	**Breakout Groups**	*LCC Proposal Development, Concurrent Sessions*
12:00 - 12:45 PM	**Lunch**	*NSU Cafeteria & Eateries Onsite*
12:45 - 1:45 PM	**Breakout Groups**	*LCC Proposal Development, Concurrent Sessions*
1:45 - 6:30 PM	**Float on Illinois River**	*Load Buses, Travel to Arrowhead, Cont. Breakout Discussions*
6:30 - 9:00 PM	**Evening Social**	*Canoe trip to terminate on location of evening social*
9:00 - 10:00 PM	**Return to NSU**	*Travel to NSU*

THURSDAY, OCTOBER 21

9:00 - 9:15 AM	**Day 3 Greeting**	*Summit Coordinators*
9:15 - 9:30 AM	**Images from Ozark Photographer**	
9:30 - 11:00 AM	**Breakout Groups**	*LCC Proposal Development, Concurrent Sessions*
11:00 - 11:15 AM	**Break**	
11:15 - 12:15 PM	**LCC Proposal Briefing**	*LCC Proposal Briefing / Q&A*
12:15 - 12:30 PM	**Close out Speaker**	
12:30 - 12:45 PM	**Final Remarks / Adjourn**	*Summit Coordinators*

Oral Presentations

REDBUD

2:00 - 2:20 PM	Overview of the Ozark Region with the Oklahoma Comprehensive Wildlife Conservation Strategy	*Mark Howery*
2:20 - 2:40 PM	Protection of Critical Ozark Land: A Case Study	*Jeff Crosby and Mark Howery*
2:40 - 3:00 PM	Geologic Framework of Ozark Karst Landscapes: Example from the Buffalo River Area, Northern Arkansas	*Mark R. Hudson, Kenzie J. Turner, Chuck Bitting, James E. Kaufmann, and Timothy M. Kresse*
3:00 - 3:20 PM	The Relation of Land Use, Geology, and Karst Features to Groundwater Quality in the Ozark Mountains of Northern Arkansas	*Tim M. Kresse, Phillip D. Hays and Mark R. Hudson*
3:20 - 3:40 PM	The stratigraphic and geographic distribution of sinkholes in the Mill Creek and Buffalo River area of northern Arkansas	*James E. Kaufmann, Aaron T. Lingelbach, and Mark R. Hudson*

MORGAN

2:00 - 2:20 PM	Planning for White-Nose Syndrome	*Rich Geboy*
2:20 - 2:40 PM	Essential Management Strategies for Maintaining Cave Ecosystems with the Anticipated Loss of Bats to White-Nose Syndrome	*Tom Aley*
2:40 - 3:00 PM	Efficient Repeatable Approach to Quantitative Call Identification	*C. Ryan Allen and Lynn W. Robbins*
3:00 - 3:20 PM	Ozark Plateau National Wildlife Refuge: Management of Federally Listed Endangered and Threatened Cave Species in Oklahoma	*Steven L. Hensley, Shea L. Hammond, Richard C. Stark, William W. Puckette, Keith Martin, and David Leslie Jr.*
3:20 - 3:40 PM	Ozark Cavefish conservation in Missouri: A pro-active approach to Karst conservation and sensitive species recovery	*Rick Horton and Blake Stephens*

DOGWOOD

2:00 - 2:20 PM	Soil Carbon Stocks and Sequestration Potential in Oklahoma Cropland. The link to Resource Conservation	*Jason G. Warren*
2:20 - 2:40 PM	Reduction of Non-Point Source Run-off in the Illinois River Watershed through Voluntary Programs Working Together	*Gina Crowder Levesque and Tashina Mitchell Kirk*
2:40 - 3:00 PM	Estimation of Surface Runoff Area Effected by Riparian Buffers in the Illinois River Watershed	*Bullit M. Farris, Jerry E. Starkey, and Gina C. Levesque*
3:00 - 3:20 PM	An Analysis of Algal, Macroinvertebrate, and Fish Community Indices for Assessing Low-level Nutrient Concentrations in Wadeable Ozark Streams	*Billy G. Justus, James C. Petersen, Suzanne Femmer, Jerri Davis, and James Wallace*
3:20 - 3:40 PM	Oklahoma Hydrologic Integrity Assessment Process: Tools for Assessment of Instream Flows for Oklahoma Streams	*Rachel Esralew, Titus Seilheimer, William Fisher, Don Turton*

CYPRESS

2:00 - 2:20 PM	Oklahoma Landscape Conservation Alliance – Supporting Landscape Conservation Cooperatives	*Dixie L. Bounds, Kim Winton, and Mark Howery*
2:20 - 2:40 PM	The Central Hardwoods Joint Venture Approach to Avian Conservation Planning	*D. Todd Jones-Farrand and Jane A. Fitzgerald*
2:40 - 3:00 PM	Foraging Forest Birds Require High Tree Diversity in the Southern Ozarks	*Carol J. Patterson and Douglas A. James*
3:00 - 3:20 PM	Landcover and Vegetation of the Ozark Plateau, Oklahoma, ca. 1897	*Bruce Hoagland and Christy Batterson*
3:20 - 3:40 PM	A Floristic Inventory of Six Tracts of Ozark Plateau National Wildlife Refuge in Adair County, Oklahoma	*Mary E. Gard, Charriss R.H. York, Steve Hensely, Will F. Lowry, and Ronald J. Tyrl*

Essential Management Strategies for Maintaining Cave Ecosystems with the Anticipated Loss of Bats to White-Nose Syndrome

Tom Aley

In the last four years White-Nose Syndrome (WNS), a recently discovered bat-specific disease, has killed over a million bats in the eastern United States. The bats that have died hibernated in caves, mines, and similar sites. WNS first appeared near Albany, New York and significant mortalities have occurred over a large area. A fungus (Geomyces destructans) associated with WNS has been found from Quebec and Ontario into Tennessee, Missouri, and northwestern Oklahoma. It is unclear whether this is a pathogenic or opportunistic fungi, but it is clearly associated with the bat deaths. WNS mortality has occurred in at least six bat species in three genera. Mortalities in infected colonies have ranged from 70 to 100%. Bats appear to have little or no natural or acquired immunity to WNS. The syndrome is primarily spread by bat-to-bat contact. Based upon current knowledge, we must expect the loss of many to most bats in temperate North America.

Bat guano is the dominant energy source for many of the most biologically significant caves in the Ozarks. Dead bats and various invertebrates shed by bats during preening may also be an important food source for some cave species. The importance of bats to some cave faunas is well illustrated at Tumbling Creek Cave. This cave, at the Ozark Underground Laboratory in Taney County, Missouri, has a current summer population of 30,000 to 50,000 gray bats (Myotis grisescens). An initial estimate is that the bats provide over 90% of the total energy input to this cave. This cave has the most diverse cave fauna of any cave west of the Mississippi River. The fauna includes several endemic species and three federally endangered species.

Management strategies that minimize environmental and food stresses on cave faunas are essential to prevent severe declines, and almost certainly extinctions, in caves where bats are an important energy source. A number of these strategies have been implemented at Tumbling Creek Cave. These include enhancement of water quality with actions including the cleanup of dumps in sinkholes or areas that feed losing streams. Establishment and protection of riparian corridors along losing streams improves water quality in associated cave streams. Various land management actions, including reforesting riparian corridors, enhance macropore flow through soils and increase the input of suspended organic matter into karst groundwater systems. Suspended organic matter is an important energy source for cave faunas, and especially for aquatic species.

Small piles of sticks can be placed in caves to partially offset the loss of bat guano. These "food plots" have been used in Tumbling Creek Cave for over 40 years to attract cave invertebrates to localized areas. They have a useful life of at least 20 years. Some general guidance for the use of this strategy is provided. Tree species likely to be particularly useful, and others that should be avoided, are identified.

Tom Aley, President, Ozark Underground Laboratory, Inc.

Oral

Efficient Repeatable Approach to Quantitative Call Identification

C. Ryan Allen and Lynn W. Robbins

Since the inception of bat detectors, researchers have attempted to successfully identify bats based on their echolocation calls. These attempts often include mathematics such as discriminate function analysis and neural networks. Though some of these efforts have produced promising results, no standard exists for quantitative identification of echolocation calls. Predominately, calls are visually identified using qualitative methods developed by comparison to known call libraries. While this is the excepted method, identification is subject to the individual tasked with analysis interpretations, making it difficult to be represented as repeatable science. Additionally, manually traversing thousands of call files is time prohibitive. With proliferation of wind farms throughout North America, bat research is increasingly based on presence/absence studies. Commonly, Anabat detectors are used in passive monitoring of these sites by researchers and environmental consultants. White-Nose Syndrome has also introduced new uses for bat detectors as a means of gathering baseline data. This type of research produces a vast amount of data, often

without a knowledgeable individual for interpretation. The goal was to produce a program capable of emulating the qualitative analysis of an experienced researcher. The program, currently named Bat Call Identification (BCID), is written in C++ and interacts with AnalookW in order to filter out noise and extract call parameters from zero-crossing call files. A known call library was collected over 10+ years from eight states by several universities using light tags, hand releases, and passive monitoring in locations where no other species were present. Extracted parameters are individually compared to quantitative ranges of parameters produced by species known to exist in particular geographic regions. Using a weighted analysis, individual chirps are assigned a species and the dominate species present in the sequence is the predicted value. If no species dominates, the sequence is assigned a value of unknown. The results can be appended directly to the Anabat file header and are displayed in an excel spreadsheet. BCID analyzes approximately 43 calls/sec or 10000 call files in 3:54. Broken into groups the following accuracy rates were obtained: Low - 100% correct species group, 86.56% correct species, 1.62% unknown, 11.83% misidentified (Eptesicus fuscus, Lasiurus cinereus, Lasionycteris noctivagans) (n = 186), Mid – 94.92% correct species group, 87.81% correct species, 3.87% unknown, 8.47% misidentified (L. borealis, Nycticeius humeralis, Perimyotis subflavus) (n = 181), Myotis – 96.22% correct species group, 84.88% correct species, 3.44% unknown, 11.68% misidentified (Myotis sodalis, M. septentrionalis, M. grisescens, M. lucifugus, M. leibii) (n = 291). The overall performance of the software with these species is: 97.24% correct species group, 86.17% correct species, 3.44% unknown, 10.79% misidentified. Given the extreme natural variation of bat echolocation, we consider these numbers to be comparable with that of an experienced investigator, while continuing to maintain repeatability. BCID is designed so individuals with no experience in call identification can obtain meaningful results from passive data, while those with extensive experience are able to adjust the settings (e.g. set minimum number of chirps, set species present, use specific filters) in order to suit their needs.

Missouri State University, Springfield, MO

Oral and Poster

Occurrence of Organic Wastewater and Other Contaminants in Cave Streams in Eastern Oklahoma and Western Arkansas

Joseph R. Bidwell[1], Carol Becker[2], Steve Hensley[3], Richard Stark[4], and Michael T. Meyer[5]

The prevalence of organic wastewater compounds in surface waters of the United States has been reported in a number of recent studies. In karstic areas, surface contaminants may be transported to ground water and ultimately cave ecosystems where they may impact resident biota. In this study, polar organic chemical integrative samplers (POCIS) and semi-permeable membrane devices (SPMD) were deployed in six caves and two surface-water sites located within the Ozark Plateau of northeastern Oklahoma and northwestern Arkansas in order to detect potential chemical contaminants in these systems. All caves sampled were known to contain populations of the threatened Ozark cavefish, Amblyopsis rosae. The surface-water site in Oklahoma was directly downstream from the outfall of a municipal wastewater treatment plant and a previous study indicated a hydrologic link between this stream and one of the caves. A total of 83 chemicals were detected in the POCIS and SPMD extracts from the surface water and cave sites. Of these, 55 chemicals were detected in the caves. Regardless of the sampler used, more compounds were detected in the Oklahoma surface-water site than in the Arkansas surface-water site or the caves. The organic wastewater chemicals with the greatest mass measured in the sampler extracts included sterols (cholesterol and -sitosterol), plasticizers (diethylhexylphthalate and tri(2-butoxyethyl) phosphate), the herbicide bromacil, and the fragrance indole. Sampler extracts from most of the cave sites did not contain many wastewater contaminants, although extracts from samplers in the Oklahoma surface-water site and the cave hydrologically-linked to it had similar levels of diethylhexyphthalate and common detections of carbamazapine, sulfamethoxazole, benzophenone, N-diethyl-3-methylbenzamide (DEET), and octophenol monoethoxylate. Further evaluation of this system is warranted due to potential on-going transport of wastewater-associated chemicals into the cave. Halogenated organics found in caves and surface-water sites included brominated flame retardants, organochlorine pesticides (chlordane and nonachlor) and polychlorinated biphenyls. The placement of samplers in the caves (nearer the cave mouth compared to farther in the

system) may have influenced the number of halogenated organics detected due to possible aerial transport of residues. Guano from cave-dwelling bats also may have been a source of some of these chlorinated organics. Seven-day survival and growth bioassays with fathead minnows, Pimephales promelas, exposed to samples of cave water indicated initial toxicity in water from two of the caves, but these effects were transient with no toxicity observed in follow-up tests.

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Poster

Oklahoma Landscape Conservation Alliance – Supporting Landscape Conservation Cooperatives

Dixie L. Bounds[1], Kim Winton[2], and Mark Howery[3]

The Department of Interior is proactively attempting to address climate change and its associated impacts on fish, wildlife, and their habitats through the development of a nationwide network of Landscape Conservation Cooperatives (LCCs). Because of Oklahoma's diversity of habitats and ecosystems, it will be divided among four LCCs. This creates tremendous potential for partnerships within the state and across state lines, but may limit the impact that Oklahoma has on each of the four LCC partnerships. On April 8, 2010, the Oklahoma Landscape Conservation Alliance (Alliance) was established with conservation partners from federal, state, tribal, and non-government organizations. The objectives of the Alliance are to: 1) identify all potential natural resources stakeholders in Oklahoma and invite their participation; 2) identify mutual research needs, relevant to climate change, within the LCC framework; 3) collaborate across state and political boundaries with other partners to work towards landscape level conservation of critical natural resources; and 4) educate the public about climate change and actions to conserve our nation's natural resources. Staff from the Oklahoma Department of Wildlife Conservation, U.S. Geological Survey, and U.S. Fish and Wildlife Service have developed and delivered outreach presentations at various locations throughout Oklahoma. We have developed research topics and solicited comments from partners within the Alliance. Information will be presented on how additional partners and research topics may be identified and developed.

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[3]Oklahoma Department of Wildlife Conservation

Oral and Poster

Aquatic vegetation monitoring at Ozark National Scenic Riverways, Missouri

David E. Bowles, Hope R. Dodd, Jan A. Hinsey, and Tyler Cribbs

Over 300 springs occur at Ozark National Scenic Riverways. Since 2007, we have monitored aquatic vegetation communities annually in six of the largest springs. Vegetation sampling is conducted on six equally-spaced, fixed transects with each having three equally-spaced 1 m2 plots (n=18). Daubenmire cover classes (% composition) are used to evaluate plant density. Diversity of aquatic vegetation is calculated for each transect and averaged across the sample reach using three measures: species richness, Simpson's index, and the Shannon diversity index. A final metric used to evaluate community structure is the ratio of exotic to native taxa. We found 46 species of hydrophytes, mosses and algae from among the six springs, and community composition and structure varied widely. No single species is dominant in more than one spring, and most springs share several co-dominants. Mean plot species richness among springs ranged from 4 to 5, and effective number for Simpson's and Shannon indices ranged from 1 to 2 and 1 to 3, respectively among springs. Similarity analysis of this data shows that aquatic vegetation communities are most similar for Alley and Big springs (77%) and least similar for Blue and Round springs (49%). Several hydrophyte species previously reported from the springs are now absent, but conversely we have documented several new distributional records for other species, including several non-native species. These findings reflect the broad

natural habitat diversity in and among these springs. The data aid resource managers in making informed, science-based decisions about these fragile systems.

