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 16 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 moved 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 6 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 Magoullick (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

## COORDINATING COMMITTEE MEMBERS

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<thead>
<tr>
<th>US GEOLOGICAL SURVEY</th>
<th>AR GAME AND FISH COMMISSION</th>
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<tbody>
<tr>
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POST-DOCTORAL ASSISTANT

Dr. Kirsten LeMar
CURRENT GRADUATE STUDENTS

Christopher Bare (M.S., Fisheriers – Magoulick)
Bret Collier (Ph.D., Wildlife – Krementz)
Sarah Coulter (M.S., Wildlife – Krementz)
Matthew Dekar (M.S., Fisheries – Magoulick)
Robert Doster (Ph.D, Wildlife – Krementz)
Shawn Hodges (M.S., Fisheries – Magoulick)
Jason Luscier (M.S., Wildlife – Thompson)
Nicholas Myatt (M.S., Wildlife – Krementz)
Michael Rabalais (M.S., Fisheries – Magoulick)
Nora Schubert (M.S., Wildlife – Krementz)
Mandy Scott (M.S., Fisheries – Magoulick)

RECENTLY GRADUATED GRADUATE STUDENTS

Amy Clifton - M.S (Krementz) Employed by USGS Kansas Cooperative Fish & Wildlife Research Unit.
Andrew James - M.S. (Krementz) Employed by Arkansas Game & Fish Commission.
Sarah Lehnen - M.S. (Krementz) Pursuing a Ph.D. at Ohio State University.
Frankie Loncarich - M.S. (Krementz) Employed by USGS Kansas Cooperative Fish & Wildlife Research Unit.
Benjamin Thatcher - M.S. (Krementz) Pursuing a Ph.D. at University of Tennessee – Knoxville.

UNDERGRADUATE ASSISTANT

Andrea Marston

TECHNICIANS

Brandon Harlan – AGFC Internship
Kristen Ellis – Rail
Justin Fletcher – Rail
Pablo Bacon – Fish Migration
Ted Thornton – Work-study Office Help
Aaron Cushing – Catch & Release Trout
Kaelo Makati – Fish Migration
Laura Simkins – Wood Thrush
Jonathan LeBlanc – Wood Thrush
Chet Atkins – Wood Thrush
Andrea Green – Marsh Bird
Jesse Bahm - Catch & Release Trout
Christy Kitterman – Catch & Release Trout
RESEARCH AND FACULTY COLLABORATORS

Dr. Steven Beaupre – Department of Biological Sciences – University of Arkansas
Dr. Johnnie Gentry – Director of Museum – 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
Dr. Robert Weih – School of Forest Resources, University of Arkansas – Monticello
Dr. Don White, Jr - School of Forest Resources, University of Arkansas-Monticello
Mr. F. Broermann – U. S. Fish and Wildlife Service - Alaska
Sam Lail – Buffalo National River, National Park Service
David Mott – Buffalo National River, National Park Service
Dr. Bruce Rieman, USDA Forest Service, Boise, ID
Mr. Steve Rosenstock, Arizona Game and Fish Department, Phoenix
Dr. Vickie Saab, USDA Forest Service, Bozeman, MT
Mr. Mike Cartwright, Arkansas Game and Fish Commission, Calico Rock
COMPLETED PROJECTS
The Buffalo River

Effects of Land Use, Stream Flow and Habitat Complexity on Fish Assemblage Structure of Arkansas Ozark Streams

Funding Source: National Park Service
Project Duration: June 2001 to June 2003
Principal Investigator: DANIEL D. MAGOULICK
Graduate Research Assistant: MANDY SCOTT (M.S. Student)

Objectives:

1. Determine relationships between percent nonforested land and discharge variability, flood frequency and flood intensity.
2. Investigate effects of these flow variables and habitat complexity on fish assemblage structure.
3. Develop a model that defines the most important abiotic variables for shaping fish assemblage structure in Arkansas Ozark streams.
4. Compare swimming abilities of selected fish species from these streams and determine if these results relate to the species’ abundances in study streams.

Management implications:

1. Development of a predictive model that relates fish assemblage structure to land use and hydrology.
2. Ability to predict impacts of changes in land use on stream fish assemblages.

Project Summary:

Much forested land is being cleared for agriculture, making the impact of land use on hydrology and stream fish assemblages an important issue. We used Geographic Information Systems, U. S. Geological Survey discharge data, and fish and habitat data
collected over two summers in 11 Ozark streams to determine the relationship between
land use and stream fish assemblage structure. Percent unforested land differed between
physiographic provinces and was negatively related to discharge variability, flood
frequency, and flood intensity. Species richness ranged from 10-25 species and was
positively related to percent unforested land. Fish density was greater in shallow sites
with greater canopy openness. Flow variables were important in explaining assemblage
structure, but habitat complexity was not. Flow regime and fish assemblage structure are
probably more affected by physiographic province than by land use in the Arkansas
Ozarks.

