Annual Report

2005

Arkansas Cooperative

Fish and Wildlife

Research Unit

USGS science for a changing world

University of Arkansas

Wildlife Management Institute Washington D.C.

Arkansas Game & Fish Commission

ARKANSAS COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

ANNUAL REPORT 2005

Arkansas Cooperative Fish and Wildlife Research Unit
Department of Biological Sciences – SCEN 523
University Of Arkansas
Fayetteville, AR 72701

Arkansas Cooperative
Fish & Wildlife Research Unit

The Unit is a Cooperative Program of the:

US Geological Survey
Arkansas Game and Fish Commission
University of Arkansas
Wildlife Management Institute

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INTRODUCTION

The Arkansas Cooperative Fish and Wildlife Research Unit first opened its doors in August 1988 as one of four units initiated that year, and one of 40 coop units across the country associated with Land Grant universities, state game and fish agencies, Wildlife Management Institute, and the U.S. Geological Survey, Biological Resources Division. The purpose of these units is to train graduate students in scientific methods of fish and wildlife management, conduct fish and wildlife research, and provide technical assistance.

Over the past 17 years the Arkansas Coop Unit has gone through a number of changes. The federal cooperator changed from the U.S. Fish and Wildlife Service to the National Biological Survey to National Biological Service and finally to U.S. Geological Survey. The University department changed from Zoology to Biological Sciences and combined with Botany and Microbiology. We have seen eight Departmental Chairs (Amlaner, Geren, Kaplan, Talburt, Rhoads, Roufa, Davis, and Smith), and five Assistant Unit Leaders move on to other coop or university positions (Annette, Martin, Griffith, Kwak, and Thompson) and one Unit Leader retire (Johnson).

Past research efforts have been broadly funded by state agencies (Arkansas Game and Fish Commission, Louisiana Wildlife and Fisheries, Mississippi Museum of Science), federal agencies (U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey, National Park Service), and non-government organizations (Ducks Unlimited, Rocky Mountain Elk Foundation, Arkansas Audubon Society Trust, Sigma Xi). These funded projects have resulted in many scientific articles. Unit leaders have taught 8 classes in fisheries and wildlife, and produced 8 workshops to natural resource agencies.

In 1999, the Unit was reformed under a new Unit Leader, David Krementz, and soon thereafter 2 new Assistant Unit Leaders were hired, Dan Magoulick (fisheries) and Bill Thompson (wildlife). With the full support of all cooperators, this new team has begun a new era at the Arkansas Coop Unit. The opportunities that exist in Arkansas for the Unit at this time are many and exciting. With the cooperation of all parties, the new Arkansas Coop Unit will excel in producing quality graduate students, solid research and supportive technical assistance.

MISSION STATEMENT

The mission of the Arkansas Cooperative Fish and Wildlife Research Unit is to conduct programs of research, graduate education, and technical assistance that address the needs of the State of Arkansas, the region, and the nation. Research programs will pursue both basic and applied scientific questions that are relevant to the management of fish, wildlife, and their habitats. Research topics will be pursued according to Cooperator priorities, availability of collaborative expertise from Cooperators, and funding opportunities.

The educational mission of the Unit shall focus on graduate and post-graduate students. Activities will include teaching of formal graduate-level classes, chairing and serving on advisory committees, mentoring the professional development of students, and participation by Unit scientists in academic programs of the University of Arkansas. Students should be educated to prepare for advancement in broad areas of natural resource management and to serve as future leaders of resource management in the State of Arkansas. Educational programs of the Unit will be consistent with the professional standards and hiring practices of the Cooperators, similar agencies elsewhere, and relevant professional societies involved with natural resource management.

Technical assistance will be provided to Unit Cooperators in the areas of scientific expertise of the Unit. This can include assistance with interpretation of data, preparation and review of experimental designs, identification of specific research voids or needs, and rendering professional judgment. Such activities will generally serve to link the scientists' previously established expertise to specific needs of the Cooperators or other related agencies.

PERSONNEL AND COOPERATORS

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CURRENT GRADUATE STUDENTS

Christopher Bare (M.S., Fisheriers – Magoulick)
Mike Budd (M.S., Wildlife – Krementz)
Sarah Coulter (M.S., Wildlife – Krementz)
Aaron Cushing (M.S., Fisheries – Magoulick)
Matthew Dekar (Ph.D., Fisheries – Magoulick)
Jon Flinders (Ph.D., Fisheries – Magoulick)
Adam Green (M.S., Wildlife – Krementz)
Shawn Hodges (M.S., Fisheries – Magoulick)
Eric Larson (M.S., Fisheries – Magoulick)
John Ludlam (Ph.D., Fisheries – Magoulick)
Mandy Scott (M.S., Fisheries – Magoulick)

RECENTLY GRADUATED GRADUATE STUDENTS

Bret Collier – Ph.D., (Krementz) Employed by Texas A & M University, Department of Wildlife and Fisheries Sciences.
Matthew Dekar – M.S., (Magoulick) Pursuing a Ph.D. at University of Arkansas, Department of Biological Sciences/Cooperative Fish and Wildlife Research Unit.
Robert Doster – Ph.D., (Krementz) Employed by U.S. Department of the Interior, Bureau of Reclamation, Albuquerque Area Office.
Jason Luscier – M.S., (Thomson) Pursuing a Ph.D. at University of Arkansas, Department of Biological Sciences.
Nick Myatt – M.S., (Krementz) Employed by Oregon Department of Fish & Wildlife
Mike Rabalais – M.S., (Magoulick) Employed by CH2M Hill

HOURLY EMPLOYEES

Courtney Begnoche – Work-Study – Forage Base & Trout Production
Matt Churchman – Forage Base & Trout Production
Ashley Clements – Work-Study – Forage Base & Trout Production
Robin Doss – Work-Study – Forage Base & Trout Production
Jared Flowers – Catch and Release Trout
Joey Gamblin – Work-Study – Office Help
Keith Gibbs – Forage Base & Trout Production
Matt Hangsleben – Catch and Release Trout
Clinton Harris – Marsh Birds
Kris Nault – Catch and Release Trout
Jonah Price – Marsh Birds
Adam Schaffer – Work-Study – Office Help
Renee Self – Work Study – Forage Base & Trout Production
Ted Thornton – Work Study – Office Help
Jennifer Vaughn – Work-Study – Office Help

Arkansas Coop Unit – February 2005

RESEARCH AND FACULTY COLLABORATORS

Dr. Steven Beaupre – Department of Biological Sciences – University of Arkansas
Dr. Johnnie Gentry – Department of Biological Sciences – University of Arkansas
Dr. Jim Peterson – Water Resources Division - USGS
Dr. Larkin Powell – School of Natural Resource Sciences – University of Nebraska
Dr. Kim Smith – Department of Biological Sciences – University of Arkansas
Dr. Fred Stephen – Department of Entomology – University of Arkansas
David Mott – Buffalo National River, National Park Service
Mr. Mike Cartwright – Arkansas Game and Fish Commission, Calico Rock
Mr. Josh Cusiomanio – Missouri Department of Natural Resources
Mr. Bob Strader – U.S. Fish and Wildlife Service
Mr. Randy Wilson – U.S. Fish and Wildlife Service
Dr. Sammy King – Louisiana Cooperative Fish and Wildlife Research Unit

COMPLETED PROJECTS

Wildlife

Wood thrush

The Effects of Forest Management on Wood Thrush in the Bottomland Hardwood Forests of Louisiana

Funding Source:	Louisiana Department of Wildlife and Fisheries
Project Duration:	May 2003 to May 2005
Principal Investigator:	DAVID KREMENT
Graduate Research Assistant:	SARAH COULTER (M.S. candidate)

Research Objectives:

1. To assess the effects of forest management on wood thrush survival, movement patterns, nest success, and densities.
2. To assess the effects of forest management on avian species richness and densities.