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Poster

Healthy Forests Reserve Program Conservation Easements and Habitat Restoration

Suzanne A. Collier, John W. Mustain, and Stephen R. Tully

The Healthy Forests Reserve Program (HFRP) is a voluntary program established for the purpose of restoring and enhancing forest ecosystems to promote the recovery of threatened and endangered species, improve biodiversity, and enhance carbon sequestration.

The Ozark Plateau Karst Dependent Species Conservation Initiative HFRP project in northeastern Oklahoma was first approved for funding in 2009. The project targets three federally endangered species, the gray bat, the Ozark big-eared bat, and the Ozark cavefish. The objective is to restore the habitat of the species through forest management practices and further protect the habitat through the purchase of conservation easements.

The HFRP is being implemented in coordination between Natural Resources Conservation Service (NRCS), the U.S. Fish & Wildlife Service (USFWS), and Oklahoma Forestry Services (OFS). Landowner protections will be made available to HFRP participants who agree, for a specified period, to restore or improve their land for threatened or endangered species habitat so that there is a net conservation benefit to the species. In exchange, the program participant will avoid future regulatory restrictions on the use of that land protected under the Endangered Species Act.

The NRCS has had a continuous program sign-up in place, with ranking periods set when funding is available. The program allocation to date for all program costs has been $4.5 million. To date 51 applications have been received on over 15,000 acres. The first conservation easement on 166 acres in southern Delaware County will close this fall. Restoration work will begin in the spring of 2011.

Habitat for the Ozark cavefish and the bats will be managed by promoting a healthy oak/hickory forest to mimic the evolution of the native oak/hickory landscape and promote the maintenance of an open canopy, moderate density, mature forest with a herbaceous understory.

The restoration work being planned on all the HFRP parcels will include an initial thinning operation, as needed, to bring the basal area to approximately 50 Ft2/Ac. This will be accomplished through a chemical treatment of trees below a pre-determined diameter at breast height. The timber stand will then be maintained through a continual application of prescribed burns on a 3-7 year sequence.

The conservation easements will limit future disturbance to the species by restricting subdivision and development on the property, while still providing opportunities for the landowners for recreational pursuits such as camping, hiking, hunting, bird-watching, etc.

With the program still being in its initial years, the impact on the endangered species cannot yet be evaluated. But work is underway to critically monitor the effects of the prescribed burns on the habitat and the species.

USDA – Natural Resources Conservation Service
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Oral and Poster

Protection of Critical Ozark Land: A Case Study

Jeff Crosby[1] and Mark Howery[2]

In an effort to address ever-increasing water quality concerns, and the struggles of communities, landowners, and additional stakeholders to effectively address and prevent source water contamination, Land Legacy developed the Spavinaw Creek Watershed Protection Initiative. This effort consists of a long-term land conservation program within the boundaries of the Spavinaw Creek watershed to acquire, through either purchase and/or donation from landowners, permanent conservation easements. Conservation easements ensure the protection of a property's natural resources while allowing for

continued private ownership and agricultural production, and keeping properties on local tax rolls.

GIS data have been utilized to identify properties with important riparian areas and/or other land traits, and landowners are contacted to encourage participation in the program. Properties are also identified based on such factors as habitat values, the presence of springs and tributaries, and other characteristics. An outreach program is included to effectively educate landowners and others of the importance of conservation easements for protecting the basin. This program has created a unique model for developing partnerships, protecting private property rights, and establishing a watershed level approach to land and water conservation.

In 2008, Land Legacy worked collaboratively with the Nature Conservancy in Arkansas, the state wildlife agencies of Oklahoma and Arkansas, and the US Fish and Wildlife Service at the Ozark Plateau National Wildlife Refuge to submit an ESA Section 6 Recovery Land Acquisition proposal for the conservation of key parcels of land that are important for the protection of several endangered and threatened species, as well as the permanent protection of the water quality of Spavinaw Creek. The funds from this grant were planned to be utilized to purchase conservation easements covering over 900 acres of land adjacent to Spavinaw Creek in Oklahoma.

As time progressed and economic factors changed, the landowners with which we had been working began to have reservations about permanent conservation easements. After months of outreach to strategic landowners and partners, a substitute property was identified and the process was initiated to amend the original grant agreement. This presentation will discuss the problems and obstacles encountered in protecting this critical piece of Ozark land and the strategies and process used to overcome these challenges.

[1]Land Legacy,
[2]Oklahoma Department of Wildlife Conservation

Oral

Quaternary Fossil Vertebrates of the Southwestern Ozark Highland

Nicholas J Czaplewski[1] & William Puckette[2]

Vertebrate fossils of late Quaternary age are relatively common in caves in the Ozark Highland and make up a part of the natural heritage of the region. Most previous studies on vertebrate fossils in the Ozarks have been done in the main portion of the region, in Missouri or Arkansas. Fewer such studies have been done at the southwestern edge of the Ozark Highland. Beginning in the 1990s until recent conservation concerns (WNS) caused us to voluntarily suspend fieldwork, we collected fossils in several caves in NE Oklahoma and one in nearby NW Arkansas. Our lab work continues with identifying, cataloging, and analyzing the fossils, finding funds to attempt radiometric dating or other analyses, and writing manuscripts. Vertebrate fossils were collected under permits and/or private landowner permission in 4 caves in Adair Co., 1 in Cherokee Co., and 1 in Delaware Co., OK, and 1 in Crawford Co., AR. As expected, the species discovered are similar to those found elsewhere in Ozark caves. Extinct species in southwestern Ozark caves include flat-headed peccary, Vero tapir, giant short-faced bear, Shasta ground sloth, and an ice-age horse. Still living species whose fossils are far outside their historical ranges include star-nosed mole, red-backed vole, meadow jumping mouse, and possibly others. These extralimital species retreated eastward to the Appalachian Mountains and northward after glacier retreat at the end of the Pleistocene. Their occurrence in Ozark caves implicates climatic cooling and attendant boreal vegetation in the Ozarks in the late Pleistocene. Identification of bat fossils is ongoing. In one cave, a large number of specimens including at least big brown bats (possibly a large Pleistocene morph), tricolored bats, and more than one size of myotis are present but are difficult to identify with isolated teeth and jaws. Relative dating indicates that all the vertebrate-containing cave deposits represent the late Pleistocene and/or early Holocene. Absolute dating has been problematic; some initial attempts at radiometric dating organic materials from bone using AMS radiocarbon method failed because insufficient collagen remains in the bones, possibly because of chemical alteration in the wet cave environments. In addition to body fossils, trace fossils occur as putative bear beds in several caves, some of which are

very large and may represent Pleistocene hibernation sites for giant short-faced bears. Modes of preservation and taphonomic settings vary from cave to cave. One deposit in Adair Co. consists almost entirely of microvertebrate remains (teeth and jaws of bats, rodents, shrews) and might reflect an accumulation from raccoon scats. In another Adair Co. cave small and mostly medium-sized to large animal remains occur, including great horned owl, turtle, Shasta ground sloth, ?dire wolf, short-faced bear, and horse. In yet another cave only two species were found in a deposit, the partial skeleton of a young male black bear and two fragments of a short-tailed shrew, probably Holocene in age.

[1] Sam Noble Oklahoma Museum of Natural History, Univ. Oklahoma, nczaplewski@ou.edu;
[2] Poteau High School

Poster

Fish Community and Habitat Assessment of Six Large Springs at Ozark National Scenic Riverways, Missouri

Hope R. Dodd and David E. Bowles

Ozark National Scenic Riverways (OZAR) was established to protect the integrity of the Current and Jacks Fork Rivers through river corridor protection. Six large springs (discharges > 0.28 m3/sec) in this watershed provide a significant amount of flow to these two rivers, making the springs an important component of the ecosystem. Although the springs are located within the park, they are vulnerable to anthropogenic disturbances through contamination of groundwater recharge outside the park boundaries. In 2007, a monitoring program was initiated to assess the status and long-term trends in fish communities of the six spring runs at OZAR. Because these aquatic systems are sensitive, springs were sampled on a three year rotation with two springs sampled each year in July. Fish were collected with pulsed DC electrofishing methods, and habitat data was collected using a point-transect method. Species richness ranged from four to nine species and abundance ranged from 2.5 to 8.9 fish/min. Richness was highest in springs with diverse habitat conditions; while fish abundance was higher in springs with less habitat diversity. Most springs were dominated by Ozark sculpin (Cottus hypselurus) and bleeding shiner (Luxilus zonatus), which are relatively sensitive to human disturbance. This baseline data indicates good fish community integrity in springs at OZAR and provides park managers with much needed information to protect these ecologically important resources.

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Poster

Oklahoma Hydrologic Integrity Assessment Process: Tools for Assessment of Instream Flows for Oklahoma Streams

Rachel Esralew[1], Titus Seilheimer[2], William Fisher[3], Don Turton[4]

Assessment of instream flows (environmental flows) is needed to aid planners, policy makers and the public in developing water-resources policy in Oklahoma. An initial step in assessing instream flow criteria for Oklahoma involves characterizing and classifying streams based on critical elements of the flow regime related to aquatic ecological health. A regulated river may need to mimic the five components of the natural flow regime in order to maintain the integrity of the aquatic ecosystem: (1) magnitude, (2) timing, (3) frequency, (4) duration, and (5) rate of change of flow. The Hydrologic Integrity Assessment Process (HIP) is a tool developed by the US Geological Survey (USGS). The HIP can provide water resource managers with information used to better balance water allocation between human and ecological uses. HIP is used to classify streams into hydrologic stream classes and identify 10 hydrologic indices that are ecologically-relevant, specific to stream classes, and characterize the five components of the natural flow regime. Overall, HIP represents an evolution from simple minimum passing flows to a complex system of hydroecologic flow parameters that support aquatic life throughout the life cycle of the organisms. Oklahoma State University, Oklahoma Cooperative Fish and Wildlife Research Unit, and USGS, with cooperation from the Oklahoma Water Resources Research Institute, conducted a HIP for Oklahoma.

As part of this methodology, a set of 171 ecologically-relevant hydrologic indices were computed for 88 USGS gaging stations across Oklahoma with a minimally altered long-term period of record. These indices describe baseline conditions for five critical elements of the flow

regime. The 27 most relevant indices representing five components of the flow regime were selected for use in the classification of 88 gages. Cluster analysis was used to group gages with similar flow characteristics into stream types.

Based on trends observed between four groups, streams in and near Oklahoma were classified as perennial runoff, perennial flashy, stable groundwater, and intermittent. Groupings of streams fell roughly within specific ecoregions of Oklahoma, notably the Southeastern Plains, Ozark-Ouachita Appalachian Forests, and Temperate and South Central Semi-Arid Prairies. Stream groupings from this analysis represent "real world" differences in the hydrologic characteristics of the watersheds. From a water resources management perspective, this information is important for development of environmental flow prescriptions that are stream and organism specific.

The baseline stream classification developed in this investigation can be used to develop software tools to easily allow water resources managers to examine the effect of proposed flow alterations on ecologically relevant hydrologic indices specific to stream classes in Oklahoma. These tools will also serve to increase our knowledge of the link between typical climate variability, climate change scenarios, and the variability of the hydrologic characteristics of streams and populations of various aquatic species.

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[2] US Forestry Service
[3] US Geological Survey Cooperative Fish and Wildlife Research Unit
[4] Oklahoma State University

Oral

Estimation of Surface Runoff Area Effected by Riparian Buffers in the Illinois River Watershed

Bullit M. Farris[1], Jerry E. Starkey[2], and Gina C. Levesque[3]

The Conservation Reserve Enhancement Program (CREP) was initiated in the Illinois River and Spavinaw Creek Watersheds in response to the decline in water quality and the overall health of streams in these watersheds. The purpose of the program is to restore lands currently in agricultural production along streams back to native bottomland forests by providing financial and technical assistance to producers for implementation of riparian forest buffers. Riparian buffers have been proven to reduce the amount of non-point source pollution from agricultural runoff that enters a stream by acting as a filter for pollutants such as fertilizers, pesticides, and sediments. There are currently several hundred acres of riparian buffers enrolled in the Illinois River Watershed, but it is also important to know the surface area of surrounding land that drains into the buffers and in turn "filtered" once the buffers are functional. The purpose of this work was to develop an efficient method for calculating the amount of land that contributes surface runoff to each individual riparian buffer. The hydrology toolbox in ArcMap 9.2 was used to create a flow direction layer from a DEM of the Illinois River Watershed. A flow accumulation layer was created from the flow direction layer to determine the path of the streams. The watershed tool was then used by placing a pour point at the downstream end of a riparian buffer. The resulting output was a raster layer showing the drainage of all lands upslope of the pour point. Another pour point was added to the upstream end of the riparian buffer and entered into the watershed tool. This output could then be subtracted from the first output which left only the drainage area of the riparian buffer. An additional step was required if the buffer was only on one side of the stream. The drainage areas were compared to a topographic map to confirm their accuracy. This method provided for an efficient way to show the effect of CREP beyond the actual acreage of riparian buffers, visually demonstrate the drainage areas for each buffer, and determine the total land surface being drained by the CREP riparian buffers in the Illinois River Watershed.

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Oral – Part 2 of OCC

A Floristic Inventory of Six Tracts of Ozark Plateau National Wildlife Refuge in Adair County, Oklahoma

Mary E. Gard[1], Charriss R.H. York[2], Steve Hensely[3], Will F. Lowry[1], and Ronald J. Tyrl[1]

Five hundred sixty species of vascular plants in 329 genera and 95 families were encountered in a five year floristic inventory of the Eagle Pass, Gittin Down Mountain, Liver, Sally Bull Hollow, Varmint, and Workman Mountain tracts of the Ozark Plateau National Wildlife

Refuge and adjoining Ozark Plateau Wildlife Management Area, which encompass approximately 2095 ha in Adair County, Oklahoma. Ninety-two percent of the species were native and the largest families were Asteraceae, Fabaceae and Poaceae, together constituting 33% of the total taxa present in the six tracts. Plant Species designated threatened or endangered by The Endangered Species Program of the U.S. Fish & Wildlife Service were not encountered. Twenty-eight species designated as rare (S1 or S2) by the Oklahoma Natural Heritage Inventory were encountered. Six invasive or aggressive introduced species are present, but occur as small scattered populations in conspicuously disturbed sites and at present do not appear to be problems. The vegetation of the region occupied by the refuge is oak-hickory deciduous forest comprising 15 associations and 1 alliance. Fourteen types of habitats were encountered.