We used paired artificial stream channels with low (smooth Plexiglas) and high
(rocks glued on Plexiglas) complexity substrates to determine critical swim speeds (CSS)
of central stoneroller *Campostoma anomalum*, cardinal shiner *Notropis cardinalis*,
orangethroat darter *Etheostoma spectabile*, green sunfish *Lepomis cyanellus* and longear
sunfish *L. megalotis*. Central stonerollers had greater swim speeds than sunfish species
in both substrates. Green sunfish selected lower patch velocities than central stonerollers
at high-speed levels in the high complexity substrate, whereas at half-speed levels there
was no significant difference in velocity patch selection between the five species. Our
results suggest that the swimming ability of central stonerollers may give them an
advantage over other species during high flows in low complexity substrates, whereas
sunfish and darters appear better able to use high complexity substrates as velocity
refuges during high flows.

We examined swimming performance and flood resistance behavior of five
common fish species from the Arkansas Ozarks. We used paired artificial stream
channels with low (smooth Plexiglas) and high (rocks glued on Plexiglas) complexity
substrates to determine critical swim speeds (CSS) of central stoneroller *Campostoma
anomalum*, cardinal shiner *Notropis cardinalis*, orangethroat darter *Etheostoma
spectabile*, green sunfish *Lepomis cyanellus* and longear sunfish *L. megalotis*. In low
substrate complexity treatments, central stonerollers had significantly greater corrected
critical swim speed (CCSS) than all other species except cardinal shiner, which did not
significantly differ from orangethroat darters. Green sunfish and longear sunfish had
significantly lower CCSS than the other three species. In high substrate complexity,
stonerollers had significantly greater CCSS than green sunfish, but all other species did
not differ significantly in CCSS. Relative velocities did not differ significantly between
species at their highest attainable CSS in low substrate complexity, whereas at half-CSS
levels green sunfish had significantly lower relative velocity than longear sunfish. Green
sunfish selected lower velocities than central stonerollers at CSS levels in the high
complexity treatment, whereas at half-CSS levels there was no significant difference in
velocity selection between the five species. All species selected below-average velocity
patches at CSS levels in both substrate types. Our results suggest that the swimming
ability of central stonerollers may give them an advantage over other species during high
flows in low complexity substrates, whereas sunfish and darters appear better able to use
high complexity substrates as velocity refuges during high flows.
Evaluating Impact of Selective Harvest Management on Age Structure and Sex Ratio of White-Tailed Deer (*Odocoileus virginianus*) in Arkansas.

**Funding Source:** Arkansas Game and Fish Commission  
**Project Duration:** 1 July 2000 to 31 July 2004  
**Principal Investigator:** Dr. DAVID G. KREMENTZ  
**Graduate Research Assistant:** Dr. BRET A. COLLIER

**Research Objectives:**

1. Determine impact of harvest management strategies (e.g. antler point restrictions) on sex and age structure of white-tailed deer harvest in Arkansas.
2. Determine if harvest management strategies influence white-tailed deer harvests differently dependent upon spatial scale.
3. Investigate the human dimension of statewide white-tailed deer management practices.

**Management Implications:**

1. Establish management recommendations based on the impact of harvest management strategies in Arkansas.
2. Verify the effectiveness of harvest management strategies and determine if harvest differences between states under those strategies and those states that are not.
3. Gather baseline information on how AGFC can assist private landowners managing white-tailed deer.
4. Estimate at which spatial scale harvest management strategies influence deer demography.
Project Summary:

We investigated the impacts of a statewide antler restriction on the age structure and sex ratio of white-tailed deer (*Odocoileus virginianus*) harvested in Arkansas. Our objectives are 1) to determine which factors have the most influence on white-tailed deer population demography pre- and post the establishment of a statewide antler restriction, 2) determine whether influence of the antler restriction is scale dependent and 3) to gather demographic information on white-tailed deer hunters in Arkansas.

Between Fall 2000 and Summer 2002, we surveyed hunting camps registered in the Arkansas Deer Camp Program and Arkansas hunting license purchasers to gather information on management practices in use on private land and on hunter opinions, preference, and attitudes concerning current and future white-tailed deer management in Arkansas. Analysis of hunting club management practices and hunter demographic data is complete and final project reports were delivered to the AGFC in October 2003 (White-Tailed Deer Management on Private Lands in Arkansas) and January 2004 (Opinions, Preferences, and Attitudes of Hunters on White-Tailed Deer Management in Arkansas).