Management Implications:

1. Provide information on which forest types are preferred by wood thrush.
2. Provide information on the relative success of wood thrush breeding in forests treated with different harvesting regimes.
3. Provide information on the scale and patterns of land-use by wood thrush including home range size, daily distance traveled and density.
4. Provide baseline data on avian communities present after various harvesting regimes.

Project Summary:

We estimated nest survival, adult survival and documented movements for 101 radio-tagged wood thrushes in 3 different management compartments at Sherburne Wildlife Management Area during the summers of 2003 and 2004. The 3 management compartments were a replanted agricultural area (RA), a regenerated clearcut (CC) and a

selectively harvested stand (SH). We also estimated wood thrush densities using distance transect surveys in those 3, as well as 4 additional compartments each summer. Movements of wood thrushes were generally smaller than the scale of management. The mean distance between consecutive locations for the entire study population was 177 m (SE=16.6) in 2003 and 127 m (SE=7.4) in 2004. Only 5 birds were observed moving between management compartments, 3 of which moved into the RA. Distance between successive nesting attempts was not affected by management compartment but tended to be greater after a failed nest than a successful one. The mean distance moved between nests was 193 m (SE=69.2) with a maximum of 9,389 m. Daily nest survival was affected by density of vegetation, but not by management compartment. As density of cover increased, so did nest survival. The daily nest survival estimate at the CC and the RA was 0.966 (SE=0.0107 and SE= 0.0081 respectively), and at the SH the daily nest survival was 0.950 (SE=0.0218). The overall 25-day nest success estimate was 0.421 at the CC and the RA, and nest success was 0.277 at the SH. Weekly survival of adult wood thrushes was not affected by management compartment, age, sex, or year of study. The probability of surviving all 11 weeks of the study each summer was 0.804 (SE=0.0612). The wood thrush population was more dense in the replanted agricultural area ($\hat{d}$ =1.1 males/ha) than at any other management compartment (0.00 to 0.23 males/ha). Density of wood thrushes was correlated to stem density across all management compartments (r=0.99). Wood thrush density was also positively correlated to midstory density (r=0.71) and negatively correlated to herb cover (r=-0.84). Our results suggest that at the southern periphery of their range, wood thrushes may prefer areas with high stem densities, dense midstory cover and reduced herbaceous cover, and that wood thrushes do not suffer reduced survival or nest survival rates when they breed in such areas. Densities of wood thrush throughout SWMA were comparable to those reported in other studies; however, there was a notable absence of wood thrushes from the reference area, an area that had not been managed >40 years. At Sherburne Wildlife Management Area, wood thrushes may prefer a stand structure typical of an early stage mid-successional stand, between ~10 and 20 years old.

The final report was submitted in June 2005.

Fisheries

Sunny Brogan listens for radio-transmitters implanted in bass along a reach of Bear Creek, Arkansas

Movement and Habitat Use of Smallmouth Bass (*Micropterus dolomieu*) in the Buffalo National River Drainage of Arkansas

Funding Source:	National Park Service
Project Duration:	March 2003 to May 2005
Principal Investigator:	DANIEL D. MAGOULICK
Graduate Research Assistant:	CHRIS BARE (M.S. Student)

Objectives:

1. Determine the extent to which relationships exit between Buffalo River and Bear Creek smallmouth bass populations.
2. Identify the effects of flow regime on smallmouth bass populations using Bear Creek.
3. Determine if smallmouth bass are selecting certain habitat types within these two streams.

Management Implications:

Results of this work will assist land managers in determining the effects of impounding the upper reaches of Bear Creek, a major tributary of the Buffalo National River.

Project Summary:

We used radio telemetry to examine movement, habitat use, and survival rate of smallmouth bass *Micropterus dolomieu* in the Buffalo River drainage of Arkansas. Linear home ranges were calculated using kernel density estimation for bass monitored during the summer and for ≥1 year. We used known fate estimates and model selection to calculate survival rates throughout the study period and compared mortality among groups of bass exhibiting different movement patterns. Radio-marked bass either remained in the same stream or migrated between Buffalo River and Bear Creek when higher flows allowed

passage. The median 95% kernel home range estimates for Buffalo River residents, Bear Creek residents, and those using both streams for ≥1 year were 15.4, 4.2, and 36.3 km, respectively. Median 95% kernel estimates for the same groups tracked during the summer were 0.7, 0.3, and 3.2 km, respectively, indicating that bass used, or were limited to, smaller areas in summer. Bass in both streams used pools and runs with water depths typically 1.4–1.8 m; however, water depths used increased in winter. Smallmouth bass used gravel-cobble substrates and boulder cover and this varied little across streams and seasons. Survival estimates for Buffalo River residents were 70–76%, significantly lower than bass residing in Bear Creek all or part of the year that had survival rates of 78–84%. Successful management of these populations will need to consider their diverse life histories, movement strategies, habitats used, and survival rates.

We used element:Ca values in water and smallmouth bass otoliths from locations within two streams to investigate relationships between water and otolith chemistry and smallmouth bass movement in an Ozark mainstem and tributary. Water and otolith samples were collected at three sites throughout Bear Creek and an additional site in the Buffalo River, Arkansas to investigate bass movement among sites. Element:Ca ratios were temporally stable with ratios significantly correlated between years for Ba:Ca (r = 0.95; $P < 0.0001$) and Mg:Ca (r = 0.97; $P < 0.0001$). Element:Ca ratios differed significantly among sites for Ba:Ca (ANOVA: $F_{27, 3} = 152.15$; $P < 0.0001$), Mg:Ca ($F_{28, 3} = 172.32$; $P < 0.0001$), and Sr:Ca ($F_{12, 3} = 7.74$; $P = 0.0039$). Water and otolith chemistries were linearly related for Ba:Ca (r = 0.77; $P < 0.0001$) and Sr:Ca (r = 0.87; $P = 0.0002$), however, not for Mg:Ca (r = 0.14; $P = 0.5349$). MANOVA results indicated that otolith signatures (i.e., Ba:Ca and Sr:Ca ratios) differed significantly among sites at summer growth bands of otoliths, yet did not differ in core loci. Element:Ca ratios from otoliths were used to classify individual fish to their resident sites with overall accuracies of 97% (summer 2004), 94% (summer 2003), 88% (summer 2002), 50% (age 2 core), and 62% (age 3 core). Canonical discriminant 95% confidence ellipses around site means did not overlap for any of the summer periods, however, there was overlap for core samples. Ba:Ca and Sr:Ca ratios from summer and core loci suggested that smallmouth bass exhibited strong site fidelity during summers and immigrated to those areas after spawning in different locations.

A sora caught at Four Rivers Conservation Area, Missouri.

