

# 2009 Annual Report

## Arkansas Cooperative Fish



## & Wildlife Research Unit



**ARKANSAS COOPERATIVE  
FISH AND WILDLIFE  
RESEARCH UNIT**

**ANNUAL REPORT  
2009**

**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

Arkansas Cooperative Fish and Wildlife Research Unit first opened its doors in August of 1988 as one of the four units initiated that year, and one of 43 coop units across the country associated with Land Grant universities, state game and fish agencies, 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.

Over the past 21 years, the Arkansas Coop Unit has become an active part of state and federal research efforts in Arkansas and across the Nation. By the end of our twenty-first year, Arkansas Coop Unit will have initiated 70 research projects with Arkansas Game and Fish Commission (23), U.S. Fish and Wildlife Services (19), U.S. Geological Survey (11), National Park Services (4), and other federal, state, and private organizations as sponsors. These projects have funded the research of 51 MS and 8 PhD students, most of which are now working as professional biologists. Presently those students are employed by federal, state, and private agencies, colleges and universities, or are continuing their graduate degrees at other schools. Arkansas Coop Unit leaders and students have published 146 scientific and technical publications listing the unit and our cooperators in byline and acknowledgements, and another six publications have been accepted or submitted for publication. Unit leaders and Assistant unit leaders have taught 47 classes in fisheries and wildlife. Finally, including base funds and contracts, Arkansas Coop Unit has brought more than \$10,000,000 directly into the community.

During the past two decades, Arkansas Coop Unit has gone through a number of changes. We have changed our federal cooperator from the U. S. Fish and Wildlife Services to National Biological Survey to National Biological Service, and we now reside within the U.S. Geological Survey. Our University department changed from Zoology, to Biological Sciences when incorporating the departments of Botany and Microbiology. We have seen nine Departmental Chairs (Amlaner, Geren, Kaplan, Talburt, Rhoads, Roufa, Davis, Smith and Spiegel), two Unit Leaders (Johnson and Krementz), six Assistant Unit Leaders (Annette, Martin, Griffith, Kwak, Thompson, and Magoulick), four Administrative assistants (Kimbrough, Koldjeski, Parker, and Moler), two Post Doctoral Assistants (LeMar and Lehnen), and nine Research Specialist/Technicians (Neal, Aberson, Vaughn, Thogmartin, Lichtenberg, Piercey, Bahm, Nault, and Kitterman).



*Brown Trout from Bulls Shoal Area*

## 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, region and country. 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.



*Vegetation site for snipe research*

## PERSONNEL AND COOPERATORS

### COORDINATING COMMITTEE MEMBERS

#### US GEOLOGICAL SURVEY

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## UNIT STAFF

### UNIT LEADER

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### OFFICE MANAGER

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## CURRENT GRADUATE STUDENTS

Jason Bolenbaugh (M.S., Wildlife – Krementz)  
Matt Carroll (M.S., Wildlife – Krementz)  
Jon Flinders (Ph.D., Fisheries – Magoulick)  
Jake Jung (Ph.D., Wildlife – Krementz)  
Leah Scott (M.S., Wildlife – Krementz)

## RECENTLY GRADUATED GRADUATE STUDENTS

Matthew P. Dekar (Ph.D., – Magoulick)  
John P. Ludlam (Ph.D., – Magoulick)

## HOURLY TECHNICIANS

Clark Baker – Sora Rails  
Noelle Boone – King Rails  
Devin Eby-Bosler – Shorebirds  
Scott Longing – Crayfish  
Jason Luscier – Woodpecker  
Shea Magstadt – Wilson's Snipe Flyway  
Kerri McCabe – Crayfish  
Maureen McClung – Web site update  
Beth Stein – King Rails  
John Stewart – General help (Work-study)  
Kwasi Asante – Mallard tracking

## RESEARCH AND FACULTY COLLABORATORS

Dr. Larkin Powell – School of Natural Resource Sciences – University of Nebraska

Dr. Fred Spiegel – Department of Biological Sciences – University of Arkansas

Dr. Bill Uhlein – 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

Dr. Tom Cooper – U.S. Fish and Wildlife Service

Molly Bunch – University of Arkansas

Dr. Robert J. DiStefano – Missouri Department of Conservation

Jacob Westoff – Ph.D. Student, University of Missouri



*Three toed box turtle*

# COMPLETED PROJECTS



*Scott Longing collecting Crayfish*

*Fisheries*



*Otter released after blood sampling for metabolism study*

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

*Funding Source:*

Arkansas Game and Fish Commission

*Project Duration:*

August 2004 to June 2009

*Principal Investigator:*

DANIEL D. MAGOULICK

*Graduate Research Assistant:*

MATTHEW P. DEKAR (Ph.D. Candidate)

**Objectives:**

1. Quantify aquatic and riparian food webs and investigate spatial and temporal variation in predator-prey dynamics between otters and the aquatic community.
2. Quantify otter diet and investigate abiotic factors regulating the seasonal availability of prey.
3. Estimate daily energy expenditure with doubly labeled water and develop a bioenergetics model to estimate seasonal consumption of aquatic prey.

**Management Implications:**

1. Results will highlight important interactions and impacts of otters on prey populations, including sport fishes.
2. Bioenergetics models will give insight into ecological and physiological constraints regulating otter populations.
3. Results will enable predictions concerning how predator and prey populations will respond to environmental variation associated with seasonal fluctuations in water levels and temperature.