We combined a stochastic age and sex structured simulation model with probabilistic graphical modeling to 1) evaluate the affects of localized management and regulatory structure on white-tailed deer population dynamics, 2) evaluate uncertainty in parameter estimates and how uncertainty influences model predictions, and 3) evaluate the impact of regulatory restrictions as spatial scales increases, and 4) show how probabilistic modeling can assist agencies when planning management programs.

Our modeling results indicated that under the antler restriction at the scale of a hunting camp or WMA, population response profiles for sub-adult and adult males were higher than when under historical regulations. However, as spatial scale increased, population responses under the antler restriction tended to decline to levels below those shown under historical regulations. While yearling recruitment into the sub-adult age class increased at the county scale, these shifts were cancelled out by increased selectivity of sub-adults under the current regulation, allowing no more males to reach mature age classes. We found that adult male population response varied little at large spatial scales. Our modeling results suggested that the antler restriction does not increase the overall population age structure of the white-tailed deer herd. Given uncertainty due to limited information regarding population demographic parameters in Arkansas, we suggest that future work focus on experimental evaluation of harvest regulations while concurrently estimating population demographic parameters at multiple scales in order to increase the accuracy of management planning and evaluation. Our results also indicated that harvest sex ratio information should not be used for prediction of post-harvest population sex ratio. Instead, preharvest sex ratio data collected by archery hunters and managers can improve population sex ratio predictions appreciably.
Barge shocking in Bear Creek, a tributary to the Buffalo River

Funding Source: National Park Service
Project Duration: 1 July 2002 to 31 June 2005
Principal Investigator: DANIEL D. MAGOULICK
Graduate Research Assistant: SHAWN HODGES (M.S. Student)
MATT DEKAR (M.S. Student)

Factors Affecting Migration and Recruitment in Headwater Fish Assemblages of
Buffalo National River, AR

Objectives:

1. Document the seasonal fluctuations in fish community species composition, relative abundance, and migration patterns at the macrohabitat, reach, and watershed scale.
2. Document larval drift densities and rates as components of fish community recruitment in the upstream, middle, and downstream reaches of Bear Creek.

Management Implications:

1. Information gained by this study will aid in interpreting the extent to which the Buffalo River depends upon Bear Creek and other tributaries to provide a fish species pool and as a potential spawning and nursery location.
2. Results will aid in interpreting the effects of barriers to fish movement, such as dams or stream drying.
3. Provide insight into the dynamics of fish reproduction and recruitment in intermittent and perennially interrupted streams.
Project Summary:

The Army Corps of Engineers is currently reviewing a permit application for the construction of a dam in the headwaters of Bear Creek, a tributary to the Buffalo National River. The decision is based in part on the assumption that the fish community will be minimally impacted due to the intermittent nature of Bear Creek and the idea that fish in small, intermittent streams move little. During 2002 and 2003, we seasonally sampled six headwater streams in the Buffalo River watershed to determine extent and timing of fish movements. In addition, in 2002-2003 we deployed weir traps seasonally at the mouth of Bear Creek to monitor directional fish movements between Bear Creek and the Buffalo River. We also seasonally sampled larval fish drift in Bear Creek to quantify dispersal rates. At the headwater sites, larger fish were found in April, than in June and August, suggesting that larger fish move into these sites to spawn. Major upstream movements of fishes from the Buffalo River into Bear Creek occurred in spring of 2003 (hundreds of individuals per day) with greatly reduced movement during the other seasons. Much of the upstream movement in spring appears due to spawning migrations and was related to stream discharge. Larval fish drift densities in Bear Creek were some of the highest on record and acted as a major input to Buffalo River in spring and summer. Drift rates peaked at night and this diel pattern was consistent regardless of flood pulses. Flow regimes appear important in this system regarding timing and extent of fish spawning migrations. Thus, alterations to the flow regime may affect fish movement in this system.
American Woodcock (Scolopax minor) Fall Migration Ecology in the Central Region

**Funding Source:** U.S. Fish and Wildlife Service  
**Project Duration:** Fall 2001 – Summer 2004  
**Principle Investigator:** DAVID G. KREMENTZ  
**Graduate Research Assistant:** NICHOLAS A. MYATT (M.S. student)

**Research Objectives:**
1. Document American woodcock fall migration routes in the Central Region  
2. Determine the timing of woodcock fall migration  
3. Investigate woodcock habitat use during fall migration

**Management Implications:**
1. Establish baseline data on woodcock fall migration ecology.  
2. Map woodcock fall migration routes.  
3. Identify priority areas for future woodcock management.  
4. Determine the range of habitats used during fall migration.