Sora Fall Migration Ecology at Four Rivers Conservation Area, Missouri

Funding Source:	AAST, David Causey Grant-In-Aid Award, Swartz Endowed Fellowship, USGS-ACFWRU
Project Duration:	August 2002 to November 2004
Principle Investigator:	DAVID G. KREMENTZ

Research Objectives:

1. Estimate stopover durations for soras (*Porzana carolina*) at Four Rivers Conservation Area, Missouri (Four Rivers).
2. Document habitat use at Four Rivers using radio telemetry.

Management Implications:

1. Information on migration timing, movements, and habitat use will provide managers with knowledge of sora management needs.

Project Summary:

Research suggests that many rail species are declining, or their status is unknown due to lack of quantitative population trends throughout most of their range. Because reliable survey techniques to detect and monitor rails have not been developed, basic life history information and population trends are lacking or incomplete for many rail species. I initiated this study to document migration timing, movements and habitat use.

In 2002, I conducted a pilot study throughout OK, AR and MO to delineate potential study sites to study stopover duration, habitat use and effects of management practices on soras and Virginia rails. I determined that Four Rivers was a good study site for conducting this research because of the abundance of soras at Four Rivers, limited funding, and manager interest.

I captured and attached radio transmitters to a sample of soras during falls of 2003 (n = 19) and 2004 (n = 29) at the Four Rivers Conservation Area. Soras were first observed around the last week of August in both years. A noticeable jump in flush rates occurred about mid-September and these flush rates remained high through the end of October. Soras departed in earnest during the last week of October although some marked birds were present through the second week in November. Marked soras remained at Four Rivers for weeks suggesting that soras were using the area as a staging area rather than a temporary stopover site. Marked soras frequented tall dense stands of emergent wetland plants that were patchy in distribution. Soras were associated with many plant species (~40) but were most often located in smartweed, cutgrass and switchgrass. Soras frequented sites from saturated soil to ~50 cm deep. Daily movements were restricted (<100 m). Most marked soras almost never left the impoundment where they were marked. The few birds that left their original impoundment did so coincident with flooding that was conducted for waterfowl management.

A final report was submitted to the Missouri Department of Natural Resources in June 2005.

CURRENT PROJECTS

Stream Mesocosms (Predator Exclusions) on the Little Mulberry

Effects of Otter (*Lutra canadensis*) Predation On Stream Communities

Project Duration: August 2004 to June 2009
Principal Investigator: DANIEL D. MAGOULICK
Graduate Research Assistant: MATTHEW P. DEKAR (Ph.D. Student)

Objectives:

1. Quantify aquatic and riparian food webs and investigate temporal and spatial variation in predator-prey dynamics between otters and the aquatic community.
2. Quantify otter diet and develop a bioenergetics model to estimate the amount of each prey type consumed.
3. Use experimental manipulations to test hypotheses regarding the impact of otter predation on stream communities.

Management Implications:

1. Results will provide information regarding the impact of otters on stream communities, including potential impact to sport fishes.
2. This study will enable predictions concerning how predator and prey populations will respond to environmental variation associated with seasonal fluctuations in water levels, and habitat degradation and fragmentation.

Project Summary:

Predation provides an important link between aquatic and terrestrial communities. In the Ozark Mountains of northwest Arkansas, U.S.A., river otters (*Lutra canadensis*) may be an important and overlooked predator in stream communities. In particular, there is growing concern in this region that otters both prey upon and compete with important sport

fishes. Therefore, our objectives are to examine the effects of river otter predation on the abundance and distribution of fish and crayfish in the Little Mulberry and Mulberry rivers of northwest Arkansas, U.S.A. In June 2005, we sampled possible otter prey items for stable isotope analysis and food web development. We sampled otter fecal matter in the field and we obtained stomachs from otter carcasses donated during the winter trapping season. In addition, we completed pilot studies with stream mesocosms to investigate if terrestrial predators impacted fish survival in a predator exclusion and open to predation design. Preliminary results indicate that otters rely heavily on crayfish prey during the summer months. Currently, we are continuing the diet analysis and bioenergetic model development to estimate the amount of each prey type consumed. Finally, the diet information will be used to develop hypotheses regarding the effects of otter predation on stream communities. These hypotheses will be tested in the field using experimental manipulations.

Mallard in flight

Harvest Distributions of Mallards in Recent Times

Funding Source:	Arkansas Game and Fish Commission
Project Duration:	January 2005 to December 2006
Principal Investigator:	DAVID G. KREMENTZ
Graduate Research Assistant:	ADAM W. GREEN (M.S. Student)

Research Objectives:

1. Determine whether mallard populations have changed in the Lower Mississippi Flyway over the past 25 years.
2. Determine reasons for changes in wintering mallard distributions if they should occur.

Management Implications:

1. Analyses should help Arkansas Game & Fish Commission respond to hunter complaints.
2. Analyses should help AGFC make corrective management actions might be taken if mallard winter distributions have changed.

Project Summary:

A recent topic of debate among hunters, especially those in Arkansas, is the apparent lack of mallards for harvest since about 2000, as compared to the high harvest years of 1998-2000. We examined distributions of mallards in the Mississippi (MF) and Central (CF) Flyways from 1980 – 2004 to determine whether distributions have changed. We used geographic information systems (GIS) to analyze spatial distributions of band recoveries, U.S. Fish and Wildlife Service Parts Collection Survey (wing receipts), and Christmas Bird Count (CBC) data. We calculated the mean latitude for each year for band recoveries, wing receipts, and CBC counts, which we weighted using the number of mallards per party hour. We then ran a linear regression of mean latitude for each data set against year to determine any overall trends. We used program CENTROID, which uses Mardia's test, to test for differences in the centroids of band recoveries and wing receipts

by year. A centroid is the mean latitude-longitude of the distribution. We also performed multiple comparison analysis of variance (ANOVA) tests to examine differences in the mean latitude of band recoveries and wing receipts by year.

Mean latitudes for band recoveries (38.06° ± 0.02° 95% CI) ranged from 37.62° ± 0.03° to 39.55° ± 0.05°, mean wing receipts (39.5° ± 0.01°) ranged from 38.66° ± 0.03° to 40.49° ± 0.03°, and mean CBC data (39.46° ± 0.06°) ranged from 38.05° ± 0.36° to 40.33° ± 0.22°. The northern border of Arkansas lies at approximately 36.5°. Only the CBC data exhibited a northward shift over time ($p=0.0004$), but the range in mean latitudes was only 2.3°. All data sets were variable in mean latitude over time, but the absolute magnitude in mean latitude only amounted to about 3 degrees.

Large sample sizes and the sensitivity of Mardia's test to small differences in centroids resulted in only 8 out of 276 (3%) tests, for each data set, failing to find a change in distribution between years. We note that the centroids for 1998 – 2000 had lower latitudes and were significantly different from all years. The years 2001 – 2003 had centroids similar to those in the early 1980s and early 1990s. Multiple comparison tests showed that mean latitudes for band recoveries were similar throughout much of the 1980s and early 1990s. There was a significant shift southward from 1995–1996 and 1998–2000 and a return to "normal" latitudes from 2001–2003. Multiple comparison tests on mean latitudes from PCS data resulted in similar trends as those for band recoveries. However, there was also a strong shift southward from 1988–1991 in addition to the one seen from 1998–2000.