## **Project Summary:**

River otters (*Lontra canadensis*) are primarily aquatic specialists and foraging in the aquatic environment requires high metabolic rates, with large costs associated with thermo-regulation and swimming. Considering the elevated energetic demand, otters must consume a large portion of local biomass production in order to grow and reproduce, with important consequences to community and ecosystem dynamics. In particular, there is growing concern 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 Little Mulberry Creek and the Mulberry River of northwest Arkansas, U.S.A. From 2005 to 2008, we quantified spatial and temporal variation of stream food webs using circular statistics and stable isotopes. In addition, we sampled otter feces for diet analysis seasonally and we obtained stomachs from otter carcasses collected during the winter trapping season. In 2007, we began monitoring crayfish abundance to develop predictive models of otter diet based on prey availability. Finally, in 2008 we began a doubly labeled water experiment with captive otters in an experimental pond to estimate daily energy expenditure. Results indicated that otters consume mostly crayfish but switch to fish during the winter, corresponding to a decrease in crayfish availability. We developed an otter bioenergetics model with diet and metabolism data to estimate seasonal consumption of aquatic prey.

*Fisheries*



*Experimental mesocosms in a greenhouse laboratory*

**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. Identify biotic and abiotic factors that influence grazer-benthos interactions in an intermittent Ozark stream and determine how two dominant grazers differ in response to flow-related disturbance.

**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 have tested 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.

## *Fisheries*



*Collecting data on trout collected in Bull Shoals tailwater, AR*

### **The relationship between forage base and trout production in catch and release areas on Bull Shoals and Norfolk tailwaters.**

*Funding Source:*

Arkansas Game and Fish Commission.

*Project Duration:*

1 January 2004 to 31 December 2008

*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 Norfolk 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 Norfolk 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 biologist to better manage the Bull Shoals and Norfolk tailwater trout fisheries.

### **Project Summary:**

Catch-and-release regulations are commonly used in sport fisheries in an attempt to provide increased residence times and survival rates and provide more and/or larger fish. Most catch-and-release studies address factors that affect immediate mortality rates in fish, but rarely evaluate fish growth rates and food resources. We used a bioenergetics modeling approach to examine whether food resources limited brown and rainbow trout production in three catch-and-release areas in Bull Shoals and Norfolk tailwaters. We incorporated field data on brown and rainbow trout thermal experience, growth, diet analysis, and abundance from catch-and-release areas into species-specific bioenergetics models to quantify seasonal consumption of benthic fish and drifting invertebrates and compared prey consumption rates to prey availability. Growth rates were reduced in fall and winter for both species, indicating a possible seasonal bottleneck in prey supply. Based on diet analysis, Amphipoda, Chironomidae, Cladocera spp., Decapoda, Gastropoda, Isopoda, and sculpin were commonly ingested by brown and rainbow trout, but varied by species, season, and site. Despite the lack of energetic value to trout, filamentous algae was also found in stomachs of rainbow trout in high proportions at each site across all seasons, indicating epibenthic foraging. Sculpin became more common in the stomachs as brown trout attained larger sizes (>250 mm), indicating a shift to piscivory with size. Abundances of trout in Norfolk C-R were nearly twice as high as Bull Shoals. Food limitation for rainbow trout appeared to occur in fall/winter, whereas brown trout were typically not food limited. Norfolk CR area supported higher consumption, growth rates and densities than Bull Shoals for both species, and Bull Shoals prey base was adequate to maintain or support brown trout growth. This information will assist managers in determining the effectiveness of the catch-and-release areas in Arkansas tailwaters.

# CURRENT PROJECTS



*Wilson's Snipe*

*Wildlife*



*Foraging juvenile western sandpiper in Arkansas*

**Concentration Area Demarcation and Abundance Estimation of Fall Migrating Shorebirds through the Lower Mississippi Alluvial Valley**

<i>Funding source:</i>	U.S. Fish & Wildlife Service
<i>Project Duration:</i>	September 2008 to March 2010
<i>Principal Investigator:</i>	DAVID G. KREMENTZ
<i>Postdoctoral Researcher:</i>	SARAH E. LEHNEN

**Research Objectives:**

1. Determine chronology, dispersion, and traditional areas of high shorebird use in the Lower Mississippi River Alluvial Valley (LMAV) during fall migration by reviewing surveys conducted 1990-2008, particularly for shorebirds at risk of transmitting the highly pathogenic avian influenza (H5N1).
2. Produce current abundance estimates of shorebirds in the LMAV by conducting surveys during the 2009 fall migration season.

**Management Implications:**

1. Information on shorebird fall migration concentration areas and timing in the LMAV will allow managers to better manage habitat for maximum shorebird use.
2. With this information, the USFWS should be able to rapidly respond to a reported HPAI event in shorebirds in the LMAV should one occur.

**Project Summary:**

Wild birds are believed to be the reservoirs of the influenza virus that infects other species including humans. Recently, outbreaks of the highly pathogenic avian influenza (HPAI) H5N1 virus in wild birds in Asia have created concern over the potential for an outbreak in North America. Shorebirds in particular are considered at high risk of transmitting the virus to North America because their behavior and long migration routes may bring them into contact with infected Asian birds. Of particular concern are shorebirds species that regularly migrate

through the Lower Mississippi River Alluvial Valley (LMAV) as they move between their breeding and wintering grounds via the Mississippi Flyway.

Following the “Early Detection and Response Plan for Occurrence of Highly Pathogenic Avian Influenza in Wild Birds”, we assisted with the identification of areas that federal and state wildlife agencies should target their search efforts for infected shorebirds during the fall period if the virus arrives in the Mississippi Flyway. We focused on the fall period because shorebirds are more dispersed during the spring migration in the LMAV and because shorebirds are at greater risk of contracting H5N1 on their breeding grounds. The shorebirds targeted by this study were those species identified by the Mississippi Flyway Council as being at high-risk for contracting H5N1: pectoral sandpiper (*Calidris melanotos*), dunlin (*Calidris alpina*), long-billed dowitcher (*Limnodromus scolopaceus*), and to a lesser extent greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*T. flavipes*), and ruddy turnstone (*Arenaria interpres*).