**Project Summary:**

Despite decreased hunter bag limits and shortening of the hunting season, American woodcock (Scolopax minor) populations have been declining since singing ground surveys began in 1968. Woodcock have been extensively studied on the breeding grounds and to a lesser extent on the wintering grounds, but virtually no research has been conducted on the species’ fall migration ecology. We know roughly when woodcock leave the breeding grounds and when they arrive on the wintering grounds, but little is known about the period in between.

In the Fall of 2001 we began a 3 year study to document American woodcock fall migration routes, timing, and habitat use in the Central Region. From fall 2001 to Fall 2003, 582 radio-marked woodcock migrated from three study sites in Minnesota, Wisconsin, and Michigan. We conducted aerial searches from fixed-wing aircraft throughout the migration period and once birds arrived on the wintering grounds. Our primary search efforts were in Iowa, Illinois, Missouri, Kansas, Oklahoma, Arkansas, Kentucky, Tennessee, Mississippi, Louisiana, and Texas.
We conducted 224 hours of aerial telemetry and found 42 possible radio-marked woodcock locations. We confirmed 32 of these locations by flushing the radio-marked bird while the remaining locations were unconfirmed due to lack of access or absence of the radioed bird when we arrived.

Our research found that woodcock commenced fall migration in late October and usually arrived on the wintering ground by the end of the second week in December. Woodcock used different migration routes than those published in the 1970’s in that they avoid the Lower Mississippi Valley. Woodcock appeared to migrate in a series of long jumps, sometimes staying at one stopover location for periods exceeding one week. We identified one priority migration area in Arkansas for future woodcock land management in the Central Region. Woodcock used higher and drier sites while on migration than expected, and while on the winter grounds, they used mixed pine-hardwood forests to a greater extent than bottomland hardwoods.
Short-term Responses of Grassland Bird Populations to Timing of Haying in Northwest Arkansas

Funding Source: AR Game and Fish Commission; USGS-BRD, CFWRU
Project Duration: August 2001 to May 2005
Principal Investigator: WILLIAM L. THOMPSON
Graduate Research Assistant: JASON D. LUSCIER (M.S. Student)

Research Objectives:

1. Evaluate short-term responses of grassland bird populations to timing of haying in Northwest Arkansas by evaluating nest survival, species richness, and bird density.

Management Implications:

1. Wait until mid-June to hay fields in Northwest Arkansas.
2. Future studies on timing of haying on grassland birds in these study areas perhaps should focus on estimating bird densities to obtain more conclusive results.

Project Summary:

North American grassland bird species have declined due to habitat loss and conversion from native, warm-season to non-native, cool-season grasses for cattle grazing and haying. Cool-season grasses are typically hayed at the peak of the breeding season, adversely affecting reproductive success of grassland birds. I evaluated short-term responses of grassland birds to timing of haying in Northwest Arkansas during 2 breeding seasons (2002 and 2003). During 2002, I evaluated species richness and nest survival of grassland birds in 3 uhayed (reference) fields, 1 field hayed early in the breeding season (19 May), and 1 field hayed during the middle of the breeding season (1 June) in the Wedington Unit of the Ozark National Forest. There were more species per ha in early and mid-hayed fields than in unhayed fields at the end of the breeding season, suggesting that these haying events provided better forage and cover for more species.
during the end of the breeding season. There were too few data to discern a haying effect on nest survival. During 2003, I evaluated the nest survival and bird densities in 3 unhayed (reference) fields, 2 fields hayed early in the breeding season (26-31 May 2003), and 4 fields hayed late in the breeding season (17-25 June 2003) in Benton and Washington Counties in Northwest Arkansas. I only detected 1 nest that was initiated in fields after early haying (26 May); however, I was not able to separate the effect from early haying from the temporal effect of 26 May. There were more dickcissels in unhayed fields than in early hayed fields after early haying, suggesting a negative effect of early haying on dickcissel densities. There was a trivial haying effect on eastern meadowlark densities. With fewer nest initiations and decreases in dickcissels after early haying during 2003, fields in Benton and Washington Counties in Northwest Arkansas should not be hayed until after the middle of June to allow for more nests to fledge young. For future research in these same areas, more nests will need to be located and monitored, requiring more fields, money, and personnel. Therefore, future studies on timing of haying on grassland birds in these study areas perhaps should focus on estimating bird densities to obtain more conclusive results.

**Funding Source:** Causey Grant-in-Aid of Research- Department of Biological Sciences, University of Arkansas. Awarded to Michael Rabalais.