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Oral

Ozark Plateau National Wildlife Refuge Management of Federally Listed Endangered and Threatened Cave Species in Oklahoma

Steven L. Hensley[1], Shea L. Hammond[1], Richard C. Stark[2], William W. Puckette[3], Keith Martin[4], and David Leslie Jr.[5]

Ozark Plateau National Wildlife Refuge was established in 1986 to assure the continuing existence and recovery of federally listed endangered and threatened Ozark cave species [Ozark Big-Eared Bats (Corynorhinus townsendii ingens), Gray bats (Myotis grisescens), Indiana bat (Myotis sodalis), and Ozark cavefish (Amblyopsis rosae)], reduce the need for future listing of species of concern, protect large stands of Ozark forest essential to migratory songbirds, and provide environmental educational opportunities. The refuge consists of nine management units in four counties in eastern Oklahoma totaling about 4,200 acres. It is in Bailey's Oak-Hickory Forest Ecoregion along the southwestern edge of the Ozark Plateau with much of the drainage underground in karst topography resulting in a number of caves and springs. The Refuge was established and managed over the past 20 years by a joint effort of a number of partners including private landowners, private caving and conservation organizations, universities, tribes, cities, counties, and state and federal agencies. This effort has included managing surrounding forested foraging habitat, protecting groundwater recharge areas and watersheds, controlling cave access through cave gate construction and maintaining cave locations confidential, working with private landowners to assist with habitat management and develop and maintaining trust and support, securing funds for long-term habitat protection through acquisition of land and easements from willing sellers and donors, developing conservation agreements, providing funding and staff for long-term management, implementing priority tasks form Recovery Plans, conducting research to identify appropriate management, and monitoring populations to determine success of present management efforts. In addition the Refuge has developed the Mary and Murray Looney Education and Research Center to educate the public on the importance of protecting such natural resources. All these efforts are accomplished through a true landscape or ecosystem approach that provides quality habitat for a variety of terrestrial and aquatic Ozark species.

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Oral and Poster

Landcover and Vegetation of the Ozark Plateau, Oklahoma, ca. 1897

Bruce Hoagland and Christy Batterson

The upland forests of Oklahoma constitute a westward extension of the oak-hickory association of the eastern deciduous forest. Progressive settlement into the region, beginning in the early 19th century, has lead to changes in vegetation structure and ecological processes. Our objective was to analyze past vegetation and settlement in the Oklahoma Ozarks. First, we created a seamless landcover map from the 63 townships surveyed by the General Land Office. All mapped features were attributed as vegetation, hydrology, agriculture, transportation, and settlement. Landscape indices were then calculated using Patch Analyst 4 and included area of each landcover type, number of occurrences, and mean size of occur-

rence. Next we entered all bearing tree into a spatial database, including plant identification, diameter-at-breast height, compass bearing, and distance. We used these data to calculate basal area, relative dominance, mean point-to-plant distance, and importance value for each species. The tree data were also attributed to section-line intersection, quarter section and mid section points (n=5029 points). Of the land cover mapped in the Ozark Plateau of Oklahoma, 85.2% was mapped as forest, 9% as grassland, and 6% as cultivated. The GLO surveyors recorded 13,689 stems of 46 taxa of woody plants, 83% of which belonged to the genus Quercus. Several species were recorded as simply "elms" or "maples" which created difficulties for analysis. Only 1% of stems were recorded as Pinus echinata. Total basal area (BA) for all trees sampled was 10,437,145 cm2. Of the rare woody plant species, only only six stems of C. pumila var. ozarkensis were recorded.

Oklahoma Biological Survey and
Department of Geography
University of Oklahoma

Oral

Characteristics of a persistent Castanea pumila var. ozarkensis population on the Ozark Plateau of Oklahoma

Bruce Hoagland and Amy Buthod

Chestnut blight (Cryphonectria parasitica) was first discovered at the Bronx Zoo in 1904. It spread rapidly across the eastern U.S. devastating populations of Castanea dentata, Castanea pumila var. pumila, and Castanea pumila var. ozarkensis, which is now considered a species of concern. In 2003, the following data were collected from persisting individuals of C. pumila var. ozarkensis: crown diameter, number of living stems per crown, and diameter of stems bearing burs, if present. Seeds were collected and weighed to determine whether stem diameter and seed weigh were correlated. Dead stems were collected and cross sectioned, diameter measured, and age determined. Regression analysis was used to explore the relationship between age and diameter. A significant relationship would provide a non-destructive method for aging living stems that bear burs. The diameter of 100 crowns was measured, ranging from 4.1 - 144.5 (mean = 74.5). Of those, 61 crowns had living stems, ranging from 1 to 28 stems per clump (mean = 54.5 stems). Fourteen crowns had living stems that produced burs, ranging from 1-7 stems per crown (mean = 2.6 stems) for a total of 39 living stems with burs. Large crowns tended to have more living stems, the relationship was not statistically significant. The diameter of 294 living stems ranged from 0.1 to 28 cm (mean = 2.73 cm). 142 seeds were collected from stems ranging 1.0-7.9 cm in size. Average seed weight ranged from 0.0410 to 0.962 g (mean = 0.73 g). Sixty-four dead stems were cross sectioned and aged. Diameters of dead stems ranged from 1.7 - 10.0 cm (mean = 4.5 cm) and age from 2 - 16 years (mean = 4.5 years). The relationship between stem diameter and age was statistically significant ($r2 = 0.61$, $P<0.0001$).

Oklahoma Biological Survey

Poster

Ozark Cavefish conservation in Missouri: A pro-active approach to Karst conservation and sensitive species recovery

Rick Horton[1] and Blake Stephens[2]

The Missouri Department of Conservation (MDC) utilized a Landowner Incentive Program (LIP) grant from the U.S. Fish and Wildlife Service to proactively implement landowner assistance projects with the goal of improving the quality of the groundwater infiltrating and recharging sensitive karst habitats in southwest Missouri. A fisheries management biologist was hired to implement and administer the grant. The program was proactive in that outreach techniques such as informational articles, direct mailings, distribution of promotional material, and landowner meetings were used to initiate contacts with landowners. Personal contact with more than 1,200 landowners in known cavefish recharge areas and providing site-specific landowner cost-share (ranging from 75-90 percent of project cost) plans to 21 individuals were accomplished during the grant period. Sixteen landowner projects were installed that minimized erosion and sedimentation, improved on-site sewage treatment, and protected connections to the karst groundwater within the recharge areas. Some planned projects were not implemented due to timing and financial constraints of the grant. Overall the objectives of the grant were achieved with quantifiable improvement to water quality documented.

Two additional benefits of the LIP were the documentation of five new Ozark Cavefish sites in southwest Missouri and the inception of a conservation easement grant to extend the groundwater improvement and protection efforts begun during this project.

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Oral

Overview of the Ozark Region with the Oklahoma Comprehensive Wildlife Conservation Strategy

Mark Howery

In 2005, all fifty states and six U.S. territories developed strategic-level conservation plans for their rare and declining species. These plans are known as State Comprehensive Wildlife Conservation Strategies (CWCS) or State Wildlife Actions Plans (SWAP). The Oklahoma CWCS is written in six chapters each of which addresses the conservation needs within a specific ecological region – Ozarks, Ouachita Mountains/West Gulf Coast Plain, Crosstimbers, Tallgrass Prairie, Mixed-grass Prairie and Shortgrass Prairie. The Ozark Region encompasses the Oklahoma portions of the Springfield Plateau and the Boston Mountains. Within this region, the conservation plan identifies 112 animal species as needing increased conservation attention. These species include five amphibians, seven reptiles, 19 fish, 35 invertebrates, 38 birds and eight mammals. The Oklahoma CWCS is largely habitat-based in that it identifies eleven habitat types that are important to the conservation of rare and declining species and it groups these species into suites based upon their habitat affinities to the extent that these are known. The highest priority habitat types identified within the Ozark Region are limestone caves, springs, mesic oak/hickory forests, gravel-bottom streams/riparian forests, and small rivers (e.g. Illinois River). Collectively, these five habitats support 79 of the region species of conservation need. The Ozark Region chapter of the Oklahoma CWCS is further subdivided into eleven sections – one for each of the important habitat types. These sections describe the specific conservation issues that are relevant to each habitat and recommend a series of conservation actions to address or ameliorate the conservation issues. All of this information is used to establish funding priorities for the State Wildlife Grants program in Oklahoma, and examples will be given of projects that have been funded in the Ozark Region.

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Oral

Geologic Framework of Ozark Karst Landscapes: Example from the Buffalo River Area, Northern Arkansas

Mark R. Hudson[1], Kenzie J. Turner[1], Chuck Bitting[2], James E. Kaufmann[3], and Timothy M. Kresse[4]

The Ozark Plateaus host extensive karst landscapes developed on soluble bedrock. Thus, full understanding of karst systems and their associated topography, hydrology, and ecosystems benefits from knowledge of their geologic framework. As an example, geologic mapping by the USGS at 1:24,000 scale in the western Buffalo River region of northern Arkansas highlights the geologic controls on karst features and provides a scientific basis for resource management at Buffalo National River (BNR), a 200-km-long, river-corridor park. The western Buffalo River flows eastward through plateau surfaces of the Boston Mountains and Springfield Plateau where it has eroded a valley 130 to 400 m deep. Stratigraphically, the watershed exposes a 500-m-aggregate thickness of carbonate, sandstone, and shale formations of Pennsylvanian, Mississippian, and Ordovician age. Limestone and dolostone intervals (potential karst hosts) are significant in five of the eight major map formations. Noteworthy are (1) the 120-m-thick cherty limestone of the Mississippian Boone Formation that has widespread surface exposures, forming the Springfield Plateau aquifer, and (2) dolostone and lesser limestone intermixed with sandstone in the underlying Ordovician Everton Formation, forming the upper part of Ozark aquifer. Structurally, most rocks in the Buffalo River region dip gently (<5°) but are broken by a series of faults and folds that formed during late Paleozoic development of the southern Ozark Dome. These structures produce vertical relief of rock units of as much as 300 m across the region. Multiple fracture sets (joints) are pervasive in bedrock, with most-common strike directions of N-S, NE-SW, and WNW-ESE.

In western BNR, comparison of a cave inventory to the

mapped geology demonstrates that most caves either lie within limestone of the Boone Formation (78 percent), or limestone or dolomite intervals within the Everton Formation (17 percent). Large sinkholes are preferentially concentrated near the contact of Boone Formation with overlying Batesville Sandstone. The greatest frequency of springs within the watershed discharges near the base of the Boone Formation, particularly in its basal St. Joe Limestone Member. The largest of these springs in the Springfield Plateau aquifer are localized in structural lows formed by faults and folds; dye-tracer studies demonstrate these may gather interbasin recharge from adjacent watersheds. A secondary concentration of springs, including the largest in BNR, discharge from the lower part of the Ordovician Everton Formation. Development of this lower karst aquifer in the Everton Formation was facilitated by a change to carbonate-rich facies from sand-rich facies of the formation farther west. In contrast to relations for the Boone Formation, structural highs localize recharge and discharge of this lower Everton karst aquifer. In summary, both stratigraphic and structural characteristic influence karst development in the Buffalo River watershed and similar geologic controls are to be expected elsewhere in the Ozarks.

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Oral – Part 1 of DOI Landscape Project session

Increasing Awareness of Physical Geology via Online Courses

Deborah Hyde

An important component of improving the quality of regional environmental sustainability revolves around making people aware of the natural geologic and hydrologic processes. Even though these processes have occurred for millions of years, people outside the environmental field of study are often unaware of both the processes and of how the daily activities of humans may affect those processes.

The author's employer does not offer a degree in Geology, but a basic understanding of Geology is necessary for students majoring in Environmental Science and Science Education. When the Physical Geology course was offered as a traditionally taught, face to face course, it suffered from very low enrollments. One of the big issues causing the low enrollments was the difficulty students had in fitting the class into their schedules. The traditional class met four days per week for a total of five hours. These set hours often conflicted with other courses the students needed to take.

To remedy the schedule conflicts, it was decided to offer the course online. The students still cover all the material as they would in a traditionally taught class. The course even includes laboratory experiences that the students complete at home. Students just choose which times they complete the work during that week. The online version of Physical Geology Lecture and Lab is just a rigorous as the traditionally taught course, but many more students are able to fit it into their schedules.

As an added benefit, the majority of the students who take the online Physical Geology course are not science majors. Many students take the course because it offers them flexibility in scheduling their study time. Consequently a whole new and larger group of students, who otherwise would not have considered taking the class, are becoming aware of the natural processes of geology and hydrology and humans' effects on the natural systems.

It is the author's contention that the only people who do NOT need to learn about geology and earth systems are people who don't live on earth. We haven't reached that many yet, but the online courses seem to be a very small step in that direction.

Northeastern State University

Poster

The Central Hardwoods Joint Venture Approach to Avian Conservation Planning

D. Todd Jones-Farrand and Jane A. Fitzgerald

The Central Hardwoods Bird Conservation Region (BCR 24) is one of 69 BCRs delineated by the North American Bird Conservation Initiative. BCR 24 encompasses 74 million acres in portions of 9 states including the Ozark Highlands of Missouri, Oklahoma, and Arkansas. Since 2000, a partnership of state agencies, federal agencies,

and non-governmental organizations has been working together to develop science-based conservation plans dedicated to linking local habitat management to national and international conservation initiatives. Officially recognized by the USFWS in 2004, the Central Hardwoods Joint Venture (CHJV) has devoted the lion's share of its efforts to developing a strong biological foundation from which to guide strategic conservation action for forest-associated songbirds. Decision support tools developed by the CHJV partnership include habitat suitability models to assess habitat condition, a productivity model to predict reproductive success in forest patches, a potential vegetation model to assess opportunities for restoring natural communities, an urbanization model to assess future threats to habitat, and a spreadsheet simulation tool that links the other tools together to predict population response to alternative landscape scenarios. Collectively, these models suggest that open forest and shrubland habitats (e.g. savannas, glades, and open woodland) are the most degraded communities in BCR 24 and conservation efforts directed at these communities could provide for sustainable populations of 22 of the 24 priority forest-associated species experiencing population declines across the region. The CHJV has set an objective of restoring 1.1 million acres of these habitat types within BCR 24 over the next 20 years. To move toward this objective, the CHJV is currently conducting a series of conservation design workshops intended to introduce the decision support tools to a broader group of stakeholders and start the process of building on-the-ground partnerships. It is the intent of the CHJV that these local partnerships will develop and implement a common vision of sustainable landscape conservation that will yield benefits beyond sustainable bird populations.

Central Hardwoods Joint Venture
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Oral

An Analysis of Algal, Macroinvertebrate, and Fish Community Indices for Assessing Low-level Nutrient Concentrations in Wadeable Ozark Streams

Billy G. Justus[1], James C. Petersen[1], Suzanne Femmer[2], Jerri Davis[2], and James Wallace[1]

Biological indices for algae, macroinvertebrate, and fish communities can be effective for monitoring streams with high nutrient concentrations, but little is known regarding the efficacy of each community for monitoring low-level nutrient concentrations. The U.S. Geological Survey National Water-Quality Assessment Program collected nutrient (nitrogen and phosphorus) and biological samples from 30 Ozark streams in 2006 and compared biological metric and index response to a nutrient index calculated from log-transformed and normalized total nitrogen and total phosphorus concentrations. Biological metrics that were the best candidates for the three indices were identified with a process that included a combination of non-parametric multivariate-, univariate-, and visual-selection procedures. After consideration of 78 algal metrics, and 58 metrics each for macroinvertebrates and fish, 4 metrics were selected for each of the three biological indices.

The algal index had higher correlations to the nutrient index and to agriculture land uses (i.e. poultry and cattle production) than did macroinvertebrate and fish indices. Our data suggest that the algal community may be most appropriate for monitoring exposure to low-level nutrient concentrations, perhaps, because nutrient uptake is more direct for primary producers than for consumers.