We evaluated dispersion and chronology for interior migrating shorebirds through the LMAV using surveys from a variety of sources that were conducted during fall migration between 1990-2008 and from standardized surveys during fall 2009. Although 34 shorebird species were observed in the LMAV between 1990-2008 and 28 species were observed during fall 2009, six species: least sandpiper (*Calidris minutilla*), killdeer (*Charadrius vociferous*), pectoral sandpiper, semipalmated sandpiper (*Calidris pusilla*), black-necked stilt (*Himantopus himantopus*), and lesser yellowlegs, accounted for 80% of the observations between 1990-2008 and 92% of the observations during fall 2009. For the shorebirds species considered at highest risk of transmitting the H5N1, only the pectoral sandpiper and to a much lesser extent long-billed dowitcher occurred in high numbers in the LMAV; for lower risk species, greater and lesser yellowlegs were the only abundant species. Pectoral sandpiper migration through the LMAV was shorter in duration (95% of birds observed within the 85-day interval between 15 July and 8 October) than long-billed dowitcher migration (95% of birds observed in the 126-day interval between 27 July and 27 of November), lesser yellowlegs migration (95% of birds observed in the 131-day interval between 13 July and 21 of November), and greater yellowlegs migration (95% of birds observed in the 158-day interval between 9 July and 14 of December). The killdeer was widely dispersed whereas the most patchily distributed species tended to be shorebirds uncommon in the LMAV, such as white-rumped sandpiper (*Calidris fuscicollis*) and buff-breasted sandpiper (*Tryngites subruficollis*); all other shorebirds species had intermediate levels of dispersion.

We estimated the overall number of shorebirds using the LMAV between 17 July to 23 September 2009 to be 409,679 (estimate using most conservative rule: 320,618, estimate using most liberal rule: 567,248). For shorebirds at risk of contracting H5N1 as well as for shorebirds overall Catahoula Lake and drained aquaculture ponds supported the most shorebirds in the LMAV, with an estimated 72% of shorebirds using these areas. Additional survey sites with high counts included Bald Knob National Wildlife Refuge in Arkansas, Coldwater, St. Catherine, and Yazoo National Wildlife Refuges in Mississippi, and T. E. Maxson Wastewater Treatment Plant in Tennessee.

*Wildlife*



*Pied-billed Grebe*

**Occupancy and Habitat Selection of Secretive Marsh Birds in the Western Arkansas River Valley**

*Funding Source:*

Arkansas Game and Fish Commission

Arkansas Audubon Society

*Project Duration:*

January 2009 - December 2010

*Principle Investigator:*

DAVID G. KREMENTZ

*Graduate Research Assistant:*

LEAH A. SCOTT (M.S. student)

**Research Objectives:**

1. Document the distribution and estimate the occupancy of secretive marsh birds on public lands along the western Arkansas River
2. Evaluate habitat use by marsh birds there
3. Relate wetland management practices to marsh bird occupancy.

**Management Implications:**

1. Determine habitat characteristics that are important to marsh bird occupancy that could help guide management

**Project Summary:**

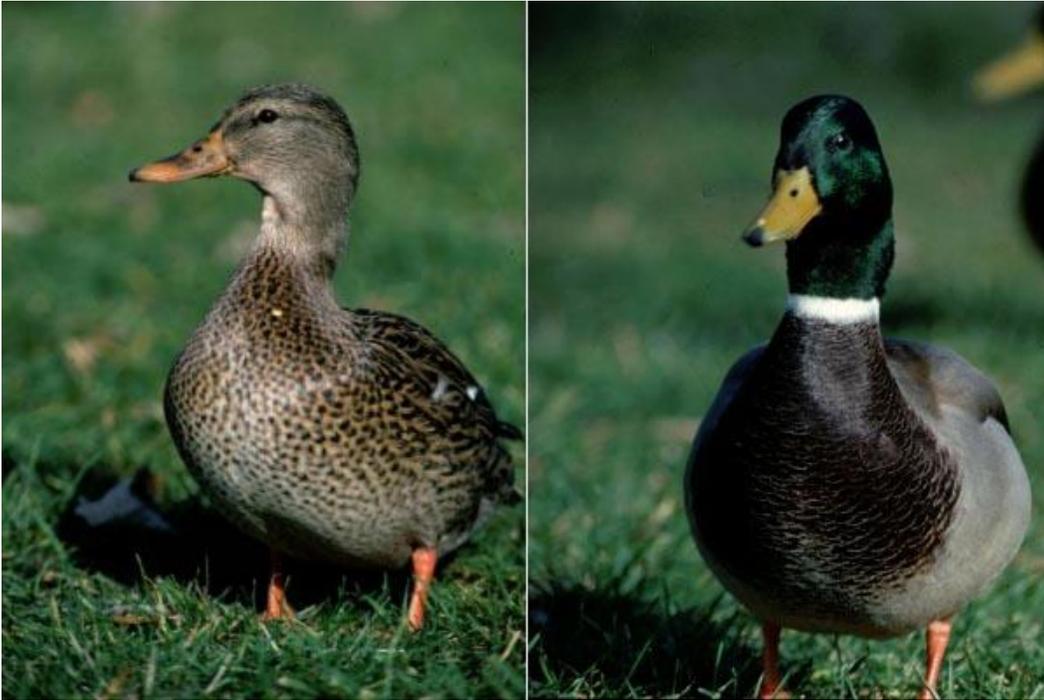
Secretive marsh birds which include the King Rail (*Rallus elegans*), Virginia Rail (*R. limicolor*), Sora (*Porzana carolina*), American Bittern (*Botaurus lentiginosus*), Pied-billed Grebe (*Podilymbus podiceps*) and Common Moorhen (*Gallinula chloropus*) occupy wetlands throughout North America. Recent evidence suggests that most secretive marsh bird populations are in decline, which may be related to the decline of palustrine emergent wetlands in North America.