**Project Duration:** 1 July 2002 to 31 July 2004

**Principal Investigator:** DANIEL D. MAGOULICK

**Graduate Research Assistant:** MICHEAL R. RABALAIS (M.S. Student)

**Research Objectives:**

1. Test the hypothesis that environmental changes do not prevent *O. eupunctus* from surviving and growing in their former range.
2. Determine the extent of resource (habitat) partitioning between *O. eupunctus* and *O. neglectus*.
3. Test the hypothesis that introduced *O. neglectus* outcompete native *O. eupunctus*.

**Management Implications:**

1. Information from this study will help determine current impacts and predict future impacts of the invading 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:

The crayfish *Orconectes eupunctus*, a species of special concern, appears to have been displaced from part of its former range in the Spring River drainage of Arkansas and Missouri by the invasive crayfish *O. neglectus chaenodactylus*. The objectives of this study were to determine: 1) if *O. eupunctus* and *O. neglectus chaenodactylus* compete for habitat, 2) whether *Orconectes eupunctus* can grow and survive in its former range, and 3) if *O. neglectus chaenodactylus* negatively impacts growth and survival of *O. eupunctus*. At a site where the two species overlap, there was no apparent partitioning of habitats between the two species, and there was no shift in habitat use, habitat selection, and species-environmental relationships by *O. eupunctus* when in the presence of *O. neglectus chaenodactylus*. Furthermore, *O. neglectus chaenodactylus* did not significantly affect the growth and survival of *O. eupunctus* in a field competition experiment. However, *O. eupunctus* was able to grow and survive in its former range suggesting that biotic interactions may have caused its displacement. These results suggest that *O. eupunctus* have been displaced from their former range by biotic interactions, but interspecific competition between *O. eupunctus* and *O. neglectus chaenodactylus* adults does not appear to be the mechanism responsible. Further study is needed to investigate the displacement of *O. eupunctus* from its former range.
Evaluation of a Mark-resight Technique for Estimating White-tailed Deer Abundance in Arkansas

Funding Source: Arkansas Game and Fish Commission
Project Duration: November 2002 to June 2005
Principal Investigator: WILLIAM L. THOMPSON
DAVID G. KREMENTZ

Research Objectives:

1. Evaluate a mark-resight method for estimating deer numbers for possible use by AGFC to intensively monitor deer population trends within select areas of Arkansas.
2. Estimate survival rates, movement rates, habitat use, and home range size of white-tailed deer near Camden, Arkansas.

Management Implications:

1. Provides a reliable means to monitor local and statewide deer populations, which would be important information for managing white-tailed deer in Arkansas.

Project Summary:

Management of the white-tailed deer population by the Arkansas Game & Fish Commission (AGFC) requires information about demographics, habitat use, movements and estimates of population abundance. Population abundance estimates of deer are not easily acquired because of; the secretive nature of deer, the wide range of habitat types found throughout Arkansas, reliance on ad hoc methods, and little free time to conduct surveys by AGFC field personnel. Most state agencies in the Southeast rely on roadside spotlight counts as an index for monitoring deer populations. However, these counts underestimate deer abundance by some unknown amount, which varies across habitats and time. Further, these counts cannot be properly extrapolated beyond surveyed areas.
adjacent to roads. Thus, reliability of counts obtained via spotlight surveys for monitoring deer populations is questionable at best. Therefore, we initiated this study to evaluate the usefulness and feasibility of a mark-resight method for estimating white-tailed deer abundance within a private hunting club near Camden, Arkansas. We planned to use a combination of diurnal and nocturnal roadside surveys, camera counts, club-member and researcher surveys to resight marked deer. With the AGFC taking the lead on capturing the targeted 60 deer, we quickly learned that our original target of only males $\geq 1.5$ years old was not possible. Capturing deer was a formidable task that was demanding in terms of manpower, time and money. After a year of capture efforts, we had marked 9 males and 17 females. Of these deer, 7 either died or were lost within 2 weeks after release. In February 2004, Dr. Bill Thompson resigned from the Coop Unit, and then in June 2004, the post-doctoral fellow resigned from the study. After discussing the change in personnel and the poor capture rates up through spring 2004, the AGFC and David Krementz decided to terminate the project. A final report was submitted to AGFC and was approved. All equipment purchased on the project was recovered by AGFC.
The Importance of Lower Mississippi River Alluvial Valley Reforestation and Wetland Restoration Sites to Wintering Migratory Birds

**Funding Sources:** U.S. Fish and Wildlife Service
USGS – BRD

**Project Duration:** September 1999 – December 2004

**Principal Investigator:** DAVID G. KREMENTZ

**Graduate Research Assistant:** ROBERT H. DOSTER (Ph.D. Student)

**Research Objectives:**

1. Determine the species composition and population density of migrant birds wintering in and using early-successional vegetation sites in the Lower Mississippi River Alluvial Valley.
2. Characterize the vegetation in early-successional fields and model the relationship between habitat characters and bird species richness and abundance.
3. Focus on two wintering grassland bird species of conservation concern (Sedge Wren and Le Conte’s Sparrow) by describing their specific wintering habitat requirements for purposes of conservation management.
4. Determine the breeding origin of selected bird species wintering in the Lower Mississippi River Alluvial Valley, through analysis of stable isotopes incorporated in feathers, for use in conservation planning between breeding and wintering sites.