To investigate whether the supposed shift in distribution of mallards resulted in a reduction in harvest, we calculated the number of mallards harvested in Arkansas during the study period using PCS data. Harvest during the late 1990s was exceptionally high as compared to the 1980s and early 1990s. Harvest decreased by approximately 50% after 2000 but was still higher than the average during the 1980s and early 1990s.

In addition to the overall distribution of mallards during the hunting season, we investigated whether the winter distribution of mallards has changed. We determined at which latitudes mallards were most concentrated during the winter (Dec – Feb) using the shortest range within the distribution of latitudes that contained 50% of the data for both band recoveries and wing receipts. The shortest range containing 50% of the distribution of winter band recoveries and wing receipts was between the latitudes representing the northern and southern borders of Arkansas during almost every year.

Although there have been slight increases in the numbers of band recoveries and wing receipts in northern states in recent years, Arkansas is still responsible for, on average, twice as many bands and wings as any other state. Mallard harvest in Arkansas, though much lower than the late 1990s, is still above the 1980-1997 average.

Approximately half of the mallards harvested in the MF and CF during the winter were taken in the latitudes representing Arkansas' northern and southern borders. All of this suggests that there is little change in the proportion of mallards available for harvest in the lower MF. We believe that the late 1990s were the years of exceptionally high harvest in the lower MF, and that the slight shifts northward and decreases in harvest from 2001–2003 reflect a return to winter distributions and harvest rates similar to those of the early 1980s.

Fisheries

Brown trout with a rainbow trout collected in Bull Shoals tailwater, AR

The Relationship between Forage Base and Trout Production in Catch and Release Areas on Bull Shoals and Norfork Tailwaters

Funding Source:	Arkansas Game and Fish Commission.
Project Duration:	January 2004 to December 2007
Principal Investigator:	DANIEL D. MAGOULICK
Graduate Research Assistant:	JON M. FLINDERS (Ph.D. Student)

Research Objectives:

1. Determine proportions of prey items consumed by brown trout and rainbow trout in special regulation areas of Bull Shoals and Norfork tailwaters.
2. Determine relative contributions of various food sources to trout production.
3. Determine whether the prey base is limiting trout production.
4. Determine effectiveness of gut contents analysis and stable isotope analysis in developing a bioenergetics model.

Management Implications:

1. This study will determine whether the prey base is adequate to support trout production within special regulation areas on Bull Shoals and Norfork tailwaters.
2. This information will help managers to determine if stocking rates are appropriate for the system and whether special regulation areas can achieve their stated goal of exploiting trout “growth potential”.

3. An understanding of the relative contribution of prey items, such as sculpins and crayfish, to trout production will provide managers information that will be valuable in determining potential impacts of bait harvest on trout production.
4. All of this information should help fishery biologists to better manage the Bull Shoals and Norfork tailwater trout fisheries.

Project Summary:

Special regulations were instituted on portions of the cold tailwater fisheries in Arkansas. Catch-and-release (C-R) trout fishing regulations were implemented by the Arkansas Game and Fish Commission (AGFC) on Jan 1, 1995 on five sections, totaling 8.9 km, of the Bull Shoals and Norfolk tailwaters of the White River, Arkansas. These areas were developed in Arkansas to provide high catch rates of larger sized trout. The basic assumption behind the C-R areas is that exploitation rates of trout will decrease and residence times will increase. In other words, trout should stay in the system longer, and therefore grow larger. This hypothesis assumes that, 1) trout do not move out of the special regulation areas, 2) trout do not suffer high mortality rates within the special regulation areas, and 3) the forage base is sufficient for growth within the special regulation areas. In this project, we will address the third assumption and we will address assumptions one and two in a companion project.

Preliminary Results:

Trout were collected from Norfork and Bull Shoals tailwater in spring and summer of 2005 and stable isotope analysis (SIA) and gut content analysis (GCA) was performed. Stomach contents and white muscle tissue was examined from trout in Bull Shoals (n = 54) and Norfork (n = 62). Large (> 400 mm TL) brown trout in Bull Shoals catch-and-release area had elevated $\delta^{15}N$ values (3‰), indicating a dietary shift and an increase in trophic position compared to smaller trout. However, this same shift in trophic position with brown trout was not apparent in Norfork tailwater. Stable isotopes revealed that smaller (<400 mm TL) rainbow trout in both Bull Shoals and Norfork contain isotopic signatures indicative of hatchery food and large (>400 mm TL) rainbow trout appeared to be feeding primarily on invertebrates. Based on gut content analysis chironomidae (pupae and larvae), *Cladocera* spp., amphipoda, banded sculpin, and isopoda were commonly ingested. Despite the lack of energetic value to trout filamentous algae was also found in high proportions of many stomachs of rainbow trout, indicating epibenthic foraging. Smaller brown trout (<250 mm TL) feed exclusively on invertebrates. Sculpin became more common in the stomachs as brown trout attained larger sizes, indicating a shift to piscivory with size. Thus, it appears that SIA is complementary to and not a substitute for GCA.

Wildlife

Bull elk near Buffalo River, AR. Photo courtesy of M. Cartwright, Arkansas Game and Fish Commission

The Ecology of Bull Elk in Arkansas

Funding Source:	AR Game and Fish Commission, Rocky Mountain Elk Foundation, University of Arkansas-Monticello, National Park Service
Project Duration:	January 2003 to December 2006
Principal Investigators:	DON WHITE, JR., School of Forest Resources, University of Arkansas-Monticello, Monticello, AR MICHAEL E. CARTWRIGHT, Arkansas Game and Fish Commission, Calico Rock, AR, WILLIAM L. THOMPSON, USGS Arkansas Cooperative Fish and Wildlife Research Unit, ROBERT C. WEIH, JR., School of Forest Resources, University of Arkansas-Monticello, Monticello, AR, and SAM LAIL, Buffalo National River, National Park Service, Harrison, AR

Research Objectives:

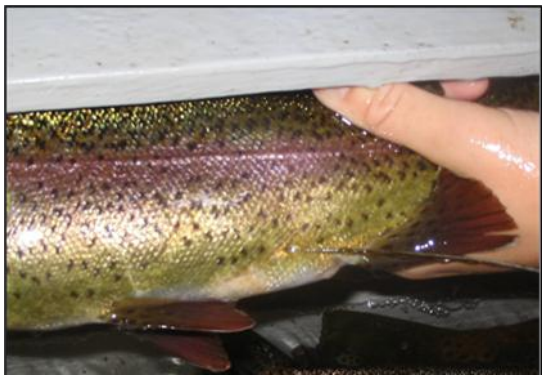
1. Develop a landcover map for the Buffalo River watershed
2. Evaluate the feasibility of various bull elk capture techniques
3. Estimate age-class specific movement and dispersal patterns and rates, seasonal home range sizes, and habitat use of bull elk
4. Estimate age-class specific survival rates and causes of mortality of bull elk
   Assess the health and physical condition of bull elk
5. Develop a GIS model to predict the location of bull elk in the Buffalo River watershed

Management Implications:

1. Results will be used to develop management recommendations for maximizing bull elk condition, productivity and survival in the Buffalo River area

Project Summary:

Thirty-five bull elk (11 yearlings and 24 adults) were captured 18-20 February 2003, by net gunning (24 bulls) or darting (11 bulls) from a helicopter on the Buffalo National River and adjacent state and private lands in northern Arkansas. Immediately after capture, 6 elk ≥1.5-years-old were fitted with either collars containing Global Positioning Systems (hereafter called GPS collars) and 29 animals were fitted with VHF transmitters. Each GPS collar was equipped with a time-controlled, drop-off mechanism that will allow recovery of the collar without capturing the animal. Each GPS collar also was equipped with a VHF tracking beacon to permit relocations of radio-marked elk from the ground or from aircraft and, eventually, for retrieval of collars. The GPS collars were programmed to record geographic position at 6-hour intervals. Such detailed relocation data is needed to understand movement rates, diel habitat use, to map travel corridors, and for detailed home range analysis. We collected chest girth measurements, a canine tooth, a 20 cc blood sample, ticks, and rectal temperature from captured each elk before its release. The mean number of antler points among the adult bulls captured was 4.7 (left) and 4.6 (right). Elk locations have been obtained from rotary-wing aircraft from flights conducted weekly during daylight hours since March 2003. To date, 6 collared bull elk have died. Three were legally harvested and 3 were found dead (probably illegally killed). Two collars fell off, probably due to fighting among bulls during the rut. Time and cause of mortality have been determined with a mortality indicator switch located in the radiocollars.



Recovered rainbow trout with transmitter.

Keith Gibbs tracking on the Norfork River.

Effect of Catch and Release Areas on Movement and Mortality of Resident Rainbow Trout in Bull Shoals and Norfork Tailwaters

Funding Source:	Arkansas Game and Fish Commission.
Project Duration:	June 2004 to May 2007
Principal Investigator:	DANIEL D. MAGOULICK
Graduate Research Assistant:	AARON CUSHING (M.S. Student)

Summary:

Special regulations have been instituted on portions of the cold tailwater fisheries in Arkansas. Catch and release (CR) areas have been located along the Bull Shoals and Norfork tailwaters to "exploit" trout "growth potential". In other words, trout should stay in the system longer, and therefore grow larger. This hypothesis assumes that, 1) trout do not move out of the special regulation areas, 2) trout do not suffer high angler mortality rates within the special regulation areas, and 3) the forage base is sufficient for growth within the special regulation areas. In this project, we will address the assumptions one and two and we will address the third assumption in a companion project.

Goal:

Determine effects of catch and release areas on movement and mortality of resident rainbow trout in Bull Shoals and Norfork tailwaters.

Project Objectives:

1. Determine most effective tag retention technique for surgical implantation of transmitters.
2. Determine whether trout maintain home ranges within the tailwater and the relationship between home range size and special regulation areas.
3. Determine movement, mortality and habitat use of rainbow trout prior to installation of planned habitat improvement projects.

Management Implications:

1.1. This study will determine the effect of catch and release areas on movement and mortality rates of resident rainbow trout in Bull Shoals and Norfork tailwaters.
2. This information will help managers to determine the effectiveness of special regulation areas.
3. Knowledge of movement and mortality rates of resident rainbow trout will help managers determine stocking effectiveness and potential causes for low numbers of trout returned to creel.
4. Knowledge of site fidelity, home range and movement patterns will permit managers to determine effective sizes of special regulation or habitat manipulation areas.

Project Update

A series of tag retention studies using a variety of fish sizes and surgical techniques were conducted at the Jim Hinkle Mammoth Spring Hatchery from the fall of 2004 to the spring of 2005. The most promising technique was then used in a preliminary field study conducted in the Norfork CR area in the summer of 2005 to become familiar with the tracking equipment and determine retention rates. Four weeks after surgery, retention rates were satisfactory and examination of tagged individuals showed complete healing with little or no infection. Tagging of all individuals was completed in the Fall 2005, and weekly tracking events will be ongoing until Fall 2006. Preliminary results show greater residence times in CR than non-CR areas, with angler mortality four times higher outside CR areas. Summer movements in all areas were limited (0-10 meters) with fish maintaining positions in single pools or riffles. In autumn, several fish made upstream migrations covering distances ranging 6-40 kilometers. Overall, approximately half of all fish moved less than 200 meters and fish tagged in the CR area were relocated within the CR area 85-100% of the time. Preliminary results support the assumptions that 1) most trout remain within the CR areas, and 2) angler mortality is lower in these areas.

King rail photo taken in Chicot Co., Arkansas by Michael J. Budd

Survey of Breeding Secretive Marsh Birds in the Delta Region of Arkansas

Funding Source:	Arkansas Game and Fish Commission
Project Duration:	April 2005 to July 2006
Principal Investigator:	DAVID G. KREMENTZ
Graduate Research Assistant:	MICHAEL J. BUDD (M.S. Student)

Research Objectives:

1. To determine the current breeding status of secretive marsh birds in the Delta of Arkansas.
2. To determine the probability of detecting secretive marsh birds.
3. To understand basic habitat types occupied by secretive marsh birds.

Management Implications:

1. The information gathered will allow the AGFC to assess the current status of secretive marsh birds throughout the rest of Arkansas.
2. Should these marsh birds be located on AGFC WMAs, then the agency would be in better control of its species of concern.
3. Results will provide population surveys that will determine responsible harvest limits.

Project Summary:

The Delta Region of Arkansas was once part of a vast wetland area comprised mostly of bottomland hardwoods as well as emergent, and submergent wetlands, and prairie.

Before European settlement, the LMAV was a 10 million-ha, forested-wetland system. Between the 1950s and the 1970s, much of this land was cleared and converted to agriculture and aquaculture facilities. Along with this change in land use has been an unknown change in the use of those wetlands by secretive marsh birds.

Secretive marsh birds include all species that primarily inhabit marshes (i.e., marsh-dependent species). Primary species of concern in North America include the King Rail (*Rallus elegans*), Clapper Rail (*Rallus longirostris*), Virginia Rail (*Rallus limicola*), Sora (*Porzana carolina*), Black Rail (*Laterallus jamaicensis*), Yellow Rail (*Coturnicops noveboracensis*), American Bittern (*Botaurus lentiginosus*), Least Bittern (*Ixobrychus exilis*), Pied-billed Grebe (*Podilymbus podiceps*), Purple Gallinule (*Porphyrula martinica*), and Common Moorhen (*Gallinula chloropus*). The U.S. Fish and Wildlife Service has identified the Black Rail, Least Bittern, and American Bittern as species of special concern because they are relatively rare and we lack basic information on status and trends in most areas.

This project will inventory secretive marsh birds in the Delta of Arkansas by employing a combination of survey methods. The data collected will be used to estimate occupancy rates. Methods include using call-playback broadcasts at randomly selected wetlands to elicit responses from secretive marsh birds. Each wetland will be surveyed ≥ 5 times to determine presence/absence to a 90% certainty.

During the 2005 season we surveyed 80 wetlands. We surveyed 21% of the sites 15 times and 56% of the sites were surveyed ≥5 times. Wetland permanence was a major issue as the Delta experienced drought like conditions, resulting in more than half of our sites drying up before we could survey them 15 times.

We did not detect any effects, positive or negative, of playing calls of other species on detection rates of any particular species

If a wetland contained a secretive marsh bird, we found that 81% of those wetlands had >1 bird. On average, we detected 2 marsh birds per occupied wetland. We found that about half (54%) of our surveyed sites had ≥1 species of secretive marsh bird. We detected an equal number of birds on visit 1 compared to visits 2-5.