Recently in Arkansas, surveys of habitat use by secretive marsh birds were assessed in the Delta, however, secretive marsh bird distribution, abundance and habitat use outside of the Delta is poorly understood. As well, the effects of management practices being used on publicly owned wetland units in the Arkansas River Valley are also poorly understood for marsh birds.

In April-June 2009, we conducted surveys for marsh birds and collected habitat data on public lands along the western portion of the Arkansas River in Arkansas. We detected 136 marsh birds at 24 survey points. The management areas where we detected marsh birds were those where water was drawn down in the middle of the growing season (May-September) or those where the water was allowed to evaporate during the summer. The areas where the water was drawn down early in the growing season (January – April) had the fewest number of detections, except where the units contained pools of water that remained throughout the growing season; this was the case with Frog Bayou's Unit 3.

We will again survey the areas surveyed in 2009 in 2010. We will reposition a subset of our survey points to locations away from the levee. We will analyze the data using the program MARK to estimate probability of detection ( $p$ ) and occupancy ( $\psi$ ) of marsh birds in our study area and the habitat factors that affect occupancy. Guidelines for better marsh bird management will be offered.

*Wildlife*



*Female and Male Mallards*

**Movements of Mallards from Arkansas to their Breeding Grounds as Determined by Satellite and GPS transmissions**

<i>Funding Source:</i>	Arkansas Game and Fish Commission
<i>Project Duration:</i>	15 May 2009 to 1 June 2010
<i>Principal Investigator:</i>	DAVID G. KREMENTZ
<i>Co-Principal Investigator:</i>	LUKE W. NAYLOR
<i>Graduate Research Assistant:</i>	KWASI ASANTE (M.S. Student)

**Research Objectives:**

1. Track movements and distribution of migrating mallards in spring. Describe habitat characteristics of principle spring staging areas, nesting areas and post-nesting areas of adult female mallards migrating from Arkansas (Mississippi Alluvial Valley).
2. Track movements and distribution of migration mallards in fall. Determine proportionate use of fall migration corridors, staging areas and dispersal relative to habitat conditions.
3. Estimate efficiency of May survey to account for mallards migrating from Arkansas (Mississippi Alluvial Valley) by estimating distribution of marked adult female mallards between surveyed and unsurveyed regions during the May surveys.

**Management Implications:**

1. With a better understanding of mallard migration biology, managers can make adequate plans about the habitat management and land acquisition for mallards. This translates into

gains like the ability to document timing, duration and length of migration and also investigate sex- and year-specific variation in those variables.

### **Project Summary:**

Drilling *et al* (2002), categorizes the mallard (*Ana platyrhynchos*) as the most abundant, most sought-after and most hunted duck in North America. This view and many others like it, have necessitated managing agencies like the Canadian Wildlife Service (CWS) and the United States Fish and Wildlife Services (USFWS) attaching importance to the harvesting of this bird in order to optimally manage the population.

Mallard migration studies are largely based on migration surveys (Bellrose *et al.* 1961, Bellrose 1980), analyses of hunter-killed mallards. (Green and Krementz 2008), and on conventional VHF radio-telemetry (Dugger 1997). Important indicators such as the timing, routes taken and the behavior of the birds while on migration have yielded many results (Drilling *et al.* 2002). However, there still is a dearth of answers partly because the technologies required for more in-depth studies have until recently been unavailable to biologists (Dugger, 1997). Advancements in radiotelemetry and the Global Positioning System (GPS) have now availed to biologists the opportunity and access of conducting research on birds of relatively smaller body size like the mallard. The methodology includes banding captured mallards from Arkansas with Platform Transmitter Terminals (PTTs).

Two types of PTTs were used; 2004 – 2005 tagging was done with battery powered PTTs while solar-powered transmitters were used on tagging done from 2006 –2007. The transmitters upload the data to the ARGOS database system where it is then sent to the client for further processing. The data processing and plotting were done with ArcView GIS (ESRI, INC. Redlands, CA). The data was divided into spring summer and fall sections, after which season-specific analyses are conducted. For the spring analyses some 143 birds were analyzed. The mean date of departure from Arkansas was 19 March with a standard error of 1.01 days with a range from 18 February to 20 April. Birds on migration typically stopped and continued until the last location in the spring. On the average, birds stopped for 9 days (S.E = 0.54) with a range of 2 –54 days; with no effect of sex nor year. There were birds that made non-stop flights; flying a mean distance of 883km (ranging from 571 – 1156km) to their nesting locations.

General patterns for rate of migration measured in km/day were similar by both year and sex. Overall, we concluded that mallard spring migration in Arkansas began as early as February and continued through March ending abruptly in April. Our ability to document non-stop migrations was hampered by the longer duty-cycle of the transmitters. In spite of this short-coming, we did document 8 cases of mallards flying non-stop to their nesting locations. The typical pattern of migration was for mallards to initially fly over the Ozark Mountains and make a series of short distance migrations until they reached the breeding grounds in the Prairie Pothole Region.