**Management Implications:**

1. Compare management and landscape attributes between study sites and determine which management regime is most beneficial to the greatest number of species and to those species that are in particular need of conservation attention.
2. Formulate management recommendations based on research objectives for the purpose of a region-wide conservation strategy aimed at providing optimal wintering habitat for the greatest number of short-distance migrant bird species.
Project Summary:

Significant efforts to restore bottomland hardwood forests and associated wetlands have been undertaken throughout the Lower Mississippi River Alluvial Valley (LMAV) in recent years. These restoration activities have resulted in large amounts of early-successional habitats throughout the region. Early-successional habitats are used by a number of grassland bird species as winter refugia. Considering that grassland birds, as a whole, are experiencing population declines and since little research has been done on their winter ecology, we investigated the role that these restored habitats within the LMAV play for this group of birds. In total, 69 sites throughout the LMAV of Arkansas, Louisiana and Mississippi were surveyed in winter 2000, 2001 and 2002 for bird species richness, abundance and distribution. Associated measurements of vegetation structure were also collected at all sites. In addition, species-specific habitat measurements were made for two species of conservation concern within the region: Sedge Wren and Le Conte’s Sparrow.

Regression models were used to explore relationships of density and species richness to habitat and landscape measures. Density models indicated decreases with increasing distance to forest; decreases with increasing distance from the Mississippi River; and increases with rising vegetation height. Species richness models showed an increase in richness with increasing vegetation height; declined with increasing distance from the Mississippi River; and smaller sites close to the Mississippi River were more likely to hold a greater number of species than distant sites.

Sedges Wren and Le Conte’s Sparrows were studied by measuring their winter habitat at 20 locations in the LMAV. We used partitions of Mahalanobis D² to discern the least variable habitat features across study sites for both species. Results indicated that Sedge Wrens preferred uniformity in vegetation height, selected a balance between plant litter depth and vertical vegetation diversity, and favored corresponding increases in composition of plant litter and forbs coverage. Sedge Wrens preferred areas dominated by grass. Le Conte’s Sparrows favored corresponding increases in grass and plant litter, occurred when a parallel increase between % forbs and % grass took place, and when mean vegetation height increased along with an increase in % plant litter and % forbs. Le Conte’s Sparrows showed an overall preference for short vegetation.

To understand where some of the birds wintering in the LMAV early-successional habitats originated from, we used stable isotope analysis. Feathers from 90 individuals of four species: Savannah, Le Conte’s, Song, and Swamp sparrows were analyzed for stable hydrogen isotope ratios. Results were compared to North American hydrogen isotope maps to determine breeding origins. Further, the delineated breeding ranges of these species were contrasted with North American Breeding Bird Survey data to see if it could be determined if birds in the LMAV could be derived from declining breeding populations. Though the procedure used has error involved, it appeared that Savannah Sparrows originated from declining populations, Le Conte’s Sparrows originated from increasing populations, Song Sparrows originated from regions experiencing mixed population trends, and Swamp Sparrows came from declining populations in northwestern Canada.
CURRENT PROJECTS
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.
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 exist 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:**

1. 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:**

Previous studies have revealed different movement patterns exhibited by smallmouth bass related to seasonal changes in water temperatures and discharge. In a nearby Missouri Ozark stream, smallmouth bass moved extensively during spring and fall, yet were found to move very little during the rest of the year. In Wisconsin, radio-tagged adult smallmouth bass traveled up to 109 km downstream to reach deep pools used as winter refuge. In Bear Creek, summer drying can be extreme and large portions of the stream dry completely or become reduced to isolated pools. The extent to which seasonal changes in water temperature and discharge affect fish migration within this system is currently unknown.