This study and an associated journal article are products of the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program. The article has been published in Ecological Indicators (Volume 10, Issue 3, May 2010, pages 627-638) and is available online at http://dx.doi.org/10.1016/j.ecolind.2009.10.007 or at http://ar.water.usgs.gov/LOCAL_REPORTS/article01072010/

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Oral and Poster

Classification of karst terrain in Missouri using pseudospectral analysis

James E. Kaufmann

Classification of karst terrain is a challenging problem. Many proposed classification schemes rely heavily on subjective information or objective data that may not be available. To address the need for statistical correlation of soil-cover collapse formation, karst areas in Missouri were modeled using a pseudospectral technique. Pseudospectral analysis uses multispectral methods to examine continuous raster datasets derived from discrete spatial data. Results of this analysis reveal distinct regions of recharge, transport, and discharge. Recharge regions—where surface water enters the subsurface—are modeled as distinct areas of upland recharge and valley recharge. Transport regions are those areas dominated by subsurface karst development such as caves and fissures. Areas dominated by springs are classified as discharge regions. Having a statistically correlated method for classifying karst terrain provides an objective basis for further model development including the development of soil-cover collapse development.

U.S. Geological Survey, Rolla, MO

Poster

The stratigraphic and geographic distribution of sinkholes in the Mill Creek and Buffalo River area of northern Arkansas

James E. Kaufmann[1], Aaron T. Lingelbach[1], and Mark R. Hudson[2]

The Mill Creek area along the Buffalo River in Arkansas has been the subject of an ongoing investigation into the occurrence of karst features. The primary goal of this project is to develop methods for identifying areas of karst development using remote sensing and other data. In April 2009, a high resolution (1-meter) elevation (LiDAR) dataset was acquired over a 470-square-kilometer area including the Mill Creek drainage basin and a section of the Buffalo River. Depressions in the elevation data were identified and subjected to a detailed analysis and classified as having a natural (karst) origin or otherwise. The karst depressions (sinkholes) are locations where surface water enters the subsurface with little impedance. Although field validation of the results has yet to be accomplished, several observations can be made. The distribution and pattern of sinkholes vary geographically and stratigraphically across the area. In areas where the Mississippian-aged Boone Formation, a cherty limestone, is exposed at the surface, the sinkholes are more evenly distributed and widely scattered. By contrast, sinkholes are densely clustered where the Batesville Formation, a sandstone overlying the Boone Formation, thins towards the edge of its outcrop. It is hypothesized that the sandstone plays a role in preserving the smaller sinkholes which are lost upon further erosion and infilling by chert residuum of the underlying limestone. Faulting is common in the study area with a significant graben cross-cutting the center of the area. The mapped faults display a strong influence on sinkhole development where hydrologically or stratigraphically favorable conditions exist; otherwise, they exert little influence on sinkhole locations.

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Oral – as part of the USGS-DOI on the Landscape: Ozark Karst session

Using acoustic surveys to gather baseline pre-White-Nose Syndrome data on bat communities of eastern Oklahoma

Andrea L. Korman[1], Shea L. Hammond[2], Steve L. Hensley[2], and Karen McBee[1]

White-Nose Syndrome (WNS) is an emerging disease that has caused mass mortality among bats in the United States. First observed in a cave near Albany, New York, the disease is visually characterized by white fungal growth on muzzles, ears, or wing membranes of affected bats. Infected hibernacula have shown decreases in bats from 30-99% annually. The disease has since spread across the eastern United States and into parts of Canada and affects at least seven species of hibernating bats. The most recent findings show the disease to have spread to the gray bat (Myotis grisescens) population in Missouri. The infection of this species is of great concern not only because the gray bats are endangered, but also because they are migratory. The migration of these bats may cause the disease to spread more rapidly than originally anticipated. The fungus associated with WNS (Geomyces destructans) has been found as far west as Woodward County, Oklahoma in the cave myotis species (Myotis velifer). It is important to note that although G.

destructans is associated with WNS, its presence does not signify an outbreak of the disease. Since the quick onset of the disease, there has been little opportunity to gather baseline data on bat population numbers before the colonies become infected. Additionally, while there is population information on endangered bat species, there is relatively little known about more common bat species of the United States. The goal of this project is to gather baseline data on species composition and population numbers of bat communities of eastern Oklahoma so that comparisons can be made if the disease becomes established in these areas. We collected acoustic data monthly during summer and early autumn from six 30 mile mobile transects across five Oklahoma counties (Ottawa, Delaware, Adair, Cherokee, and Sequoyah). The transects cover a range of habitat types including urban, agriculture, streams and forests. We collected acoustic calls using a microphone roof mount attached to an Anabat ZCAIM unit, which was also attached to a GPS unit in order to obtain geographic data. The coordinates associated with observed bat calls were imported into GIS where it is then possible to observe the number of bats in a given area. Overall, the mean calls per transect ranged from 14 to 75 (SD ± 19) bat calls. On average, August was the peak month for observed bat activity with 107 being the highest number of bat calls observed from a single transect. In the future, this project has the potential to provide other important data on bat ecology. For example, the ability to identify calls to the species level will allow us to acquire information regarding which bat species are present in particular areas. The spatial data available in GIS will also provide useful information on essential habitat types that are frequently used for foraging. Ultimately, since eastern Oklahoma bat colonies are currently not infected with WNS, this monitoring is imperative to trace movement of the disease both into and out of bat populations.

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Poster

The Relation of Land Use, Geology, and Karst Features to Groundwater Quality in the Ozark Mountains of Northern Arkansas

Tim M. Kresse, Phillip D. Hays and Mark R. Hudson

The effects of land use, geology, and karst features on groundwater quality in the Buffalo River watershed in northwestern Arkansas were investigated in a two phase study. For Phase I, existing data from numerous sources were aggregated for eight counties in the Ozark Plateaus (Ozarks) of northwestern Arkansas to characterize the dominant controls on the distribution and magnitude of nitrate as nitrogen (NO3-N) concentrations in shallow aquifers in the Ozarks. For Phase II, springs in the Buffalo River watershed were selected for water-quality sampling based on criteria defined from Phase I with the goal of determining the effects of karst development on groundwater quality in the shallow aquifers. Nitrate was chosen as a relatively conservative surrogate tracer to represent the flux of surface-derived nutrients to the groundwater table; sinkholes were identified and digitized by delineating closed basins on regional topographic maps; and a 1-mile radius constructed for each spring to represent an estimated recharge area.

The Ozarks are divided into three hydrologic units: the Western Interior Plains confining system of the Boston Mountains, the Springfield Plateau aquifer, and the Ozark aquifer (Salem Plateau). A total of 860 sites with NO3-N concentration data were obtained from various federal and state agencies and universities. The Springfield Plateau aquifer was observed to have statistically significant greater mean NO3-N concentrations than the other two aquifers. Additionally, a positive linear trend (r2 = 0.14) was noted between agricultural land use (percent of total land use) and NO3-N concentrations for samples from the Springfield Plateau aquifer.

Information from Phase I was used to reduce influencing variables to the occurrence and density of sinkholes by sampling springs from the Springfield Plateau aquifer and in areas of only agricultural land use. Fifty-six springs were sampled in areas of concentrated sinkhole occurrence (Group I springs) and areas devoid of mapped sinkholes (Group II springs). Application of the Wilcoxon rank-sum test showed statistically significant greater nitrate-N concentrations in the Group I springs compared

to the Group II springs (p-value of 0.0095); however, review of 2004 summer land use showed a much greater percentage of cleared land in the Group I areas. A linear regression of agricultural land use and nitrate-N concentrations revealed a positive linear trend (r2 = 0.10) compared to a weakly positive relation between sinkhole area and NO3-N concentrations (r2 = 0.007). As such, it was difficult to remove the overriding influence of land use on shallow groundwater quality.

An interesting finding from this two-phase study and one in northeast Arkansas is that NO3-N concentrations exceed regional mean concentrations where agricultural land use exceeds approximately 30-40 percent of total land use. This suggests that shifting of land use from dominantly forested to agricultural land use exceeding 30-40 percent may result in elevated mean NO3-N concentrations and consequently may increase the potential for degradation of groundwater resources. With further corroboration, this could be an important criterion for guiding land-management planning.

U.S. Geological Survey

Oral- as part of the USGS-DOI on the Landscape: Ozark Karst session

Reduction of Non-Point Source Run-off in the Illinois River Watershed through Voluntary Programs Working Together

Gina Crowder Levesque[1] and Tashina Mitchell Kirk[2]

The Illinois River Watershed is listed as impaired by the Environmental Protection Agency. To help address issues of non-point source pollution in this watershed, the Oklahoma Conservation Commission submitted a proposal for a Conservation Reserve Enhancement Program (CREP) and implemented a 319 Program. Sign-up for CREP began in June 2007 and Illinois River 319 began sign-ups in 2008. CREP is a voluntary USDA Farm Service Agency program where producers enter into agreements to retire and restore riparian acreage for 10-15 years in exchange for an annual rental payment. Goals of this program include improving water quality through reduction in run-off, erosion control, and creation of wildlife habitat. Illinois River 319 takes its name from section 319 of the Clean Water Act and is funded by monies from The Environmental Protection Agency. Both programs cost-share with producers to implement installation of Best Management Practices (BMPs) that protect water quality. There are significant differences between the two programs that make them highly complementary to each other. CREP BMP installation is limited to practices directly related to protection and restoration of riparian zones whereas 319 monies can be used to either enroll currently wooded riparian acreage or address other BMP needs a producer might have. The success of water quality protection in this watershed is greatly enhanced by having these two programs working together. So far this cooperation has protected and restored several hundred acres of riparian buffers which, in turn, process the run-off from thousands of acres in the Illinois River Watershed.

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Oral – Part 1 of OCC

Foraging Forest Birds Require High Tree Diversity in the Southern Ozarks

Carol J. Patterson and Douglas A. James

We studied forest birds in spring, summer, and winter in 2002 to 2004 in the southern Ozarks of Arkansas in order to determine relationships between foraging insectivorous bird species and tree species used. Six study areas were selected in northwestern Arkansas, varying from 15 to 20 ha, each consisting of a closed canopy oak-hickory forest. Five of the areas were surrounded by extensive oak-hickory forests. Foraging birds encountered during study area searches were noted including their foraging tree identifications and tree diameters. Overall vegetation was ascertained by measuring trees species size categories on scattered 0.04 ha circular plots. From tree sizes (diameters), relative dominance of the tree species was calculated. Knowing the total observations for a particular bird species in a season this was multiplied by the proportion of the forest dominance (based on summation of diameters) of a particular tree species or taxa to obtain the number of times that bird would be expected to use that tree or tree taxa. This was compared with the number of actual observations of the bird in that tree/taxa using a chi square analysis to determine whether or not there was a significant usage or avoidance between the bird and tree. A similar analysis was employed in analyzing tree size usage. The foraging data set was adequate for eight bird species. In five

cases through the seasons oak taxa were used by birds in excess of oak relative dominance in the forest, and in seven cases oaks were used less than their dominance level. However, there were twenty-two cases where five other tree taxa, including dead trees, were favored and six cases in which a group including ten lesser represented trees were chosen. Tree size analysis showed that size matters with small and medium sized trees being utilized in deference to large trees. This study indicates that although oaks are being utilized in foraging by the commonest forest birds a number of other tree species, depending on the bird species, are being utilized too showing that Ozark forests should be managed for high tree species diversity. The predominant usage of trees smaller than large ones shows that Ozark forests should be managed for a diversity of ages in forest trees.

Department of Biological Sciences, University of Arkansas

Oral

Soil Carbon Stocks and Sequestration Potential in Oklahoma Cropland. The link to Resource Conservation

Jason G. Warren

Prior to settlement, Oklahoma's soils contained approximately 2.3 billion tons of organic carbon. During the past 100 years approximately 114 million tons of carbon have been lost due to cropland cultivation. This loss results from the oxidation of this organic carbon as well as erosion losses. Elimination of tillage from the cropland systems through the conversion of cropland to grasslands or to no-till cropland management can result in the accumulation or sequestration of atmospheric carbon in the soil organic carbon pool. This sequestration occurs because microbial decomposition of organic residues is reduced and/or organic residue input to the soil system is increased. Carbon sequestration in cropland soils after conversion to permanent grass or no-till management has the potential to offset CO2 emissions, thereby reducing net emissions. Oklahoma has 8.2 million acres of cultivated cropland. Using current estimates of carbon sequestration for the region, the conversion of this cropland to no-till could sequester 3.28 million Mt CO2 per year. Currently, efforts are being made to assess carbon stocks and the potential rate of carbon sequestration in Oklahoma cropland in order to verify the current estimates being used. Collection of soil samples to a depth of 110 cm from cropland fields in Oklahoma show that these soils can contain 187 to 85 Mtons of CO2-C per acre. Carbon sequestration potential of no-till was determined by comparing the Carbon contents in the surface 40 cm. This comparison showed that no-till soils contained 2.42 Mton more CO2-C per acre than did cultivated fields and a potential sequestration rate of 0.53 Mtons of CO2-C per acre. These preliminary results are supportive of the current estimates however, the large variation among fields require additional sampling to provide statistical differences among the findings. The continuation of this research will provide improved accuracy and confidence in estimates of carbon sequestration used in the carbon market. In turn the Marketing of the carbon credits produced from soil carbon sequestration may provide incentive to producers to adopt these conservation practices, which dramatically reduce soil erosion and the transport of sediment bound contaminates to surface water bodies. Additional benefits of these sequestration practices may include improved cover and food resources for wildlife compared to conventional tillage systems.

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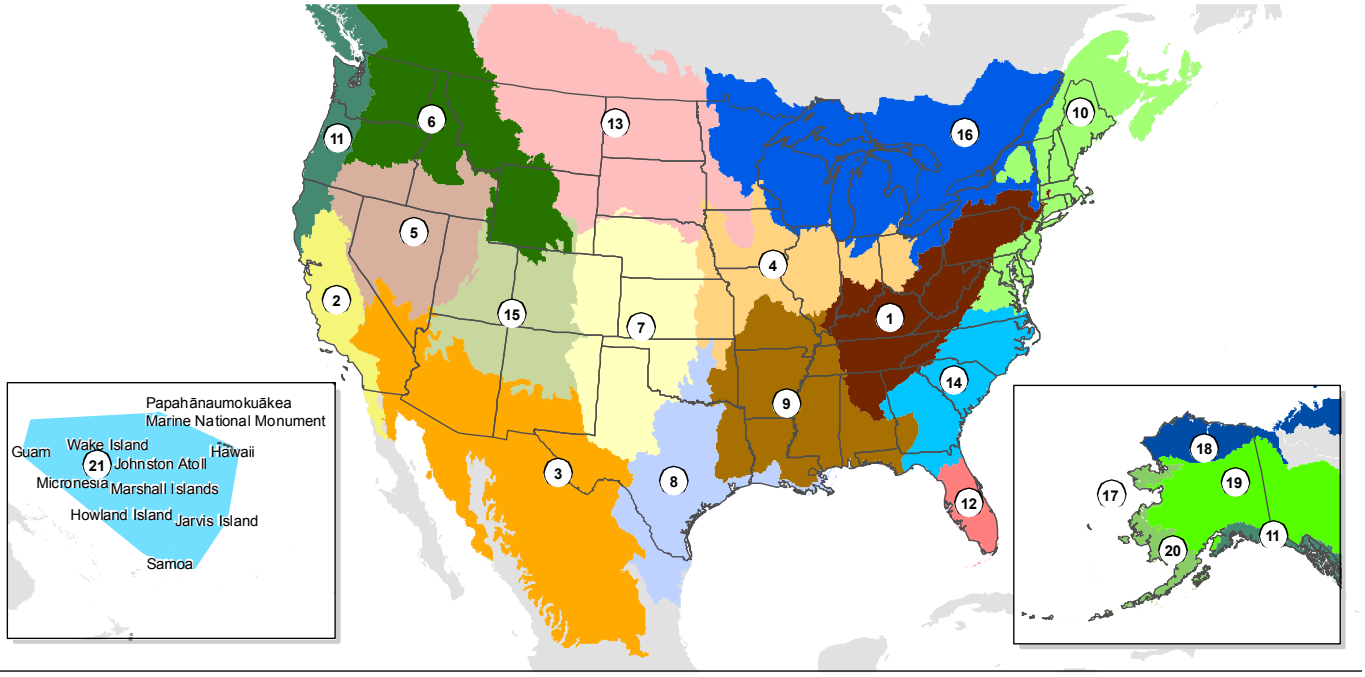
Oral

Landscape Conservation Cooperatives (LCCs)

Welcome to the Ozark Summit! The following information has been compiled from various resources as a reference for general information during the breakout sessions and to help spur ideas.