## Wildlife



*Wilson snipe observed in Tate County, Mississippi. February 2010*

### **Development of a Winter Survey for Wilson's Snipe in the Mississippi Flyway**

<i>Funding Source:</i>	US Geological Survey
<i>Project Duration:</i>	January 2009 to May 2011
<i>Principal Investigator:</i>	DAVID G. KREMENTZ
<i>Graduate Research Assistant:</i>	J. MATTHEW CARROLL (M.S. Student)

### **Research Objectives**

1. To gain population abundance estimates for wintering snipe in the Mississippi Flyway.
2. To determine the need for including survey-specific covariates into the survey approach.
3. To examine the factors that may affect variation for differing yearly abundance estimates at individual sites.

### **Project Summary**

Despite being widespread and relatively important in the bag of webless game birds, the Wilson's snipe (*Gallinago delicata*) is one of the least studied North American game birds. To date there are no reliable estimates of population numbers or trends for the snipe, and the only continent wide trend survey for snipe is the Christmas Bird Count (CBC) which was not designed for surveying snipe. However, the CBC indicates that snipe significantly declined between 1959 and 1988. Prior research has indicated that mid winter (primarily February) is the best time to conduct surveys for snipe due to the comparative stability of the population.

During January and February 2009, we conducted line transect surveys for Wilson's snipe in the lower Mississippi Alluvial Valley in Arkansas, Mississippi, and Louisiana, as well as, coastal Louisiana and the Red River region of Louisiana. Line transects 1.8 km in length accounted for over 700 km of survey effort. Overall, we detected 1492 individual snipe in 49 townships throughout Arkansas, Mississippi and Louisiana. Our 2 highest counts included 338 snipe in a township near Turrell, Arkansas and 232 snipe in a township near Hollandale, Mississippi. Snipe were detected in 47% of townships surveyed. Using program DISTANCE, we estimated 0.91 (2.45 SE) snipe per square kilometer with a mean cluster size of 1.82 (0.73 SE).

We recorded habitat covariates including habitat type, water cover, water depth, and vegetation cover. Most snipe (91%) were detected in association with shallow standing water. General agricultural habitats defined as crop fields (including rice) and pasture had the highest number of snipe comprising 95% of the total number of snipe detected. Comparing habitat available with numbers of snipe detected, we noted that snipe appeared to use agriculture more often than available.

In 2010, survey coverage was increased within the original study area by 37 townships. We detected 2484 snipe in 84 townships. Our increased effort resulted in 705 surveys for ~1200 km of survey effort.

We detected 1084 snipe in the townships that were repeated from 2009. Snipe were detected in 51% of the 47 townships surveyed. Due to poor road conditions and flooding, 2 of the 49 townships surveyed in 2009 were not surveyed in 2010. Also, several individual transects in some townships were not surveyed. Because of this, survey effort for repeated townships was less than in 2009 (657 km). We detected 1400 snipe in the 37 added townships. We detected snipe in 60% of these townships. These surveys accounted for ~600 km of survey effort. Our 2 highest counts included 343 snipe in a township near De Witt, Arkansas and 250 snipe in a township near Rolling Fork, Mississippi. Most snipe (98%) were detected in association with shallow standing water. General agricultural habitats defined as crop fields (including rice) and pasture accounted for 97% of the snipe detected.

We will use Program DISTANCE to estimate snipe density for the 2010 surveys. Factors affecting yearly variation of abundance estimates at individual sites will be analyzed. Analysis of habitat data and survey covariates is underway.

*Wildlife*



*King Rail detected BK Leach Conservation Area (Bittern Basin Unit), Elsberry, MO.*

**Assessing an Expert-Based Landscape Approach to Predict King Rail Habitat in the Upper Mississippi River/Great Lakes Joint Venture**

<i>Funding Source:</i>	U.S. Fish & Wildlife Service
<i>Project Duration:</i>	January 2008 to September 2010
<i>Principal Investigator:</i>	DAVID G. KREMENTZ
<i>Graduate Research Assistant:</i>	JASON R. BOLENBAUGH (M.S. Student)

**Research Objective:**

1. To evaluate the predictive ability of the king rail Landscape Suitability Index (LSI) model.
2. To determine the distribution of the king rail in the Upper Mississippi River/Great Lakes Region Joint Venture (JV).
3. To identify areas of high king rail abundance within the JV.
4. To provide recommendations that will assist in creating a more reliable LSI model for future king rail management.

**Management Implications:**

1. The information gathered will allow federal and state agencies to better assess the current status of king rails throughout the JV.
2. The information gathered will also allow the JV to assess the current LSI model and make possible improvements for future king rail management.
3. The habitat use information will allow agencies to better manage for king rails throughout the JV.

## Project Summary:

Recent advances in geographic information systems (GIS) and remote sensing technologies have enabled researchers to use sampling strategies that result in inferences over large landscapes. When combined with predictive models such as Landscape Suitability Index (LSI) models, researchers can examine how occupancy of target species relates to varying habitats across the landscape. LSI models can be especially important when managing for rare species, such as the king rail, and can be used to facilitate protection and restoration of critical habitats.

My study area was located in the Upper Mississippi River/Great Lakes Joint Venture, hereafter referred to as the JV. The king rail population in this region is considered migratory, has an estimated population of ~350 individuals, and is considered threatened or endangered in 8 of the 10 states that comprise the JV. Severe population declines over the last 30 – 40 years have been attributed to habitat loss and degradation caused by agricultural practices and urban development.