Radio-telemetry results indicated that some smallmouth bass in these populations are using habitats in both Bear Creek and the Buffalo River. Other individuals in these two streams have annual home ranges consisting of only a few adjacent pools. In addition, fish movements
coincided seasonally with higher levels of water flow. We will be determining habitat selection to better understand what habitat variables are associated with these populations. Lastly, we are beginning the analysis and comparison of microchemical signatures found in otoliths and water samples collected within the stream reaches to determine movement histories of smallmouth bass.
A sora 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 sites with water ~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.
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: 1 January 2004 to 31 December 2006
Principal Investigator: DANIEL D. MAGOULICK
Graduate Research Assistant: AARON CUSHING (M.S. Student)

Research Objectives:

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

Special regulations have been instituted on portions of the cold tailwater fisheries in Arkansas. Catch and release areas have been located along the Bull Shoals and Norfork tailwaters to “exploit” trout “growth potential”. The logic behind these catch and release 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 assumptions one and two and we will address the third assumption in a companion project.
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: 1 January 2004 to 31 December 2007
Principal Investigator: DANIEL D. MAGOULICK
Graduate Research Assistant: JON 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 have been instituted on portions of the cold tailwater fisheries in Arkansas. Catch and release areas have been located along the Bull Shoals and Norfork tailwaters to “exploit” trout “growth potential”. The logic behind these catch and release 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.
Wood thrush advertised it’s territory.

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: 1 May 2003 to 31 May 2005
Principal Investigator: DAVID KREMENTZ
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:

The Atchafalaya Basin is one of very few publicly owned contiguous tracts of bottomland hardwood forest remaining in southern Louisiana. The Sherburne Wildlife
Management Area is over 30,000 acres of hardwood forest owned cooperatively by the Louisiana Department of Wildlife and Fisheries (LDWF), the US Army Core of Engineers and the U.S. Fish and Wildlife Service. The LDWF manage the area with an assortment of harvesting regimes, aimed at speeding succession and providing a diversity of habitats for both game and non-game species. Our project is to examine the effects of these harvesting regimes on forest-dwelling, breeding birds. We focused the study on wood thrush because they are considered to be a forest interior species sensitive to management. We radio-tagged 35 adult wood thrush in 2003 and 66 in 2004. We tracked their daily movements from mid May through mid August and obtained 564 daily locations in 2003 and 2,166 in 2004. The largest movement we recorded was 9.4 km by a female wood thrush who moved from a selectively harvested area to an agricultural complex. The median distance between consecutive locations for males was 80 m, and for females was 58 m. Male and female home ranges were similar, and the overall mean size was 6.3 ha (SE=1.12 ha). We monitored 14 wood thrush nests in 2003 and 36 in 2004, and measured several habitat covariates at each nest site. With these data we will compare survival, home range size, movements and nest success among treatments. We also conducted bird surveys in each of 7 different management compartments. We surveyed a total of 60.6 km of transect in both 2003 and 2004 and detected 38 different forest-dwelling breeding birds on the study area. We surveyed vegetation along each transect in order to correlate habitat features with avian densities. In 2003 we conducted a mark-recapture program aimed at estimating survival for 5 species of passerines. This component of the project was discontinued in 2004 in order to place more effort in the radio-marking and tracking of wood thrush. The final report for this project is expected by December 2005.
NEW PROJECTS
Changes in Winter Distributions of Mallards in the Lower Mississippi Flyway in Recent Times

Funding Source: Arkansas Game and Fish Commission
Project Duration: 1 January 2005 to 31 December 2006
Principal Investigator: DAVID G. KREMENTZ
Graduate Research Assistant: ADAM W. GREEN (M.S. Candidate)

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.

Management Implications:

1. Analyses should help Arkansas Game & Fish Commission respond to hunter complaints.
2. Analyses should help AGFC determine what management actions might be taken to changes in mallard winter distributions.

Project Summary:

A topic of debate among waterfowl hunters in Arkansas has been whether winter distributions of mallards have changed during recent times (~25 years) in the Lower Mississippi Flyway. Although over the past few years mallard harvests in Arkansas have been at all time highs (USWFWS unpublished data), Arkansas hunters have complained that fewer mallards were available for harvest. Suggestions as to why wintering mallard populations have decreased in Arkansas are many and include changes in climate (milder winters, delayed onset of winter), changes in land use (loss of bottomland hardwoods, increased acreage of cotton), reduction in food availability as a result of changes in rice varieties and harvest techniques, short-stopping (providing food and water north of Arkansas to “hold” mallards), and others.

We propose to examine winter distributions of mallards in the Mississippi and Central Flyways from the 1990s to present day to determine if winter distributions have changed and if so, why. These analyses should help Arkansas Game & Fish Commission in responding to hunter complaints and what management actions might be taken.
Survey of Breeding Secretive Marsh Birds in the Delta Region of Arkansas

Funding Source: Arkansas Game and Fish Commission
Project Duration: 1 January 2005 to 30 June 2007
Principal Investigator: DAVID KREMENTZ
Graduate Research Assistant: MICHAEL BUDD (M.S. candidate)

Research Objectives:

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

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 (*Porphyria 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.