Landscape conservation cooperatives (LCCs) are conservation-science partnerships between the U.S. Fish and Wildlife Service, U.S. Geological Survey (USGS), and other federal agencies, states, tribes, NGOs, universities and stakeholders within a geographically defined area. They inform resource management decisions to address landscape-scale stressors—including habitat fragmentation, genetic isolation, spread of invasive species, and water scarcity—all of which are accelerated by climate change.

LCCs provide scientific and technical support for conservation at "landscape" scales—the entire range of an identified priority species, prioritizing and coordinating research, and designing species inventory and monitoring programs. LCCs also have a role in helping partners identify common goals and priorities to target the right science in the right places for efficient and effective conservation. By functioning as network of interdependent units rather than independent entities, LCC partnerships can accomplish a conservation mission no single agency or organization can accomplish alone.



Landscape Conservation Cooperatives

1. Appalachian
2. California
3. Desert
4. Eastern Tallgrass Prairie and Big Rivers
5. Great Basin
6. Great Northern
7. Great Plains
8. Gulf Coast Prairie
9. Gulf Coastal Plains and Ozarks
10. North Atlantic
11. North Pacific
12. Peninsular Florida
13. Plains and Prairie Potholes
14. South Atlantic
15. Southern Rockies
16. Upper Midwest and Great Lakes
17. Aleutian and Bering Sea Islands
18. Arctic
19. Northwestern Interior Forest
20. Western Alaska
21. Pacific Islands
Unclassified

Albers Equal Area Conic NAD83
Produced by FWS, IRTM, Denver, CO
Map Date: 03182010

Collectively, LCCs will comprise a seamless national network supporting landscapes capable of sustaining abundant, diverse and healthy populations of fish, wildlife and plants. They will provide a strong link between science and conservation delivery without duplicating existing partnerships or creating burdensome and unnecessary bureaucracy. Rather than create a new conservation infrastructure from the ground up, LCCs build upon explicit biological management priorities and objectives, and science available from existing partnerships, such as fish habitat partnerships, migratory bird joint ventures and flyway councils, as well as species- and geographic-based partnerships.

LCCs support adaptive resource management by evaluating implementation of conservation strategies, maintaining and sharing information and data, and improving products as new information becomes available. Shared data platforms serve multiple purposes, including the collaborative development of population/habitat models under alternative climate scenarios to inform spatially explicit decision support for all partners. Decision-support systems and products developed by LCCs not only help determine the most effective conservation actions to support shared priorities, but also provide tools to compare and contrast the implications of management alternatives.

In the face of accelerated climate change and other 21st-century conservation challenges, LCCs will regularly evaluate the effectiveness of scientific information and conservation actions and support necessary adjustments as new information becomes available. This iterative process of information sharing will help scientists and resource managers deal with uncertainties on the landscape and provide tools to compare and contrast the implications of management alternatives.

For more information on U.S. Fish and Wildlife Service landscape conservation work with partners, visit **www.fws.gov/science/shc/index.html**

Source: Fish and Wildlife Service FY 2010 and 2011 Budget Justifications
http://www.fws.gov/budget/2011/FWS%20-%20FY11%20Greenbook%20Final%202-4-10.pdf

Species Risk and Vulnerability Assessments

These assessments are the essential first step in deciding where to focus the conservation activities and additional scientific effort necessary to help fish and wildlife adapt to climate change. These assessments will enable the Service and LCC partners to focus their Inventory and Monitoring, Population-Habitat Assessments, Biological Planning and Conservation Design, Management Evaluation and Research, and Conservation Genetics activities on high-risk species and habitats.

Risk and Vulnerability Assessments are scientific analyses of the risks likely to be produced by climate change and the associated effects on fish, wildlife, plants, their habitats, and ecological functions and processes. These assessments enable us to identify the species, habitats, and ecological functions and processes that are most sensitive and have the greatest exposure to the effects of climate change and other stressors so that conservation actions can be focused on the highest priority species and habitats. These assessments are an essential first step in identifying priorities for biological planning and conservation design. They help to set priorities among conservation actions that work towards the protection of FWS lands and other trust resources. Ultimately, these assessments will inform future conservation actions that remove, minimize, or offset specific stressors at appropriate scales in space and time.

Inventory and Monitoring

The Service will develop additional capacity to participate in inventory and monitoring programs, develop or acquire systems for managing data, and evaluate assumptions and scientific information used in models that link populations to their habitats and other limiting factors. The Service will coordinate its inventory and monitoring programs with other Bureaus, especially the National Park Service, and integrate its data and results with those of other agencies, especially those ones in the DOI Climate Effects Network.

Inventory and Monitoring is a long-recognized weakness in conservation. FY 2010 funding will be used to build on the existing capacity within the Service and to leverage the capacity of Service science partners to begin building a scientifically sound inventory and monitoring program. These funds will be used to design scientific protocols and frameworks for inventory and monitoring programs. Science expertise is needed to assure that monitoring is statistically valid, and can develop into long-term trend data. To the greatest extent possible, the Service will ensure that inventory and monitoring activities are coordinated across Service programs and with partners to maximize efficiency and ensure data are scientifically credible.

Population and Habitat Assessments

These assessments will improve the Service's understanding of the relationship between species and their habitats at various spatial scales as well as among species. This information will be used by LCCs to predict how climate change will affect populations of fish and wildlife and their habitats, and how various management treatments can reduce or avoid those effects.

Population and Habitat Assessments inform biological planning and conservation design at the landscape scale, and will enable the Service and its conservation partners to (1) better describe and predict changes in the nature and dynamics of populations of species and habitats; (2) make informed management decisions in the face of uncertainties resulting from climate change; (3) effectively assess changes in populations and habitats resulting from physical and chemical changes in the environment, especially as temperatures increase and water resources decrease; and (4) develop structured and adaptive decision support frameworks for harvest, species conservation, and habitat management at landscape or other appropriate scales.

Biological Planning and Conservation Design

Science needs for biological planning and conservation design include highly-specialized expertise, training and tools, and the use of complex statistical methods and modeling. This capacity is a critical component of the work of LCCs. Inherent in this capacity is the ability to examine alternative management options, identify their strengths and weaknesses, and ultimately identify a mix of conservation actions that has the greatest likelihood of achieving the desired biological and ecological outcomes.

Biological Planning and Conservation Design is an primary function of LCCs, and requires the input of scientific studies and analysis. The Service needs to use the best

available scientific information to develop explicit fish and wildlife population objectives, conservation strategies, and decision-support tools in the face of climate change.

Management Evaluation and Research

These critical scientific "learning" activities will provide essential feedback needed for adaptive management. Science funding will support evaluations and research that will assist LCC staff in answering questions that arise from habitat and species responses to management actions. Targeted research will enable the Service to fill information gaps and reduce uncertainty regarding climate change and its likely impacts on species and habitat.

Management Evaluation and Research are important tools for evaluating current delivery strategies and activities, which will then provide information for the Service to address crucial information gaps in relation to stressors produced by climate change on a landscape scale. The requested funding will be used to work closely with other Federal agencies and partners to bolster the Service's limited capacity to support evaluation of the effectiveness of conservation actions, and research related to climate change. Evaluation will provide essential feedback needed to determine which actions produce desired conservation results at the lowest cost, and help identify research needed to reduce uncertainty in future decisions. Targeted research will enable the Service to fill information gaps and reduce uncertainty regarding climate change and its likely impacts on species and habitat. This information and knowledge will guide improvements to the SHC processes of biological planning, conservation design, conservation delivery, inventory and monitoring, and operational evaluations.

Conservation Genetics

Conservation genetics research will provide the basic scientific information needed to identify distinct population and management units. Biological assessments, conservation design strategies, and conservation delivery activities are most effective when they recognize the genetic population structure of a given species. Maintaining genetic diversity is essential for maintaining healthy, resilient populations of fish, wildlife and plants that are more able to cope with the stressors of climate change.

Conservation Genetics is needed to support landscape conservation strategy, delivery and evaluation. Understanding genetic variation provides the raw material which enables the Service to better understand species adaptation and evolutionary flexibility in response to environmental change. As genetic diversity declines, a species' ability to adapt to environmental change decreases and extinction risk increases. Furthermore, when habitat shifts occur, conservation and management habitats (landscapes) can use genetic information to conserve the genetic diversity and variability of a species.

Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative

April 2010

The Purpose

The Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative (GCPO LCC) will facilitate conservation planning and design across this highly diverse region in southeastern North America that extends for 180 million acres from the mountain tops of the Ozark, Boston and Ouachita ranges, to the pine savanna and prairies of the West and East Coastal Plains, down into the swamps, bayous and alluvial bottomlands of the Mighty Mississippi River and Tributaries, and along the beachfronts and shorelines of the northeast Gulf Coast. With accelerating climate change threatening to impact wildlife and fisheries, a capability is being developed to test, implement and monitor conservation strategies responsive to this dynamic landscape. These strategies are model-based and geographically defined, allowing us to effectively apply our emerging climate knowledge to predict habitat and species changes and to target our conservation action.

The U.S. Fish and Wildlife Service is collaborating with agencies across the Department of the Interior, state agencies, and non-governmental organizations consistent with the Secretarial Order issued in September 2009.

The Habitat

■ Ozark, Boston and Ouachita Mountains

The Ozarks, Boston and Ouachita mountains include much of southern Missouri and northern Arkansas and small portions of Illinois, Kansas and Oklahoma. The hills, valleys and karst formations of these mountain ranges feature prairies, savannas, open woodlands, glades, fens, springs, rivers, lakes and cliffs that harbor species found nowhere else on earth.

■ West and East Coastal Plains

The Coastal Plains extending from western Georgia to eastern Texas has been identified as an "endangered ecosystem" due to human-induced impacts and the potential threat of climate change. This vast landscape supports one of the highest acreage of longleaf and shortleaf pine ecological communities in the world, though less than three percent remain of its historic range. The freshwater communities

Bottomland hardwoods by USFWS/Larry Richardson

interspersed and embedded within the mixed pine-hardwoods, pine-savannas and prairie grasslands make this one of the most diverse ecological systems in North America. The southern terminus of the LCC is crowned by the beach habitats of the Emerald Coast.

■ Mississippi Alluvial Valley

The Mississippi Alluvial Valley is the nation's largest floodplain extending 27 million acres from southern Missouri to coastal Louisiana. It is an ecosystem created by "America's River" and its annual flood pulse, as historically hundreds of thousands of acres were inundated annually, and tens of millions of acres less frequently. More than 75 percent of the forested wetlands have been cleared for development and suffers from systemic water quality degradation, but the region still supplies habitat of hemispheric significance for migratory birds. Its riverine and floodplain fisheries are unparalleled in scope and diversity. It is North America's most productive wetlands ecosystem.

Adaptation Benefits

Building on a conservation legacy established with partners for over a century -- and more than a decade of innovation in the Lower Mississippi Valley -- the GCPO LCC will be one cooperative in a national network of more than 20 that will acquire wildlife and habitat adaptation expertise by working closely with the U.S. Geological Survey's Climate Science Centers. It will be a conservation science partnership between the Service, federal agencies, states, tribes, NGOs, universities and other entities. What's more, it will be a fundamental unit of planning and science capacity that will help us carry out the functional elements of Strategic Habitat Conservation (i.e. biological planning, conservation design, conservation delivery, monitoring and research), filling existing gaps in our science capacity, and ultimately informing our response to accelerating climate change and other stresses.

Some of the data gathered will include climate, land-cover, and land-use trends and patterns as well as species vulnerability and hydrology data in spatially-explicit contexts to develop

measureable biological objectives that will guide resource management decisions and actions. Facing the most compelling conservation challenges of our generation, the science-based partnerships will augment resource manager's ability to deliver the right conservation to the right places to most benefit America's fish and wildlife. The result: Treasured landscapes connected to one another and healthier fish and wildlife populations.

The Partnerships

The organizational and operational structure of the GCPO Landscape Conservation Cooperative will emerge as partners coalesce around the region's resource challenges. However, the

Cooperative is envisioned to be modeled after the internationally successful private, state and federal Joint Venture partnership, which includes a management board, a conservation science and coordination office, and a network of teams and action groups.

Participation is anticipated to include agencies and organizations that by virtue of their mission, mandates or authorities have identified conservation of our nation's natural resources as a priority to accomplish their objectives. Organizations would commit to participate as an equal member working cooperatively in a non-regulatory forum. The Service's contribution, commitment and participation will focus on natural resource processes directly associated with supporting and sustaining fish, wildlife, plants and their habitats.

Specifically, the Service will join others in establishing population objectives for priority species, identifying relationships between species and habitats and other limiting factors, and helping coordinate conservation and development actions to inform where and how much habitat is needed to sustain fish and wildlife populations. Developing and coordinating adaptation strategies for the GCPO LCC in response to climate change and other key stressors (e.g. urban growth, water quality and quantity, and invasive species) represents a primary focus of the Service's interest in participating in this and other landscape conservation cooperatives.

Key organizations include state fish and wildlife agencies, state water quality agencies, state forestry agencies, the Service, USGS, National Park Service, Bureau of Indian Affairs, U.S. Forest Service, Natural Resource Conservation Service, U.S. Environmental Protection Agency, U.S. Department of Transportation, non-governmental conservation organizations, foundations, universities, and many others.

Conservation science and coordination capacity would be built by the membership with the Service contributing technical staff to serve in a dedicated capacity with the GCPO LCC, and the Service anticipates its members will contribute science resources including dedicated or cost-shared positions along with other identified science-driven needs. Other members of the GCPO LCC may also contribute dedicated positions or seek ways to cost-share positions. The staff could be located in one office or otherwise but would work as a team on behalf of the cooperative. The network of teams and action groups would accomplish the conservation work, guided by the priorities and activities set by the partnership.

Existing Capacity and Anticipated Needs

An avian-based GCPO-wide conservation science and coordination capacity exists through three Joint Venture partnerships (Lower Mississippi Valley, Central Hardwoods and East Gulf Coastal Plain) as well as the Southeast Aquatic Resource Partnership whose area of responsibility expands beyond the boundary of the GCPO LCC. In addition, the conservation community supports numerous conservation management, science and technical staff serving within the GCPO LCC geography whose work and contributions will be vital to its success. The Lower Mississippi Joint Venture, for example, has a JV coordinator, an avian science coordinator, a natural resource planner, a GIS application biologist and Mississippi Alluvial Valley and West Gulf Coastal Plains conservation delivery coordinators.