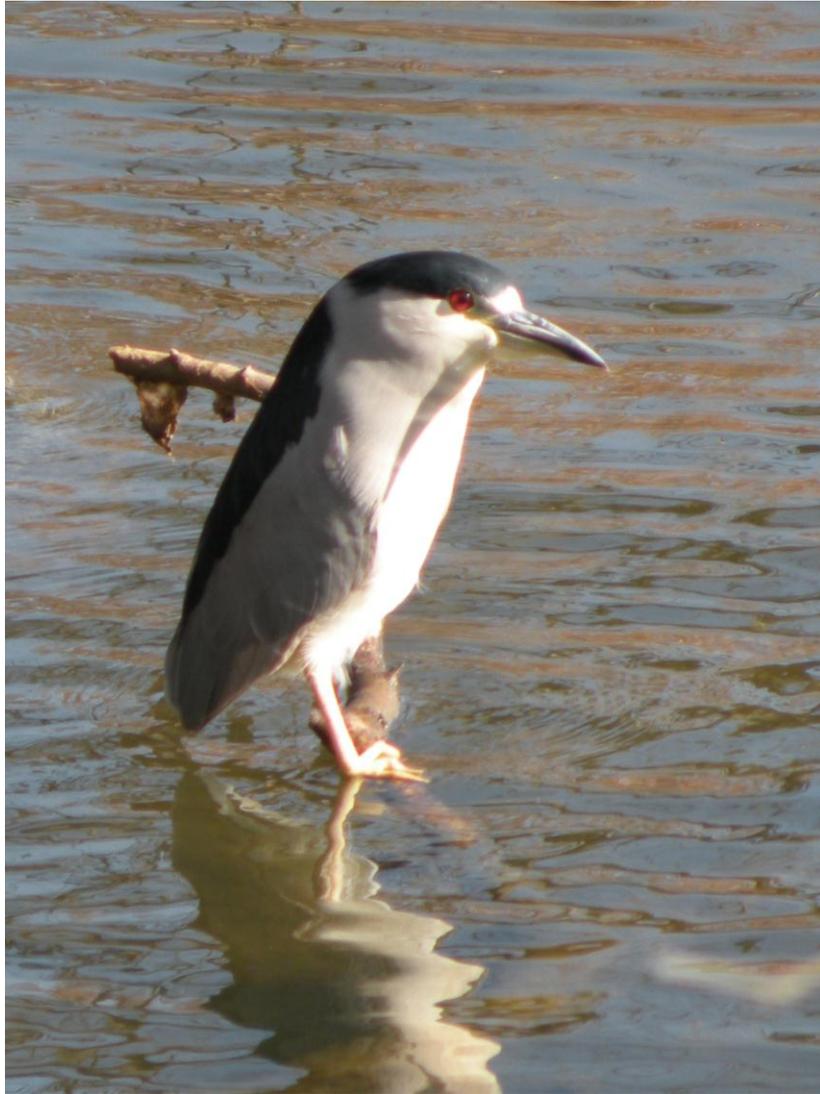
We conducted call-playback surveys from 4 May to 9 July 2009, following the North American Marsh Bird Monitoring Protocol. We surveyed 264 high, moderate, and low suitability sites on 3 separate occasions during either morning or evening. At each site we estimated local habitat variables such as the proportion of open water, short and tall emergent vegetation, woody vegetation, and interspersions within a 50-m radius centered at the survey point. We also used FRAGSTATS 3.3 to estimate landscape parameters within a 5-km radius believed to influence marsh bird occupancy. Nine species were broadcast: least bittern, yellow rail, sora, Virginia rail, king rail, American bittern, common moorhen, American coot, and pied-billed grebe.

We detected more marsh birds in 2009 ( $n = 924$ ) than in 2008 ( $n = 705$ ). We also detected more marsh birds per survey round in 2009 (Rd1 = 400, Rd2 = 359, Rd3 = 165) than in 2008 (Rd1 = 368, Rd2 = 200, Rd3 = 137) with both years experiencing similar declines in detection rates as the season progressed. Although overall detection increased, king rail detections decreased to only 5 in 2009 compared to 8 in 2008. We detected king rails at BK Leach Conservation Area (Bittern Basin Unit) in Elsberry, MO, and Goose Pond Fish & Wildlife Area in Linton, IN.

The most common marsh bird detected for the second straight season was the pied-billed grebe, 327 individuals at 102 sites. We detected 168 American coot at 71 sites, 115 soras at 59 sites, 96 Virginia rails at 52 sites, 81 American bitterns at 46 sites, 69 common moorhens at 35 sites, and 63 least bitterns at 39 sites. We did not detect any yellow rails in either year.

We are currently using the occupancy estimation module in program MARK to estimate detection probabilities and occupancy rates for each species for each season. This model incorporates site-specific and survey-specific covariates into the estimation of detection ( $p$ ) and occupancy ( $\psi$ ) that allow us to assess which covariates influence marsh bird occupancy.

# NEW PROJECTS



*Black-crowned Night-Heron*

*Wildlife*



*Bristle-thighed Curlew*

**Habitat and Population Assessments of Bristle-thighed Curlew Breeding in the Southern Nulato Hills, Alaska**

<i>Funding Source:</i>	U.S. Fish and Wildlife Service
<i>Project Duration:</i>	January 2010 to May 2013
<i>Principal Investigator:</i>	DAVID G. KREMENTZ
<i>Graduate Research Assistant:</i>	JAKE F. JUNG (Ph.D. Student)

**Research Objectives:**

1. To estimate population size and trends for Bristle-thighed Curlew breeding in the southern Nulato Hills, Alaska
2. To determine demographic rates (nest success, fledgling success, and adult annual survival) for input into a demographic population model
3. Determine if habitat changes on the breeding grounds have occurred due to global climate change

**Management Implications:**

1. To determine if the population is declining and is in need of listing under the Endangered Species Act
2. To better understand breeding ecology and habitat requirements of Bristle-thighed Curlews
3. Determine proper management for curlews if habitats are changing as a result of global warming

**Project Summary:**

Bristle-thighed Curlews (*Numenius tahitiensis*) (BTCU) have become of interest to conservationists in recent years due to their low breeding population. Very little is known of BTCU compared to other species of shorebirds, mostly due to their remote breeding and wintering grounds. Bristle-thighs winter on remote islands in the central and south Pacific, including the Northwestern Hawaiian Islands and Marshall Islands. From the wintering grounds, BTCU have one of the longest migrations of any bird to their breeding grounds in western Alaska, with some flying non-stop for >6,000 km.