The current status of breeding secretive marsh birds in Arkansas is mostly unknown. The Breeding Bird Survey has routes in the Delta that have been run for a number of years, but two aspects of the BBS do not lend themselves to relying on this survey for secretive marsh birds. First, secretive marsh birds are by nature difficult to detect, and usually can only be detected using playback calls which is not part of the BBS protocol. Evidence of the difficulty in detecting secretive marsh birds is the absence of any secretive marsh birds showing up on Arkansas wetland bird trend analyses for 1980-2002 censuses. Second, the reliance on roads from which to conduct BBS surveys does not lend itself well to monitoring marsh birds that occupy extensive marshes. This project will inventory secretive marsh birds in the Delta of Arkansas by employing a combination of survey methods. Methods include using call-playback broadcasts at randomly selected wetlands to illicit responses from secretive marsh birds. Each wetland will be surveyed $\geq 5$ times to determine presence/absence to a 90% certainty. The data collected will be used to estimate occupancy rates. We will collect auxiliary data to help understand what factors might be explaining occupancy rates. Factors will include wetland type, wetland size, adjacency to nearby wetlands, presence of nearby ditches with woody vegetation, whether surrounded by agriculture.
Effect of the Introduced Crayfish, *Orconectes neglectus*, on Native Crayfish in the Spring River Drainage

_Funding Source:_ Arkansas Game and Fish Commission, U.S. Fish and Wildlife Service  
_Project Duration:_ 15 July 2005 to 15 December 2007  
_Principal Investigator:_ DANIEL D. MAGOULICK  
_Graduate Research Assistant:_ ERIC LARSON (M.S. Student)

**Research Objectives:**

4. Test the hypothesis that introduced *O. neglectus* outcompete native *O. eupunctus*.
5. Examine other potential mechanisms for displacement of native crayfish by introduced *O. neglectus* such as differential predation and reproductive interference.

**Management Implications:**

4. Information from this study will help determine current impacts and predict future impacts of the invading crayfish species on native species.
5. 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.
6. 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 invasive crayfish *O. neglectus chaenodactylus*. Previous research (see completed projects) suggested that *O. eupunctus* have been displaced from their former range by biotic interactions, but interspecific competition between *O. eupunctus* and *O. neglectus chaenodactylus* adults during summer does not appear to be the mechanism responsible for this displacement. Therefore, the objectives of this study are to further examine competitive interactions during different seasons and among different size classes of crayfish. Additionally, we will examine other potential mechanisms for displacement of native crayfish by introduced *O. neglectus* such as differential predation and reproductive interference. We will use field observations, field experiments and lab experiments to address these questions.
HONORS AND AWARDS

Nicholas Myatt – Scott D. Shull Award, Department of Biological Sciences, University of Arkansas, 2004
Christopher Bare – Leggett Fellowship, University of Arkansas 2004
John Ludlam – Distinguished Doctoral Fellowship, University of Arkansas, 2004
Matthew Dekar – Doctoral Academy Fellowship, University of Arkansas, 2004
Christopher Bare – Causey Grant, University of Arkansas, 2004

COURSES TAUGHT

Magoullick – Fish and Wildlife Seminar – Spring 2004

PUBLICATIONS AND PROFESSIONAL PAPERS PRESENTED

Scientific Publications


Technical and Semi-Technical


Theses and Dissertations


Papers Presented


Lehnen, S. E., and D. G. Krementz. 2004. Stopover Duration Estimates For Least Sandpipers at Tree Sites in the Lower Mississippi Alluvial Valley During Fall Migrations. Cooper Ornithological Society Meeting. La Crosse, WI.


Posters Presented


Committees/Task Forces/Recovery Teams

Krementz, D. G., Migratory Bird Science Team, Lower Mississippi Valley Joint Venture
Krementz, D. G., Shorebird Research Working Group, Lower Mississippi Valley Joint Venture
Krementz, D. G., Waterfowl Team, Arkansas Game & Fish Commission.
Krementz, D. G., Woodcock Task Force, International Association of Fish & Wildlife Agencies.

TECHNICAL ASSISTANCE

Magoulick, D. D., Associate Editor - North American Journal of Fisheries Management, 2004
Magoulick, D. D., Ecologist search committee, Dept. of Biological Sciences, University of Arkansas, 2004
Thompson, W. L. Organized and taught a 1 day workshop on using program MARK to estimate survival rates and abundance to graduate students and faculty of the Dept. of Biological Sciences, University of Arkansas, 2004.

Training Received