Among the skills, talents and expertise identified so far, we expect to work with partners to fill the following needs: a landscape simulation and forecasting modeler, monitoring coordinator/biometrician, a geo-database development manager, biological carbon sequestration/biofuels specialist, a bio-hydrologic modeler, conservation scientists (e.g. fisheries population ecologist/science coordinator, an adaptation management restoration ecologist/science coordinator), a public engagement and communications specialist and a webmaster with new media expertise.

Timeline

In FY 2010, an interagency team will convene a climate change rapid prototypic workshop that will engage the JV boards and other partners and identify ecological intersection among the State Wildlife Action Plans, National Bird Plans and other Conservation Plans.

In FY 2011, the GCPO LCC will be formally constituted. Its technical staff will begin work on priority biological planning projects and a climate change adaptation strategy for this geographic area.

For More Information

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Robert Ford, Senior Science Adviser for Climate Change, 901/327 7631, robert_p_ford@fws.gov

To Learn More

Please visit our Region's web site at www.fws.gov/southeast/LCC/GulfPlains/. Other resources can be found at www.fws.gov/southeast/climate and www.fws.gov/southeast/shc.

Research Needs for the GCP&O LCC in Oklahoma Identified by the Oklahoma Landscape Conservation Alliance Based on 6 Categories of Climate Change Science

Species Risk and Vulnerability Assessment
Inventory and Monitoring
Population and Habitat Assessments
Biological Planning and Conservation Design
Management Evaluation and Research
Conservation Genetics

Species Risk and Vulnerability Assessment

Great Plains LCC: focusing on large riverine systems - particularly the Cimarron, Canadian and Red rivers because of the potential effects of decreased rainfall and increased dewatering. Focal species: Lesser Prairie Chicken, Arkansas River Shiner, Speckled Chub complex, Flathead Chub, Chub Shiner, Arkansas Darter, Least Tern and Snowy Plover

Gulf Coastal Plain/ Ozark LCC: focusing on species with limited range, specialized habitats, limited dispersal capabilities, and occur at relatively high elevations. Focal species: Plethodonid salamanders, terrestrial snails (e.g. slitmouth snail), crayfish, small stream fish (primarily cyprinids and darters) and freshwater mussels

Inventory

More efficient monitoring systems for non-bird wildlife

Establish monitoring programs that transcend state lines and regional lines within states

ALL LCCs: Better baseline regarding current habitat distributions and conditions

ALL LCCs: Evaluate and develop monitoring protocols for most non-bird wildlife (reptiles, amphibians, small mammals, freshwater mussels, and small nongame fish)

Population and Habitat Assessments

Use birds as test cases for modeling and responses to habitat change

Biological Planning and Conservation Design/ Management and Evaluation Research

USFWS set population goals for migratory birds and threatened and endangered species

Effects of prescribed fire and fire seasonality and frequency on forest-dwelling salamanders, ground-nesting grassland and forest birds, terrestrial turtles and lizards, and tree and cavity dwelling bats

Most effective ways to control invasive and exotic species such as aquatic vascular plants e.g. Seracea lespedeza, autumn olive, saltcedar, privet, amur honeysuckle, Japanese Brome, Old World Bluestem and tall fescue

Conservation Genetics

Genetic variability of current threatened and endangered species

Gulf Coastal Plain/Ozarks LCC: Focal Species: Ozark Big-eared Bat, Ouachita Rock Pocketbook, Scaleshell, Leopard Darter, Ozark Cavefish, Gray Bat, American Burying Beetle and Winged Mapleleaf

Effects of missing populations of the same species that have different genetic characteristics

Should different populations not be mixed because of regional adaptations?

Do the genetics of one population overpower the other?

Do animals from transplanted populations die out after a few generations?

Do transplanted animals pass along genes that reduce the fitness of their hybrid offspring?

Are hybrid populations more or less resilient to habitat (or climate) change?

Should there be concern with keeping populations isolated because of genetic issues?

Resolving taxonomic discrepancies with aquatic species

e.g. Ouachita Creekshell and Ozark Pigtoe. Are they distinct species or ecomorphs or populations with aberrant shell morphology?

Population assessment and habitat requirements of freshwater mussels within the Little River Watershed

Combine field data along with laboratory data to provide information on the vulnerability and risk of mussel species in response to human and climate change stressors

Develop strategies and management actions to minimize and or eliminate the adverse effects to climate change stressors

Monitoring Bottomland Hardwood Forests of Eastern Oklahoma to promote adaptive management

Implement extensive monitoring program to determine how climate stressors affect and influence disturbance regimes throughout the bottomland hardwood forest in eastern Oklahoma

Long-term monitoring and spatial modeling to implement a risk-assessment system that identifies potential risks and effects of climate related stressors on forest structure and function and wildlife and fisheries populations

Continual monitoring of the ecosystem and implementing management activities to determine new management strategies that address impacts on bottomland hardwood forests

Deep Fork National Wildlife Refuge Bottomland Hardwood Ecosystem Health

Attain data on forest health in the Deep Fork River floodplain in Okmulgee, McIntosh, and Creek counties. (FWS, USGS, ODWC)

Effects of prescribed and wildfire on bottomland hardwood ecosystems

Baseline inventory of flora and fauna on the refuge

More data on Swainson's warbler

Identifying gaining and losing reaches of riparian streams for managing aquatic habitats associated with potential climate change

Ecosystem dependence on water quality (salinity) as related to a mappable hydrologic/geologic framework

Hydrologic modeling of in-stream flow conditions required for maintaining ecologic integrity

Habitat loss in response to increased sedimentation associated with decreased vegetation through climate change

Methods and examples for using USGS surface water data for characterizing stream habitats

USGS literature relevant to evaluating hydrologic conditions associated with climate change

USGS datasets relevant to evaluating hydrologic conditions associated with climate change

Develop platforms/databases that interface data types for respective disciplines (biology, hydrology, geology, and climatology)

Develop web portal for project teams with links to data, literature, scientists, and current projects

Strategy for deployment of a stream gauging network for monitoring precipitation changes (runoff) in response to potential climate change

Strategy for deployment of a groundwater-level network for assessing groundwater contributions to streamflow

Anticipated variation in the water-quality of lakes in response to climate change (emphasis on nutrients, algal toxins)

Habitat loss in lakes in response to decreased capacity through increased sedimentation

An analysis of Canadian River fish refugia during drought, using aerial imagery.

Conservation Genetics of Arkansas River Shiner (Notropis girardi) (proposal developed)

Method for mapping and delineating potential impacts of reduced streamflow through climate change on habitat distribution of the Arkansas River shiner and paddlefish (proposal developed)

Analysis of long-term ecological change in the Cimarron River watershed (proposal developed)

Thermal tolerances of leopard darter (Percina pantherina) and other darters of southeastern Oklahoma (preproposal developed)

Thermal and salinity tolerance of Arkansas River shiner (Notropis girardi) and Red River shiner (Notropis bairdi)

Ozark Big-eared Bat habitat requirements and response to climate change

Implement appropriate forest and cave management strategies and document affects of climate change

Attain data that compares:

- forest and other habitat types using acoustical, infra-red, thermal, and other monitoring
- data using methods that document habitat preference, forest species composition, basal area, canopy closure, seasonal habitat preferences, movement patterns, foraging areas, and food habits

Response of Endangered Gray Bats to Fire and Climate Change

Monitoring data for:

- bat populations
- migration patterns
- Timing
- smoke entering caves
- air quality at multiple distances from the cave opening
- correlation between fuel and smoke entering caves

ash entering caves

cave water quality

other pertinent parameters

Adair, Delaware, Cherokee, and Ottawa Couties Management Units Plant Survey

Baseline survey of woody, herbaceous, and rare plant species

Need for two sets of voucher specimens of plant species found on the Mary and Murray Looney, Alvin A. Beck (Krause), Lake Euche, Potter, Gittin Down Mountain, Liver, Varmint, Sally Bull Hollow, and Boy Scout Management Units

Quantify effects of climate change and baseline conditions important to the management of Federally-listed Ozark big-eared bats and gray bats

Target important areas and assist in prioritizing management decisions

Ozark Salamander Species Climate Change Stress Evaluation

Develop a means of monitoring the impacts of stressors related to climate change (temperature and hydroperiod) on corticosterone and developmental and physiological limits

establish baseline levels for species in the wild

develop gene markers that could be used for assessment of health of populations

Ozark Big-Eared Bat Conservation Genetics

Develop genetic makers that provide baseline information for understanding natural levels of genetic variation within and genetic differentiation among populations, levels of relatedness of females within maternity colonies, and genetic characteristics of male Ozark big-eared bats across the bat's range (Arkansas and Oklahoma)

Determine the highest priority colonies/caves that should be protected in order to maintain genetic integrity

Baseline Population Data on Non-Listed Bats in eastern Oklahoma

Long-term trend data to assess effects of climate change and White Nose Syndrome using the following survey techniques: acoustical monitoring, mist netting, and cave inventories

Expect the GCP&O LCC RFP to be similar to this.

REQUEST FOR PROPOSALS
U.S. Fish and Wildlife Service, on behalf of the Great Plains Landscape Conservation Cooperative
Opportunity Title: Climate Change Adaptive Science Capacity – Great Plains Landscape Conservation Cooperative Fiscal Year 2010
Opportunity Number: FWSR2-GPLCC-FY2010

The U.S. Fish and Wildlife Service (Service) is soliciting proposals for applied scientific work with fish, wildlife, and/or plants in the Great Plains Geographic Area on behalf of the Great Plains Landscape Conservation Cooperative (GPLCC). The GPLCC is an applied conservation science partnership in the Great Plains; see http://www.fws.gov/science/SHC/lcc.html for a map of the Great Plains Geographic Area, and http://www.fws.gov/science/SHC/pdf/GreatPlains.pdf for the preliminary action plan for the GPLCC. Scientific projects of interest to the GPLCC will ultimately help inform resource management decisions that address landscape-scale stressors to fish, wildlife, and plants of the Great Plains.

The GPLCC was officially formed at the first meeting of its Steering Committee on March 4, 2010. Funds for scientific work in the GPLCC were appropriated to the Service in the FY 2010 budget allocation. That budget allocation contains mandatory performance measures that oblige the Service to quickly and astutely commit the funds to priority scientific projects. The quick response to this Request For Proposals (RFPs) is required in order to ensure work begins as quickly as possible on FY 2010 projects in light of the expectations for deliverables by the Service before October 1, 2010. The Service expects to obligate at least $875,000 to scientific projects for the GPLCC under its Climate Change Planning and Adaptive Science Capacity Program. We urge applicants to consider the scope of their project and design projects that can be delivered in the time specified. This could mean utilizing data already collected, performing a synthesis of work from previous studies such that the project can be completed without additional field work, or other creative strategies. The GPLCC Steering Committee anticipates that future RFPs will be timelier and will allow for projects that may include one or even more field seasons and collection of new data.

SELECTION CRITERIA Interested parties should read the background material referenced above, and consider the following selection criteria that will be used to evaluate and score project proposals:

1. **Duration.** Ideally, the proposed scientific project should be concluded and final reports/deliverables completed by September 30, 2010. Longer projects will be considered, but projects that can be completed by September 30, 2010 will receive higher scores on this critierion.
2. **Nexus with climate change.** LCCs were formed provide the science to address land management questions. Landscape stressors, including climate change impacts, are a primary focus of LCCs. Project proposals should have a direct application to addressing climate change impacts in the GPLCC geographic area.
3. **Performance measures.** Satisfies or contributes to one or more of the LCC performance objectives. Proposals that address more performance objectives will be scored highest. See Table 1 below for a list of performance measures.
4. **State Wildlife Action Plan (SWAP) or state/federally listed status.** Proposals that address species listed in one or more SWAPs or which are on the federal or one or more state threatened or endangered species lists will receive higher scores.
5. **All taxa.** In addition to the species listed in number 4, science supported by the GPLCC should be inclusive and contribute to the diversity of knowledge required to manage landscapes for the benefit of all native taxa. Projects focusing on relatively understudied taxonomic groups are especially encouraged and will be scored accordingly.
6. **Applicability to the landscape.** LCCs were formed to address climate change impacts in landscapes that have similar ecological attributes and are experiencing similar threats. Scientific projects should be designed for the entire GPLCC geographic area or for a landscape scale appropriate to the range distribution of the focal species or can demonstrably be scaled up to a larger landscape.
7. **Proposal comes from a partnership.** To complete high-quality applied scientific projects that address climate change issues throughout a large landscape and among a variety of taxa, partnerships are essential. Applicable partnerships can consist of cross-disciplinary scientific or conservation alliances among professionals in research, conservation planning and delivery/management, and communications.
8. **Consultation and partnership with conservation delivery personnel.** Since project results will eventually be applied, it is important to understand what existing private and/or public partnership has requested or may use the product(s) of the proposed scientific project. Scientific projects that have direct application to on-the-ground management and meet one or more partner objectives will be scored accordingly.

9. Consideration will also be given to scientific merit, methodology, and overall quality of the proposal.

PROPOSAL FORMAT Persons and organizations interested in submitting proposals should go to the Full Announcement and Application Instructions posted on Grants.gov (Funding Opportunity Number: FWSR2-GPLCC-FY2010).

SELECTION PROCESS A committee of 8-10 members representing a variety of taxonomic/ecosystem expertise will be convened. An attempt will be made to have representation from throughout the GPLCC from state wildlife managers; researchers at the state, federal and university level; not-for profits, etc. Successful applicants will be notified May 3, 2010.

Table 1: Department of Interior performance measures relative to Landscape Conservation Cooperatives for FY 2010.

1	Number of LCCs with an initial baseline inventory of bureau's available climate change data
2	Number of Landscape Conservation Cooperatives established that have begun identifying areas and species most vulnerable to climate change
3	Number of decision-support tools provided to conservation managers to inform management plans/decisions and ESA Recovery Plans
4	Number of conservation delivery strategies and actions evaluated for effectiveness
5	Number of landscape-scale conservation strategies developed (including explicit species-specific, scalable population objectives and adaptation approaches) that can direct management expenditures where they have the greatest effect and lowest relative cost
6	Number of risk and vulnerability assessments developed or refined for priority species or areas.
7	Number of inventory and monitoring protocols developed, refined or adopted to capture data on priority species addressed in LCC work plans that are expected to be vulnerable to climate change
8	Number of population and habitat assessments developed or refined to inform predictive models to provide predicted changes in species populations and habitats as a result of climate change
9	Number of biological planning and conservation design projects developed in response to climate change
10	Number of management actions evaluated for effectiveness in response to climate change and research activities conducted to address information needs in response to climate change
11	Number of conservation genetics projects to improve and enhance conservation design and delivery for fish and wildlife populations in response to climate change
12	Acres of Bureau lands with sufficient information to forecast biological and ecological changes to priority species addressed in LCC work plans that are expected to be most vulnerable to climate change
13	Number of LCCs having identified how climate change is expected to affect the priority species addressed in LCC work plans that are expected to be most vulnerable to climate change.
14	Number of LCCs having sufficient information to forecast biological and ecological changes to priority species addressed in LCC work plans that are expected to be most vulnerable to climate change
15	Number of non-FWS riparian (stream/shoreline) miles restored to address climate issues, including miles restored through partnerships (includes miles treated for invasives & now restored)
16	Number of wetlands acres enhanced/restored to address climate issues through voluntary partnerships (includes acres treated for invasives & now restored)
17	Number of non-FWS uplands acres enhanced/restored to address climate issues through voluntary partnerships (includes acres treated for invasives & now restored)
18	Number of habitat assessments completed to address climate issues
19	Number of fish passage barriers removed or bypassed to address climate issues
20	Number of miles reopened to fish passage to address climate issues
21	Number of acres reopened to fish passage to address climate issues
22	Number of miles of stream/shoreline restored in U.S. to address climate issues

Example proposal format for LCC based on the Great Plains LCC RFP

During the Ozark Summit, we will focus on the following: 1) Title, 2) Problem Statement, 3) Objectives, 4) Anticipated Products, and 5) Identify team members which remaining tasks will be divided out.