Bristle-thighed Curlews have two disjunct breeding grounds, one on the Seward Peninsula and the other in the Nulato Hills located in the Andreafsky Wilderness of the Yukon Delta National Wildlife Refuge. The Nulato Hills contain the larger of the two breeding populations and also the highest nesting density. Birds begin arriving to the breeding grounds from early-mid May with nest initiation occurring soon after arrival. Breeding areas are characterized by series of hills containing upland tundra with sparse vegetation at higher elevations to more shrub thickets at lower elevations and near drainages, with nests located most often in dwarf-shrub meadows. There have been few population assessments with the latest population estimates being only 3500 breeding pairs. Introduction of exotic species such as feral cats, dogs, and pigs to the wintering grounds has led to increased predation and the fear that the population may be declining. Another recent concern is that large shrubs and trees are intruding into the tundra where BTCU breed as a result of global warming. In recent years major climate changes have occurred in Alaska leading to this shift in vegetation. Global warming could be altering BTCU habitat with the intrusion of trees and tall shrubs into the tundra habitats, increases of graminoids into the tundra, higher frequency of wildfires, and modification of food sources, mainly berry production. These vegetation changes may have a significant effect on BTCU breeding and nest success. These concerns have led BTCU to become a Category 2 candidate for the United States Department of the Interior List of Endangered and Threatened Wildlife. In addition, BTCU are considered a species of great conservation concern by the U.S. Fish and Wildlife Service, International Union for Conservation of Nature and Natural Resources, U.S. Shorebird Conservation Plan, South Pacific Regional Environmental Program, Alaska Shorebird Plan, and Audubon Alaska.

Point counts will be conducted at the Allen Creek study site located within the Andreafsky Wilderness area to compare previous counts from 1993-94. Line transects will also be conducted between point counts. Nests that are discovered will be monitored for success and input into a demographic model. Territory mapping will be conducted to determine nesting density and to generate a population estimate. Upon brood-rearing, play-back calls will be given near located curlews to entice mobbing behavior, at which point attempts will be made to capture birds using mist-nets. Captured adults will be given a federal metal band along with a green leg flag that has a unique alpha-numeric code. Leg-banded curlews will provide a means for a detectability estimate that can be used for region-wide point count surveys. Habitat analysis will be conducted with current and past images using ArcGIS 9.3 to evaluate changes in vegetation on the breeding grounds in association with global climate change.

*Fisheries*



*Bear Creek in the Boston Mountains*

**Ecological Limits of Hydrologic Alteration (ELOHA)**

<i>Funding Source:</i>	Arkansas Game and Fish Commission
<i>Project Duration:</i>	July 2009 to June 2010
<i>Principal Investigator:</i>	DANIEL D. MAGOULICK
<i>Post-doctoral research associate:</i>	SCOTT LONGING

**Objectives:**

1. Determine hydrology and biology database occurrence, quality and usefulness in Arkansas.

**Management Implications:**

1. Results will determine whether databases are adequate for ELOHA or similar approach.

**Project Summary:**

This project has been initiated on a national scale and the Coop Unit has taken a leading role in Arkansas efforts. A proposal related to this research has been submitted to the AGFC State Wildlife Grant Program (see below). Activities conducted to date include inventories of hydrological and biological data sources by the Arkansas Environmental Flow Team.

Specific activities conducted by the Coop Unit for ELOHA include literature reviews and data acquisition from ADEQ and the USGS NAWQA program. Site locations and inventories of fish and macroinvertebrate data were acquired from the ADEQ online database. NAWQA

data was acquired online (facilitated by Jim Peterson) and was associated with three sites that replicated reaches within streams. The latter data will allow analyses of within-stream variation in macroinvertebrate assemblages, although at a limited number of sites. Determining within stream variability of macroinvertebrates is important to guide future sampling and to validate the use of single reach sampling for future assessments, monitoring, and community inventories. Moreover, it supports accurate assessments of taxonomic richness and biological traits representative of communities shaped by particular long-term flow regimes. GPS coordinates for all fish and macroinvertebrate collection sites from ADEQ and USGS “site Information” (from NWIS including GPS coordinates) have been compiled.

Associated products of these ELOHA-associated activities are two EndNote libraries, one for “ELOHA” and one for “Climate Change.” While the former should contain much information on the current state of the science and activities related to ELOHA (n = 79 articles), the latter (n = 63) contains some pertinent reviews of climate change effects on biota and ecosystems but are inherently limited in scope considering the potentially large number of contemporary climate change studies. Furthermore, the ELOHA body of literature will guide the initial phases of the proposed ELOHA work for Arkansas.