We detected pied-billed grebes at 9 sites with an average of 2 individuals sighted at each wetland. At 14 sites we detected least bitterns, and a few least bitterns were detected on non-selected wetlands. We encountered 9 American bitterns, of which 4 were located in the same wetland at Bald Knob National Wildlife Refuge. We detected soras at 21 sites, king rails at 12 sites, Virginia rails at 5, common moorhens at 2, purple gallinules at 2, and the American coot at 5.

Fisheries

Experimental crayfish and central stoneroller grazing exclusions in the Little Mulberry River, AR

The Effects of Stream Drying on Grazer-Mediated Processes in Boston Mountain Streams and the Importance of Grazer Identity

Project Duration:	June 2005 to December 2008
Principal Investigator:	DANIEL D. MAGOULICK
Graduate Research Assistant:	JOHN LUDLAM (Ph.D. Student)

Research Objectives:

1. Test the hypothesis that stream drying will increase grazer-mediated stream functioning (GMSF) resulting in decreased fine sediment deposition and algal abundance, and increased biomass specific primary production and leaf litter decomposition.
2. Test the hypothesis that grazer identity will have important consequences for the responses of GMSF to stream drying and predation risk.

Management Implications:

1. Stream drying is likely to increase in frequency and severity under recent climate projections. Understanding how drying affects stream functioning will inform management decisions for conserving these systems.
2. This research will help in developing predictions for changes in water quality and nutrient dynamics in headwater streams due to stream drying.

Project Summary:

Crayfish and central stonerollers graze algae, consume detritus and invertebrates, resuspend deposited silt and alter substrate characteristics. Through these mechanisms they can have large impacts on functioning of headwater streams. Seasonal drying in Boston Mountain streams reduces water levels in pools, dries riffles, disconnects habitats, increases densities of aquatic organisms, and may alter predation risk for biota. Additionally, it may affect the ability of crayfish and central stoneroller minnows to mediate stream functioning. We are examining how drying affects grazer-mediated stream functioning (GMSF) and testing how grazer identity affects the responses of GMSF to stream drying. Manipulative field experiments will test these hypotheses in natural systems using electric fence chargers to control the presence of grazers. We are also using experimental stream mesocosms to simulate drying in a more controlled laboratory setting.

A laboratory trial of agonistic interactions between introduced and native crayfish from the Spring River, AR

Effect of the Introduced Crayfish, *Orconectes neglectus*, on Native Crayfish in the Spring River Drainage

Funding Source:	Arkansas Game and Fish Commission
Project Duration:	July 2005 to December 2007
Principal Investigator:	DANIEL D. MAGOULICK
Graduate Research Assistant:	ERIC LARSON (M.S. Student)

Research Objectives:

1. Test the hypothesis that environmental changes do not prevent *O. eupunctus* juveniles from surviving and growing in their former range.
2. Test the hypothesis that *O. neglectus* outcompete *O. eupunctus* at the juvenile life history stage.
3. Compare life histories of *O. neglectus* and *O. eupunctus* in the Spring River drainage.

Management Implications:

1. Information from this study will help determine current impacts and predict future impacts of the introduced crayfish species on native species.
2. Understanding mechanisms of displacement and effects of introduced crayfish on native species will allow managers to develop informed strategies regarding the need for mitigation and potential success of mitigation efforts.
3. Information gained here will be especially important in making decisions regarding the conservation of three species that are potentially at risk from this invasion, *Orconectes eupunctus*, (locally rare and uncommon and globally imperiled) *Orconectes marchandi* (both locally and globally imperiled), and *Cambarus hubbsi*.

Project Summary:

Two native crayfish species, *Orconectes eupunctus* (globally imperiled) and *Cambarus hubbsi*, appear to have been displaced from part of their former range in the Spring River drainage of Arkansas and Missouri by the introduced crayfish *O. neglectus chaenodactylus*. Previous research suggested that *O. eupunctus* have been displaced from their former range by biotic interactions, but interspecific competition between *O. eupunctus* and *O. neglectus* adults during summer does not appear to be the mechanism responsible for this displacement. Therefore, one objective of this study is to examine competitive interactions at the juvenile, rather than adult, life stage. Juvenile crayfish compose the majority of the crayfish community in Ozark streams and rivers through the summer and fall, and exhibit high growth rates. Consequently, this may be an appropriate life stage at which to detect competition. We will use field experiments in stream enclosures and agonistic interactions in the laboratory to test for evidence of competition between *O. neglectus* and *O. eupunctus* juveniles. We will also use stream enclosures during the competition study to test whether *O. eupunctus* juveniles can survive and grow in their former range. The second objective of this study is to examine the role of life history in the *O. neglectus* introduction and apparent displacement of native Spring River crayfish. Life history has been found to contribute to some crayfish species replacements. Currently, the life history of *O. eupunctus* has not been documented, and life history studies of *O. neglectus* may not apply to the introduced population in the Spring River drainage. Monthly life history sampling of *O. eupunctus* and *O. neglectus* will be used to gather information on timing of reproductive events, fecundity, and juvenile growth rates that may contribute to *O. neglectus'* apparent displacement of native Spring River crayfish.

NEW PROJECTS

Young Ivory-billed woodpecker at Singer Tract

Woodpecker-Habitat Relationships on Public Lands in the Big Woods of Arkansas

Funding Source:	U.S. Fish & Wildlife Service
Project Duration:	April 2006 to May 2008
Principal Investigator:	DAVID G. KREMENTZ
Graduate Research Assistant:	MICHAEL STRAUSER (M.S. Student)

Research Objectives:

1. To determine the habitat use of woodpeckers in the Big Woods of Arkansas

Management Implications:

1. The information gathered will allow state and federal natural resource agencies to better manage public lands for woodpeckers, and especially the ivory-billed woodpecker.

Project Summary:

The recent rediscovery of the ivory-billed woodpecker (*Campephilus principalis*, IBWO) in the Big Woods of Arkansas has raised a number of questions regarding how to best manage for this bird in the Mississippi Valley Bird Conservation Region. To begin this process, an understanding of the habitat needs of the IBWO is necessary. Based on historical accounts, we know that IBWO had some habitat affinities including a selection for: 1) extensive continuous forest areas, 2) very large trees, 3) continuing supply of recently dead trees, 4) an open canopy, and 5) an association with some tree species (e.g., sweetgum, Nuttall's oak) along with an avoidance of other tree species (e.g., overcup oak, water hickory). These habitat needs probably met both foraging needs, and nesting/roosting tree requirements. Whether any one or some combination of these variables met some limiting requirement is unknown, but Tanner suggested that forage availability was an important determinant for the presence of IBWO in a particular woodland tract. With these habitat variables known, in theory, it should be possible to survey for IBWO on public lands in the Big Woods of Arkansas and assess which variables are more or less important. Unfortunately there are few IBWO to survey.

However, Tanner mentioned that an indicator of good IBWO habitat was an abundance of any woodpeckers. Thus, I propose to investigate IBWO-habitat relationships on public lands in the Big Woods of Arkansas using woodpecker densities as a surrogate for IBWO use.