General Instructions: Proposals submitted should address priority species, habitats, and issues outlined in the GCP&O LCC Operations and Development Plan (2009). Moreover, prioritization of proposals will be directed at projects that address the Performance Measures. Proposals may not exceed 10 pages. This includes everything from the title to budget justification. All proposals should be submitted as a single MS Word Document and use 12-point TNR or Arial font with 1-inch margins.

1. **Title:** Provide a brief description title for the project.
2. **Names and Contact Information of Authors:** Provide the name(s), title, affiliation, mailing address, telephone, fax, and e-mail.
3. **Abstract:** The abstract should provide a brief, informative description of the project, anticipated deliverables, and a clear description of the relevance to the GCP&O LCC. The abstract should not exceed 300 words.
4. **Introduction:** The introduction should include the following components.
   a. Background: Address the technical and scientific issues that underlie proposed scientific project. Information should include related ongoing activities, current relevant findings, and scientific value of proposed results.
   b. Integration: How will the project enhance knowledge in the GCP&O LCC on climate change and conservation? State what specific performance measure this proposal addresses (Performance Measures), and describe how the problem relates to a GCP&O LCC priority outlined in the GCP&O LCC Operations and Development Plan.
   c. Problem Statement and Implications: Clearly describe the exact management problem and how the proposed study will address this need.
   d. Objectives: Clearly describe the goals and objectives of the proposed project or the need for continuation of an existing project. Explain the priority and significance of the project as it relates to the issue(s) being addressed.
5. **Methods and Study Area:** Clearly describe methodologies and how they will achieve the stated objectives. Methods must detail the means by which each of the objectives will be achieved. Provide sufficient detail so that the likelihood of achieving each of the can be fully evaluated. Include a description of the proposed study area(s).
6. **Partnership and Roles:** Describe the partnership and the responsibilities of each participant in the project. If there are collaborators not included in the list of authors, include a letter (not included in the page total) from the collaborator describing support of the project and commitment of participation.
7. **Project Duration/Timeline:** Provide the start date and completion date (the completion date is when deliverables are provided to the USFWS POC). Include a table that describes major milestones towards project completion.
8. **Products:** Provide information on specific products expected and delivery dates (include quarterly progress reports for multi-year projects). Provide a timetable for achievement of milestones, major accomplishments, and completion of project. Specify the product format in which these results would be most useful. Products in electronic format streamline dissemination as well as enable the FWS to include such products into its electronic library. Special requests for products in hard copy format, in addition to electronic format, should be included in the section of the proposal.

9. **Qualifications of Project Personnel:** List all project personnel and their respective roles and responsibilities. Summarize the qualification of the principal investigator, and each co-investigator, cooperator, and partner that will make significant contributions to the success of the project.
10. **Budget and Justification:** Provide a budget itemized in the following categories as appropriate: (1) Personnel (2) Fringe Benefits (3) Travel (4) Equipment (5) Supplies (6) Contractual (7) Construction (8) Other, and (9) Indirect Charges. The budget must include a breakout by federal government fiscal year.

Projects Highlighted by the GCP&O LCC Operations and Development Plan (2009)

Table 8. Select high priority science project needs of the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative that are detailed in Appendix H. . Descriptions of these projects are provided in Appendix H. The order of projects in this table and in the appendix does not reflect any predetermined ranking for anticipated funding.

PROJECT	COMPLETE BUDGET (ALL COSTS)	EXISTING PARTNER CONTRIBUTIONS	UNMET FUNDING NEEDS
Climate Change Impacts on Ground and Surface Water Dynamics of the Mississippi Alluvial Valley: Implications for Priority Species	$1,194,000	$120,500	$1,073,500
Predicting the Effects of Land Use and Climate Change on Wildlife Communities and Habitats in the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative	$1,500,000	$751,000	$749,000
An Integrated Forest Management Database for the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative	$320,000	$70,000	$250,000
Multi-Resolution Assessment of Potential Climate Change Effects on Priority Aquatic Species – Phase II of the Southeastern Pilot	$1,610,000	$1,410,000	$200,000
Common Ground: Expanding and Updating Land Cover Classifications for the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative	$300,000	$100,000	$200,000
Biological Planning, Conservation Design, and Monitoring Longleaf Pine in the Gulf Coastal Plains and Ozarks and South Atlantic Landscape Conservation Cooperatives	$226,750	$76,750	$150,000
Expanding the Integrated Coastal Assessment of the Southeastern Pilot	$415,500	$277,000	$138,500
Monitoring the Effects of Climate Change on Waterfowl Abundance in the Mississippi Alluvial Valley: Tools for Increasing Monitoring Efficiency	$125,000	$40,000	$85,000
Assessment of Desired Forest Conditions within the Mississippi Alluvial Valley: Spatial and Temporal Considerations	$136,000	$78,000	$58,000
Development of a Treasured Landscape Decision Support Tool to Safeguard Priority Fish and Wildlife Populations in the Mississippi Alluvial Valley	$75,000	$25,000	$50,000
Optimal Conservation Strategies for Dynamic Landscapes	$782,500	$732,500	$50,000
Assessing the Impact of Human Development on High Priority Species in the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative	$50,000	$25,000	$25,000

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Karst hydrogeology and recharge area delineations for springs and caves with species of concern
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Biologist at Cookson, Ozark Plateau & Sparrow Hawk WMAs
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CAROL BECKER
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Carol has worked with the USGS, Oklahoma Water Science Center for approximately 20 years. Carol has worked on a wide range of water-related projects but primarily has focused on groundwater quality in relation to land use and naturally occurring constituents.
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Larisa was recently hired as a research assistant and field technician for the Bat Research Lab at Missouri State University and will begin her Master's in Biology in the spring of 2011.
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STEVEN BOND
Steven Bond assists in the preservation of traditional Southeastern practices involving plants and their uses. At the Chickasaw Culture Center in Sulphur, OK, he is developing Environmental Education programs to extend our education and outreach efforts into the 109 acre campuses.
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MS Aquatic Biology - Southwest Texas State University
BS Biology and Natural Resources - Ball State UniversityDavid has directed the Aquatic Program for the NPS Heartland Inventory & Monitoring Network since 2004. He oversees a staff of three full-time employees, one part-time research specialist and two student workers. The Aquatic Program conducts inventory and monitoring activities related to water quality, aquatic vegetation, invertebrates, fish and habitat of streams and springs in 15 NPS units.

JEFF BOXRUCKER
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Jeff has 30 years as fisheries research biologist for Oklahoma Department of Widlife Conservation; 3 years Assistant Chief of Fisheries-responsible for management of fisheries statewide experience and manages a staff of 85.
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SCOTT BRANYAN
Formally schooled in music and theology, Scott is a fly-fishing guide, writer and naturalist. He is researching on the White River in Arkansas and Missouri, has written entries for the Encyclopedia of Arkansas on Corps of Engineer projects and water resources, and advises Arkansas Chapter of Trout Unlimited on stream conservation.
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STEPHANIE BUCK
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MS Biology - University of Nebraska
For the past four years Stephanie has worked for the USGS, Oklahoma Science Center Tulsa Field Office. She has mined data for water quality and continuous real-time water quality monitors. She brings a biological background to the Oklahoma Water Science Center.
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AMY BUTHOD
Amy Buthod has been at the Oklahoma Biological Survey as a Botanical Specialist since 2000. She participates in botanical field studies throughout the state and maintains the Oklahoma Natural Heritage Inventory's tracking list of rare plants. She is also the collection manager of the Robert Bebb Herbarium at the University of Oklahoma.
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DR. WILLIAM CARROMERO
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MS Tropical Ecology – University of Puerto Rico
BS Biology - University of Puerto Rico
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Durwin Carter
BS & MS Biology
For the past 2 years, Durwin has served as the Project Leader for Holla Bend and Logan Cave NWRs in Arkansas. Several organizations have supported both of these refuges with monitoring, and management actions.
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JEFF CROSBY
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Jeff has been the Project Manager at Land Legacy for the past four years working on land conservation projects across Oklahoma and western Arkansas, with a special emphasis on Land Legacy's program to protect the Spavinaw Creek watershed in NE Oklahoma.
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ROBERT CSARGO
BS Wildlife & Fisheries Management - University of Minnesota
Robert is the Ozark National Forest's Forest Biologist, arriving to Arkansas about one year ago. He has approximately 22 years of service with the USFS, having spent most of his career serving in different positions in Arizona on several forests. All positions were always related to the management of forests and especially regarding wildlife and fire.
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CANDACE CUNNINGHAM
BS Biological Science - Oklahoma State University
For the past four years Candace has been a Technical Writer/Environmental Scientist for the OCC WQ division. OCC is the lead technical agency for nonpoint source pollution in Oklahoma. OCC WQ actively works to reduce nonpoint source pollution in the state through monitoring, implementation of best management practices (such as riparian fencing), and the Blue Thumb education program. BMPs installed by OCC reduce the amount of sediment, bacteria, and phosphorus entering streams during runoff rainfall events.In addition to writing reports she is involved with Cyanobacteria identification and counts.
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Since 1984, Jerri has been the Water-Quality Specialist for the USGS, Missouri Water Science Center. She was a project member on the USGS National Water-Quality Assessment project in the Ozark Plateaus from 1992-1997 and again in 2006-2007.
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REED DETRING
Reed Detring is the superintendent at ONSR, managing 134 miles of scenic rivers on the Jacks Fork and Current in Southern Missouri. The park has over 400 significant cave resources and as many springs. The park has 160 employees and a budget of $6.5 million.
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HOPE DODD
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Hope is currently the fisheries biologist for the Heartland Inventory and Monitoring Network of the National Park Service. She coordinates long-term monitoring of fish assemblages, physical habitat, and water quality in prairie streams and Ozark river systems. Her research interests focus on anthropogenic disturbances in lotic systems and assessment of these long-term effects on water quality, habitat, and biota. Previously, Hope worked as a stream ecologist at the Illinois Natural History Survey conducting research on the assessment of restoration practices and dam removal on stream fish and invertebrate communities.
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STEVE FILIPEK

BS Fishery Biology - Colorado State University
For past 8 years, Steve has been an Asst. Chief over the Fisheries Division's Program's Section. He has a staff of 8, 4 of which focus on stream habitat and integrity evaluation, stream remediation, stream team work including water quality work with over 750 stream teams in the state. He also has 4 sport and nongame biologists that work with rivers and streams, instream flow, development impacts, mussels, commercial fish, nongame fishes, herps, and crayfish.
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DOUG FLETCHER

MS Biology (Mammalogy/Herpetology)
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Doug is a charter member of the Arkansas Karst Team. He serves as Chief of Stewardship for the past 12 years and is responsible for the management of all lands within the State of Arkansas' System of Natural Areas. Doug supervises a staff of 8 field ecologist and land stewards.
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DR. KAY FRANK

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Since retirement, Kay continues to serve as Education Coordinator for the Solid Waste Institute of Northeast OK. She leads hands-on activities in illegal dumping, recycling and other solid waste management issues. Kay is also involved in Environmental Education with Blue Thumb and with Projects WET, WILD, and LEARNING TREE.
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DANIEL FRANKE

BS Marine Science - University of Hawaii Hilo
Daniel is currently employed by the Oklahoma Conservation Commission as a stream monitor in N.E. Oklahoma. He performs weekly water quality monitoring of priority watersheds. This includes physical/chemical data, biological indicators, and maintaining automated water samplers.
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KEN FRAZIER

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Ken serves as the Assistant Field Supervisor of the Tulsa Ecological Services Office of the U.S. Fish & Wildlife Service. Ken has 30 years of experience in natural resource protection and management in Oklahoma.
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MARY GARD

BS & MS Botany – OSU
Mary is a recent Graduate of OSU who, as part of her thesis, was contracted by the USFWS to conduct a floristic survey of the OPNWR.

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KEITH GRABNER

MS Forestry - University of Missouri
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For the past 12 years, Keith has been working as an ecologist with the US Geological Survey. His research interests include prescribed fire behavior; the effects of management on wild land fuel accumulation; vegetation inventory, monitoring, and classification; forest management; and the effects of prairie and woodland restoration.
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ROBERT GREGORY

For the past 8 years, Robert has served as Executive Director of Land Legacy, a nonprofit organization focused primarily on land conservation through conservation easements, including riparian protection.
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BS Biology - Northeastern State University
Pat has a staff of approximately 40 and a program of approximately 12.5 million dollars. CN Natural Resources ensures compliance with applicable laws and regulations for all NR Programs. Administers BIA funded self-governance programs ensuring that the natural resources trust responsibilities are met.
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DR. CHRISTINE HALLMAN

PhD Geography - University of Arizona
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MS Geography – Murray State University
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With a background in dendrochronology (tree-rings), Christine has been researching climate change and biogeography of ancient bristlecone pines in California as part of her PhD, which she completed summer 2010. She is a newly hired Assistant Professor of Geography at Northeastern State University and is interesting in pursuing studies in tree phenology and dendrochronology in the Ozarks and nearby areas.
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SHEA HAMMOND
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Shea is currently a USFWS Wildlife Refuge Specialist working on the Ozark Plateau National Wildlife Refuge in Oklahoma. His duties include forest and cave/karst management on refuge lands, he is the director of the Mary and Murray Looney Education and Research Center, and is involved in various bat monitoring programs in Oklahoma.
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STACY HANSEN
MA Professional & Technical Writing
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Ms. Hansen has been with the Oklahoma Conservation Commission since 2006 and Director of the Oklahoma Carbon Program since 2008. During initial development of the Carbon Program Stacy worked with three stakeholder groups representing 30 agencies, companies, and organizations to successfully draft agency rules for the carbon program and facilitate their approval by the Oklahoma Legislature. Stacy has collaborated with Oklahoma NRCS to draft verification protocols for no-till and grassland and to create a training program for their use by Conservation District employees and Oklahoma Conservation Commission staff. Stacy is responsible for all aspects of the carbon program, including policy and protocol development, Conservation District training and communications, partner collaboration, website content, and coalition building with state, federal, and national carbon market partners. She also coordinates with OSU to move forward soil carbon research in Oklahoma and with Oklahoma Forestry Services to develop a forestry carbon verification protocol.
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Steve is a biologist with 37 years of experience in the Ozarks mainly with the US Fish and Wildlife Service working on cave biology and management, federally listed endangered and threatened species, NEPA, Fish and Wildlife Coordination Act, contaminants, wetland delineation and management, aquatic and terrestrial habitat evaluation, in-stream flow, reservoir and hydropower impacts. The last 12 years, Steve has managed Ozark Plateau National Wildlife Refuge to recover federally endangered and threatened cave species (bats and cavefish). Steve continues to be a source of information concerning bats, cavefish, cave invertebrates, caves management, surrounding forest, streams, and groundwater recharge areas that caves and their species depend on.
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Rosanna has currently accepted a position with Top of the Ozarks RC&D as project coordinator for DNR Trails Redesign Project. Prior to accepting her current position, she was an Americorp and Vista volunteer for the Rural Communities of the Ozarks. Her project focus is water quality in the Jacks Fork Watershed.
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For the past thirteen years Rick has worked as a Fisheries Management Biologist for the Missouri Department of Conservation. Rick's primary duties include aquatic resource management in the southwest corner of Missouri.