The study site will include Dagmar and Rex Hancock/Black Swamp WMAs, and Cache and White River NWR. A recently completed habitat inventory and assessment for IBWO on public lands in the Big Woods of Arkansas (http://www.lmvjv.org/IBWO_habitat_inventory_&_assessment.htm) will be the sampling frame. This sampling frame will allow me to select a set of available points to survey. Again, these points will be selected based on the five variables above. I recognize that a balanced sample will not be possible for various reasons (logistical, availability), and so I will emphasize selecting across variables 2 (large trees), and 3 (continuing supply of recently dead trees) first. Large trees are required by IBWO to produce roost and breeding cavities in. Forage availability for IBWO was considered uncertain across time and space and was thought to directly influence stand occupancy rates.

Point-transect bird surveys will be conducted at each site for 2 months during 2007 spring (before leaf out: Feb, Mar) and 2006 & 2007 summer (after leaf out; May, June). I will employ the bird monitoring protocol for forest interior birds as described by the Lower Mississippi Valley Joint Venture population monitoring group at: http://www.lmvjv.org/library/pop_monitoring/LMVJV_Point_Count_Procedures.doc. I will use program DISTANCE to analyze the distance data using the recorded variables as covariates. Using these analyses, I can estimate detection probabilities. These probabilities will be built into my below habitat selection analyses. To explain selection of a site by woodpeckers, I will have matrix of available sites and used sites, based on unmarked woodpeckers, at the population level across the study area. This sampling design lends itself to the use of logistic regression. Thus the response variable will be either multivariate (numbers of each species of woodpecker using a site) or univariate (numbers of an individual woodpecker species using a site) along with the appropriate detection probability. The predictors will include the five variables, and biologically reasonable interactions, as well as year, season, and site. The basic approach will be to, a priori, develop a series of biologically sound candidate models and use AIC to select among the competing models to assess which model(s) best explain the data. To address higher scale issues, I will run a second set of analyses to relate woodpecker use to landscape variables such as relative habitat block size, amount of forested cover within say 10 km, etc.

Expected Products:

By examining woodpecker use across a variety of sites with different combinations of habitat components, I hope to assess if woodpeckers are selecting habitats used based on those variables. The inclusion of season and year in the mix will allow me to assess if biological needs, e.g., reproductive requirements, or weather factors, e.g., drought, influence habitat selection decisions across time. Finally, the examination of landscape level variables should allow a better understanding if large scale variables can influence habitat selection at different scales. With a better understanding of how woodpeckers select habitat in the Big Woods, managers should be able to better manage public lands there for IBWO.

Wildlife

King rail

Distribution of King Rails (*Rallus elegans*) in the Lower Mississippi Flyway

Funding Source:	U.S. Fish & Wildlife Service
Project Duration:	April 2006 to May 2008
Principal Investigator:	DAVID G. KREMENTZ
Co-Principal Investigator:	SAMMY L. KING
Graduate Research Assistant:	ABBY DARRAH (M.S. Student)

Research Objectives:

1. To determine the distribution of migrant king rails in Missouri during the breeding season.
2. To determine the occupancy rate of migrant king rails across Missouri during the breeding season
3. To better understand the habitat use of migrant king rails in Missouri during the breeding season

Management Implications:

1. The information gathered will allow state and federal natural resource agencies to better assess the current status of king rails throughout the lower Mississippi Flyway.
2. The habitat use information will allow agencies to better manage for king rails throughout the lower Mississippi Flyway.

Project Summary:

The king rail (*Rallus elegans*) is a large rail that associates with both fresh and brackish marshes and is widely distributed across eastern United States, southeastern Canada, eastern Mexico, and Cuba. The king rail has both resident and migratory populations.

Those populations in the middle to northern parts of its range west of the Appalachians migrate to the Gulf Coastal Plain to winter. The population in the southern range, about Arkansas southward, is resident. The Mississippi Valley is the primary migration corridor though little is known about migration in this species. King rail populations have declined alarmingly over the past 30 years throughout its range. Most of the migratory populations are classified as Endangered or of Special Concern in the Mississippi Flyway. In Canada, the king rail is classified as Endangered throughout its range. Loss of freshwater wetlands, especially those supporting tall emergent vegetation, would seem to be the most obvious potential cause of the population declines.

The king rail represents a very unusual game bird in that the migratory population is classified as Endangered or a Species of Concern while the resident population is a game bird. Based on the breeding and year-round distribution of king rails, we believe that migratory king rails migrate to coastal areas where they are exposed to harvest.

As compared to the more stable resident king rail population, the migratory king rail population is in trouble. Because of this pattern, we are proposing a multi-stage series of interrelated projects to better understand the ecology of king rails in the lower Mississippi Flyway. First, we will assess the distribution, occupancy rates, and habitat use of king rails in Missouri during the breeding season. With better knowledge of this, we will then propose to investigate in more depth, the timing and routes followed and habitats used during fall migration, and determine the distribution, occupancy rates and habitat use of wintering king rails in coastal Louisiana.

We decided to attack this study in a series of studies because we recognize that 1) little is known about king rails, 2) populations of king rails outside of coastal Louisiana are quite small, and 3) capturing king rails will be difficult. Through the information gained on the first project, we expect to be in a better position to attack the follow-up projects with an increased probability of success. With our information, both Federal and State migratory bird managers will be able to immediately better manage for king rails in the Mississippi Flyway.

The study will be conducted along the Mississippi River between Hannibal and St. Louis, Missouri during the breeding seasons of 2006 and 2007. We will survey across all likely public wetlands using playback call surveys following the national marshbird monitoring protocol. Once king rails are located, we will return to those sites and monitor nesting and brood rearing success. Too, we will evaluate the feasibility of capturing king rails for an upcoming study where we will place radio transmitters on the birds to track them to the Gulf Coast. Should we capture any king rails, we will collect several feathers from each bird and analyze those feathers for carbon, nitrogen, hydrogen and sulfur isotopic signatures. These signatures will be compared to a sample that has been collected in coastal Louisiana and Texas.

PRODUCTIVITY

HONORS AND AWARDS

Sarah C. Coulter – Scott D. Shull Award, Department of Biological Sciences, University of Arkansas, 2005
Matthew Dekar – Leggett Fellowship, University of Arkansas 2005
Matthew Dekar – Doctoral Academy Fellowship, University of Arkansas, 2005
John Ludlam – Distinguished Doctoral Fellowship, University of Arkansas, 2005
John Ludlam – Causey Grant, University of Arkansas, 2005
Daniel D. Magoulick – Promotion to Adjunct Associate Professor, University of Arkansas, 2005
Daniel D. Magoulick – Elected to Full Member Sigma Xi Scientific Research Society

COURSES TAUGHT

Krementz – Analysis of Animal Populations – Spring 2005
Krementz and Magoulick – Fish and Wildlife Seminar – Fall 2005
Magoulick – Fish Ecology – Spring 2005

PUBLICATIONS AND PROFESSIONAL PAPERS PRESENTED

Scientific Publications

Lehnen, S. E., and **D. G. Krementz**. 2005. Turnover rates of fall-migrating pectoral sandpipers in the lower Mississippi alluvial Valley. J. Wildl. Manage. 69:671-680.

Powell, L. A., J. D. Lang, **D. G. Krementz**, and M. J. Conroy. 2005. Using radio telemetry to reduce bias in nest searching. J. Field Ornithol. 76:274-278.