His responsibilities include management of warm water and coldwater stream resources, small public impoundment management, Roaring River State Park management team instream habitat and fisheries management, Ozark Cavefish Recovery team leader for Missouri, and private lands pond and stream technical assistance.
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ELANE HUDSON

Elane is an interested citizen.
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DR. MARK HUDSON

MS & PhD Geology - Colorado School of Mines
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For the past decade, Mark has been producing geologic maps as a USGS researcher in the Buffalo National River area of northern Arkansas.
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Deborah taught high school science for nine years, before joining the NSU faculty in January 2008. She primarily teaches geosciences courses, including some online courses. Deborah is also active with NSU's environmental sustainability task force.
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DR. DOUGLAS JAMES

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After 57 years Doug is still actively engaged in teaching and research at the University of Arkansas in the areas of ornithology, mammalogy, animal behavior, endangered species, and ecology including tropical ecology.
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MS Zoology - Southern Illinois University-Carbondale
For the last 5 years, Todd has been developing bird habitat models and other decision support tools to assist conservation planning. He was named the Science Coordinator of the Central Hardwoods Joint Venture in July 2009 and is currently working to refine JV science for forest birds and develop JV decision support tools for all other bird groups in the region.
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JAMES KAUFMANN

MS Geology - Missouri University of Science and Technology
BS Physics - Missouri University of Science and Technology
Jim is a Research Physical Scientist at the USGS Mid-Continent Geographic Science Center in Rolla, Missouri. His primary research interest is in the geography of karst, karst related hazards, and ecosystem service resiliency.
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ANDREA KORMAN

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Andrea is currently working on a MS degree in zoology from Oklahoma State University. Her research is focused on monitoring bats in the Ozark region via acoustic surveys.
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GINA LEVESQUE

MS Zoology - University of Arkansas
BS Biology - Purdue University
Gina has worked for the Oklahoma Conservation Commission since 2006 and has been the coordinator for Oklahoma's Conservation Reserve Enhancement Program (CREP) since it began in 2007. She has a staff of four conservation plan writers and a budget of 21 million dollars. CREP works with landowners to protect and restore riparian areas in the Illinois River and Eucha/Spavinaw Watersheds.
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AARON LINGELBACH

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JOE MACON

Attended University of ArkansasJoe attended University of Arkansas and has recently joined the Land Legacy team in order to contribute to their conservation efforts in the Spavinaw Creek watershed.
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LEESIA MARSHALL

PhD Candidate Biology - University of Arkansas
MS Biology - University of Arkansas, Fayetteville
BS Biology - Christopher Newport University, Virginia
Leesia is a behavioral ecologist whose emphasis lies in ornithology. Her master's thesis work pertained to the response of female hooded warblers, Wilsonia citrina, to threats of nest predation. Her PhD research is devoted to a riparian obligate neo-tropical migratory songbird, the Louisiana Waterthrush, Wilsonia citrina, its aquatic invertebrate prey, and responses of it and its prey to anthropogenic changes in the watershed of the upper Buffalo National River.
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DR. KEITH MARTIN

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For more than 20 years, Keith has been involved in cave management/protection measures in northeastern Oklahoma, primarily for gray and Ozark big-eared bat populations.
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CLYDE MASON

BS Microbiology - Oklahoma State University
Clyde has 37 years of experience in public health and environmental regulation. He has managed 10 local Environmental Specialists for the Department of Environmental Quality, covering all agency regulatory programs in northeastern Oklahoma for the past 10 years.
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MARK MASTERS

MBA Student - Cameron University
BS Wildlife & Fisheries Ecology - Oklahoma State University
Mark conducted graduate studies in Forestry and Wildland Fire Ecology at the University of Idaho. After a nine year career with the federal government Mark recently returned to academia to pursue an MBA while launching a private sector natural resources services provider: Chloeta Fire, LLC.
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RODERICK MAY

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Liisa recently began her career as a Fish and Wildlife Biologist for the USFWS with the Partners for Fish and Wildlife program. The Partners program helps to restore and conserve habitat on private lands for candidate, threatened, and endangered species; migratory birds; and other federal trust species. Liisa's focus area is the Ozarks of Missouri.
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EDWARD PARISOTTO

BS Biology (Wildlife Management) - Northeastern State University
The US Army Corps of Engineers makes permit decisions via Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 concerning impacts to jurisdictional waters of the United States and associated wetlands. The mission of the Corps of Engineers Regulatory Program is to protect the nation's aquatic resources, while allowing reasonable development through fair, flexible and balanced permit decisions. The Corps evaluates permit applications for essentially all construction activities that occur in the nation's waters, including wetlands.
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Jim has been a hydrologist with the USGS since 1979. He currently is study unit chief of the Ozark Plateaus National Water Quality Assessment Program.
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ASHLEY RHEA

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Ashley moved to Oklahoma in 2007 and has worked for the Oklahoma Conservation Commission since. She works as a Water Quality Specialist and is in charge of the water monitoring for the Illinois River Watershed.
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RUSSELL SATTELBERG

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BA Biology & Chemistry - North Central College
For the past four years, Mark has been the Field Supervisor of the US Fish and Wildlife Services' Arkansas Ecological Services Field Office in Conway, AR. He supervises a staff of 14 employees that are responsible for Endangered Species, Federal Project Reviews, Partners

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MS & PhD Geology - Stanford University
BS Geology - University of Missouri-Columbia
Eugene has served as the Director of the USGS Geology and Environmental Change for past two years with a staff of about 60 and a program of about $11 million. The science center conducts research on past climatic and environmental changes, the geologic framework of natural resources and hazards, and the interactions among geologic, biologic, and hydrologic systems. This work supports land and resource management decisions, the search for new sources of key materials, and the assessment of the environmental effects of climate change and human activities.
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ALLISON SHIPP

MS Environmental & Water Resources Engineering - University of Texas at Austin
BA Biology - University of Texas at Austin
Allison is the Science Program Officer for the USGS South Central Area. The South Central Area includes KS, MO, OK, AR, TX, and LA. There are 6 Water Science Centers, 2 Biological Science Centers, and 1 Geographic Science Centers in the SCA. She coordinates activities where it is necessary to bring multiple disciplines together to address complex science issues or large scale research efforts that cross multiple boundaries. Allison facilitates research and science efforts with partners. She helps formulate budget initiatives for the agency and work with USGS headquarters staff to ensure that program goals are met.
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SHERRI SHOULTS

BS Biology - Henderson State University
Sherri is a fish biologist and has been the Project Leader for Greers Ferry National Fish Hatchery for the past 8 years. The hatchery has a small staff of 5 people and raises over a million trout annually. Greers Ferry is a mitigation hatchery and provides rainbow and brook trout to suitable trout habitat below Corps of Engineers water projects in Arkansas and eastern Oklahoma, including the tailwaters below the Tenkiller and Broken Bow dams. The hatchery also is involved in conservation of threatened/endangered nongame fish species indigenous to the Little Red River in Arkansas.
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JAMI SKIMBO

BS Environmental Management - NSU
AA Chemistry - EOSCJami is currently enrolled in the MS IOM program at NSU

DR. AMY SMITH

PhD Zoology - University of Arkansas
BS Biology - Southwest Missouri State University
Amy Smith is the chair for the Fish and Wildlife program at Northeastern State University. Her research has focused on the impacts of disturbance on stream invertebrates. She has also studied the reproductive dynamics of the American burying beetle.
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MARK SPRICK

MA Planning & Policy - Texas A&M University
BA American History - University of Missouri
Mark is a Natural Resource Planner with the Southwest Region of the U.S. Fish and Wildlife Service. For the past 16 months, he has worked with the Ozark Plateau NWR to develop its comprehensive conservation plan to manage the refuge for the next 15 years. Mark has over 25 years professional experience as an urban, transportation, and environmental planner in California, New Mexico, and Texas.
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RICHARD STARK

MS Zoology - Oklahoma State University
BS Wildlife & Fisheries Ecology – Oklahoma State University
Richard has worked for the past 11 years as a fish and wildlife biologist in the threatened and endangered species branch of the U. S. Fish and Wildlife Service's Oklahoma Ecological Services Field Office. His responsibilities that are pertinent to the summit include office lead for cave/karst resources and bats, national recovery lead for the Ozark big-eared bat, and regional recovery lead for the gray bat, Indiana, bat, and Ozark cavefish.
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JERRY STARKEY

Jerry has worked for the Oklahoma Conservation Commission, since November of 2007, as a Conservation Plan Writer for the Conservation Reserve Enhancement Program.
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DR. ESTHER STROH

PhD Ecology - University of Missouri
MA Biology - Indiana University
MS Environmental Science - Indiana University
BS Education - National Louis University
Esther has served as an ecologist in the Department of Interior for sixteen years, affiliated with the National Park Service, the National Biological Survey and the US Geological Survey. She has worked as a field scientist and as a coordinator of regional and national research programs. Esther's primary research interests are conservation biology and plant-climate interactions. In the Ozarks, her work has focused on the study of native plant communities and rare plant populations.
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CHRISTOPHER TANNER

Christopher is currently finishing a BS degree in Environmental Science at Northeastern State University. Christopher has been approved as a STEP for the US Fish and Wildlife Service as he continues his education in graduate school.
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DAVID TAYLOR

BA & JD - University of Arkansas
For the past 46 years David has been the custodian of the files of the Arkansas Speleological Survey and the Assn for Arkansas Cave Studies, Inc. His work includes location, description, survey, and other documentation of caves and related features.
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JOHN TIRPAK

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BROOKS TRAMELL

Brooks began as an OCC employee in Cherokee County where he was the lead field investigator for a national monitoring project as well as the lead in general monitoring projects for the area. He became the Monitoring Coordinator in 2003. Brooks transferred to the Oklahoma City office in May of 2008. Monitoring activities in the Ozark Ecoregion have included special stream water quality projects and cave system water quality monitoring in cooperation with The Nature Conservancy.
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TRAMPAS TRIPP

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JEREMY TUBBS

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For the past five years Jeremy has worked for The Nature Conservancy at the Nickel Preserve. He has recently become the Preserve Manager at the Nickel Preserve.
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STEPHEN TULLY

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WILLIAM UIHLEIN

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CHRIS WHISENHUNT

From 2002 to 2006, Chris was involved in the streams program with the Oklahoma Department of Wildlife, working in both biology and applied fluvial geomorphology, assisting with stream restoration and habitat enhancement. Since 2008, Chris has been working as a regional fisheries biologist in Northeastern Oklahoma, primarily working on reservoirs.
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CHRIS WILSON

MS Environmental Science - Oklahoma State University
BS Fisheries & Wildlife - University of Missouri
Chris is The Nature Conservancy's Program Manager for the Oklahoma Ozarks & Ouachitas, where he coordinates strategic conservation partnerships and initiatives in the region. He has managed projects and preserves for the Conservancy in Arkansas, Tennessee, and Oklahoma, including 9 years as the Preserve Director for the 17,000-acre Nickel Preserve near Tahlequah. His interests include fire ecology and prairie & savanna restoration.
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DR. KIMBERLY WINTON

PhD Agronomy - University of Arkansas
MS Agronomy - Oklahoma State University
BS Zoology – Oklahoma State University
For the past six years Jane has been the Director for the USGS, Oklahoma Water Science Center. She has a staff of approximately 40 and a program of approximately 5 million dollars. The work at the Oklahoma Science Center focuses on stream gauging, water quality monitoring, aquifer studies, surface-water studies, and new technology.
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SAM ZIARA

BS Fisheries & Wildlife - Northeastern State University
Mr. Ziara has been employed by the Grand River Dam Authority for the past 4 years. He specializes in aquatic nuisance species and water quality, in addition to other conservation efforts established by the Authority.
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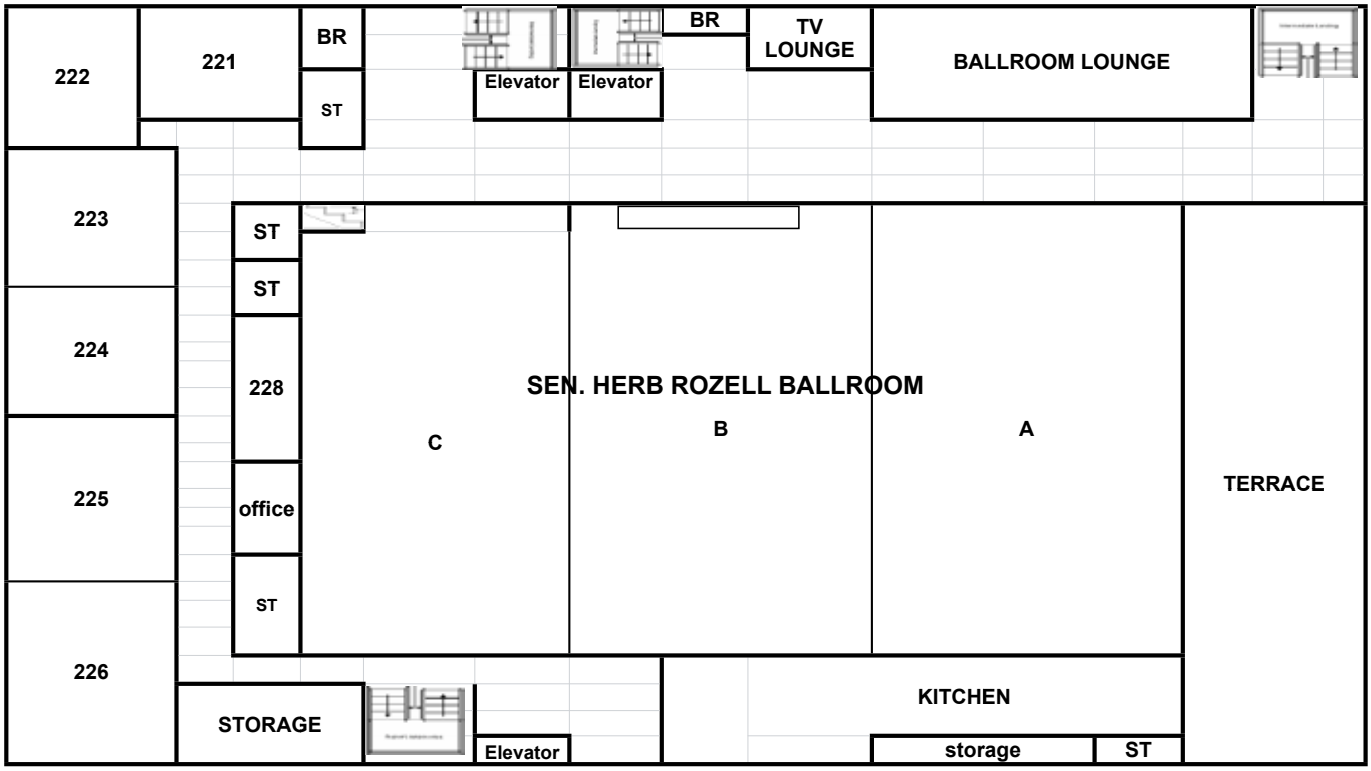

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