Thatcher, B. S., **D. G. Krementz**, and M. Woodrey. 2006. Henslow's sparrow winter survival estimates and response to prescribed burning. J. Wildl. Manage. 70:

Clifton, A., and **D. G. Krementz**. 2006. Estimating numbers of greater prairie-chickens using mark-resight techniques. J. Wildl. Manage. 70:

Stober, J. M., and **D. G. Krementz**. 2006. Variation in Bachman's Sparrow Territory Size at the Savannah River Site, South Carolina. Wilson Bulletin .

Collier, B. A., and **D. G. Krementz**. 2006. White-tailed deer management practices on private lands in Arkansas. Wildl. Soc. Bull.

Rabalais, M.R. and **D.D. Magoulick**. 2006. Is competition responsible for species displacement: native and invasive crayfish interactions. Biological Invasions (In Press)

Rabalais, M.R. and **D.D. Magoulick**. 2006. Influence of an invasive crayfish species on diurnal habitat use and selection by a native crayfish species in an Ozark stream. American Midland Naturalist (In Press)

Flinders, C.A. and **D.D. Magoulick**. 2005. Distribution, habitat use and life history of stream-dwelling crayfish in the Spring River drainage of Arkansas and Missouri with a focus on the Mammoth Spring crayfish (*Orconectes marchandi*). American Midland Naturalist 154:358-374.

Theses and Dissertations

Collier, B. A. 2004. Evaluating Impact of Selective Harvest Management on Age Structure and Sex Ratio of White-Tailed Deer (*Odocoileus virginianus)* in Arkansas. Ph.D. Thesis, University of Arkansas.

Coulter, S. C. 2005. Effects of Forest Management on Wood Thrushes in the Atchafalaya Basin, Louisiana. M.S. Thesis, University of Arkansas.

Scott, M. K. 2005. Influence of Land Use and Flow Regime on Reach-Scale Habitat and Fish Assemblage Structure: Relationship to Fish Swimming Ability. M.S. Thesis, University of Arkansas.

Doster, R. H. 2005. Ecology and Conservation of Wintering Migratory Birds in Early-Successional Habitats of the Lower Mississippi River Alluvial Valley. Ph.D. Thesis, University of Arkansas.

Bare, C. M. 2005. Movement, Habitat Use and Survival of Smallmouth Bass in the Buffalo National River Drainage of Arkansas. M.S. Thesis, University of Arkansas

Papers Presented

Thatcher, B. S., **D. G. Krementz**, and M. S. Woodrey. 2005. Henslow's Sparrow winter survival estimates and response to prescribed burning. American Ornithologists' Union Mtg.

Coulter, S. C., **D. G. Krementz**, L. A. Powell, and K. F. Ribbeck. 2005. Wood thrush density, home ranges and movements in relation to forest management in the Atchafalaya Basin, Louisiana. American Ornithologists' Union Mtg.

Collier, B. A., and **D. G. Krementz**. 2005. Modeling White-Tailed Deer Population Responses to Regulatory Influences at Multiple Spatial Scales. 28th Annual Meeting of Southeast Deer Study Group.

Collier, B. A., and **D. G. Krementz**. 2005. Modeling Impacts of Harvest Management and Population Demographics Using Probabilistic Networks. 28th Annual Meeting of Southeast Deer Study Group.

Collier, B. A., **D. G. Krementz**, and C. Gray. 2005. Do harvest sex ratios really help managers in making decisions? 28th Annual Meeting Southeast Deer Study Group.

Coulter, S. C., **D. G. Krementz**, and L. A. Powell. 2005. Some effects of forest management on wood thrush at Sherburne Wildlife Management Area. Louisiana Association of Professional Biologists.

Krementz, D. G., M. Budd, and S. E. Lehnen. 2005. Shorebirds and secretive marsh birds of the Lower Mississippi Valley. Lower Mississippi Ecosystem Team Meeting.

Magoulick, D.D., C.M. Bare, M.P. Dekar, S.W. Hodges, C.A. Flinders and A.N. Dick. 2005. Intermittent streams and habitats function as refugia for fish and crayfish. Special session on *Temporary Waters: Ecological Values, Policy, and Management*, North American Benthological Society, New Orleans, Louisiana.

Bare, C.M. and **D.D. Magoulick**. 2005. Movement and habitat use of smallmouth bass in the Buffalo National River drainage of Arkansas. Arkansas Chapter American Fisheries Society, Pine Bluff, Arkansas.

Flinders, J.M. and **D.D. Magoulick**. 2005. The contribution of prey to trout production in Ozark tailwaters: stomach contents versus stable isotope analysis. White River Fisheries Partnership, Theodosia, MO.

Cushing, A.W. and **D.D. Magoulick**. 2005. Effects of catch and release regulations on rainbow trout movement and mortality in Ozark tailwaters. White River Fisheries Partnership, Theodosia, MO.

Magoulick, D.D. and M.K. Scott. 2005. Effects of land use, flow regime and habitat complexity on lotic fish assemblage structure. U.S. Fish and Wildlife Service Ozark Ecosystem Team meeting, Harrison, AR.

Posters Presented

Collier, B. A., and **D. G. Krementz**. 2005. Modelling white-tailed deer population responses to harvest regulation changes in Arkansas at multiple scales. The Wildlife Society Mtg.

Bare, C.M. and **D.D. Magoulick**. 2005. Movement and habitat use of smallmouth bass in the Buffalo National River drainage of Arkansas. Southern Division American Fisheries Society, Virginia Beach, Virginia.

Committees/Task Forces/Recovery Teams

Krementz, D.G., Ivory-billed Woodpecker Recovery Team - Biology Working Group. 2005.

Krementz, D.G., IUCN Species Survival Commission: Woodcock & Snipe Specialist Group. 2005.
Krementz, D.G., Migratory Shore & Upland Game Bird Subcommittee of the Mississippi Flyway Technical Section. 1999-present. Currently Chair of committee.
Krementz, D. G., Lower Mississippi Alluvial Valley Joint Venture Migratory Bird Science Team member. 2001-present.
Krementz, D.G.,Woodcock Task Force of the International Association of Fish and Wildlife Agencies. 2001-present.
Magoulick, D.D., Graduate Studies Committee, 2005–present
Magoulick, D.D., Faculty Search Committee, Ecologist, 2004-2005

TECHNICAL ASSISTANCE

Training Offered

Magoulick, D.D., 2005. Line Transect Sampling in Streams. Presented as a workshop to AFS Warmwater Streams Committee, Yellville, AR, August 23, 2005.

Training Received

Bahm, Jesse – Principles and Techniques of Electrofishing Correspondence Course, US Fish and Wildlife National Conservation Training Center.
Christopher Bare – Principles and Techniques of Electrofishing Correspondence Course, US Fish and Wildlife National Conservation Training Center.
Cushing, Aaron – Motorboat Operator Certification Course, US Fish and Wildlife Services, Manhattan, KS.
Cushing, Aaron – Principles and Techniques of Eletrofishing Correspondence Course, US Fish and Wildlife National Conservation Training Center.
Kitterman, Christy – Motorboat Operator Certification Course, US Fish and Wildlife Services, Manhattan, KS.
Kitterman, Christy – Principles and Techniques of Eletrofishing Correspondence Course, US Fish and Wildlife National Conservation Training Center.
Kristofor Nault – Motorboat Operator Certification Course, US Fish and Wildlife Services, Manhattan, KS