*Big Creek Crayfish*

**Is Interspecific Competition a Mechanism of Displacement of Imperiled Big Creek Crayfish by Invasive Alien Woodland Crayfish in The St. Francis River Drainage?**

*Funding Source:*

Missouri Department of Conservation

*Project Duration:*

July 2009 to June 2010

*Principal Investigator:*

DANIEL D. MAGOULICK, ROBERT J. DISTEFANO

*Graduate student:*

JACOB WESTHOFF (Ph.D. Student)

**Objectives:**

1. Determine effects of invasive woodland crayfish on growth and survival of native Big Creek crayfish.
2. Determine ability of woodland crayfish to grow and survive in their former native range.

**Management Implications:**

1. Results should determine mechanisms responsible for the disappearance of the imperiled *O. peruncus* from St. Francis River drainage streams.
2. Results will allow managers to identify conservation/management alternatives.

**Project Summary:**

We conducted a field experiment to determine if native *O. peruncus* can survive and grow in both the absence and presence of competitive interactions with *O. hylas* in two stream segment sites (middle Carver Creek and upper Big Creek) where *O. peruncus* has been extirpated (their former range) and *O. hylas* has invaded. We used 0.71 m long x 0.40 m wide

x 0.21 m high wire-cloth enclosures (0.28 m<sup>2</sup>), secured to the stream bottom, to contain experimental crayfish. Each enclosure will constitute an experimental unit with a block design employing four experimental treatments per block (or site). Treatments were structured as follows:

- 1) low density control = 8 native male YOY *O. peruncus*
- 2) high density control = 16 native male YOY *O. peruncus*
- 3) low density interspecific = 4 native male YOY *O. peruncus* and 4 invasive male YOY *O. hylas*
- 4) high density interspecific = 8 native male YOY *O. peruncus* and 8 invasive male YOY *O. hylas*

Stocking densities were selected to emulate a range of natural densities measured for these species in these and other streams during summer 2008.

Prior to random assignment to enclosures, each crayfish was wet-weighed (nearest 0.1 g) after “blotting” on paper towels for approximately 10 seconds, and measured (CL). Because *O. peruncus* and *O. hylas* are difficult to distinguish as juveniles, all crayfish were marked with a uropod clip that will identify species. Each enclosure contained a single 9 cm x 20 cm brick paving tile to provide a substrate for periphyton growth, and a standard 4-L volume of gravel and pebble collected from each site to provide shelter for crayfish.

The experiment was conducted from early July 7 through Sept. 29, a period that incorporated the majority of the growing season. Enclosures were “conditioned” for three weeks prior to initiation of the experiment to permit accumulation of natural crayfish foods (periphyton, invertebrates). At initiation and termination of the study, current velocity and depth were measured at each enclosure location, and dissolved oxygen, pH and conductivity were measured at the site. These variables will be compared among sites with ANOVA. Water temperature was measured throughout the experiment duration using two remote temperature loggers at each site to calculate and compare cumulative degree days for each site. Survival (%) and growth (weight and CL) served as response variables, and were determined for crayfish in each enclosure every four weeks throughout the study (3 post-initiation sampling events). Growth values for crayfish in a given enclosure (treatment) will be averaged for that enclosure. Analysis will be conducted using a randomized block repeated measures ANOVA design, where each site will be considered a block to remove variation among sites.



*Coldwater Crayfish*

**Distribution of the Imperiled Coldwater Crayfish (*Orconectes eupunctus*) in the Black River Drainage of Missouri and Arkansas: Examination of Occupancy Estimation**

*Funding Source:*

Missouri Department of Conservation

*Project Duration:*

July 2009 to June 2010

*Principal Investigator:*

DANIEL D. MAGOULICK, ROBERT J. DISTEFANO

*Graduate student:*

JACOB WESTHOFF (Ph.D. Student)

**Objectives:**

1. Determine effectiveness of occupancy estimation approach for determining distribution of coldwater crayfish.
2. Determine important covariates of occupancy for coldwater crayfish.

**Management Implications:**

1. Results will inform a proposed larger study to examine population ecology of coldwater crayfish.
2. Results will allow determination of needed samples sizes for occupancy estimation for coldwater crayfish.

**Project Summary:**

We determined distribution and abundance of populations of coldwater crayfish in the Eleven Point River using occupancy estimation methods by sampling stream segments. A minimum of three riffle habitats or “sites” (*sensu* MacKenzie et al. 2006) and three run sites

were identified within each sampling reach. Riffles and runs were delineated by qualitatively assessing depth and flow rate of the stream. We used a quantitative kicknet method to determine densities of crayfish in each stream segment. Crayfish were dislodged from a randomly chosen 1-m<sup>2</sup> quadrat “sub-sample” area by thoroughly kicking and disturbing the substrate directly upstream of a 1.5 x 1.0-m seine net (3-mm mesh). Replicate kicknet surveys consisting of multiple sub-samples were collected from each riffle or run site. Sampling will occur only in water depths of  $\leq 1$  m because we are unable to use the 1-m<sup>2</sup> kick seine in deeper water.

At all sampling reaches, physical characteristics of riffle and run sites were collected. We will use crayfish presence data to estimate occupancy rates using program PRESENCE. Relationships between occupancy rates and environmental variables will be determined using covariates. We will use power analysis to determine needed sample sizes for additional proposed work.



*Ringed Crayfish*

**Could displacement of the Coldwater crayfish by the Ringed Crayfish affect ecosystem structure and function in the South Fork Spring River, Arkansas and Missouri, USA?**

<i>Funding Source:</i>	Arkansas Game and Fish Commission
<i>Project Duration:</i>	July 2009 to June 2010
<i>Principal Investigator:</i>	DANIEL D. MAGOULICK
<i>Post-doctoral research associate:</i>	SCOTT LONGING

**Objectives:**

1. Determine affects of introduced and native crayfish on stream ecosystem structure and function.
2. Are the coldwater crayfish and the ringed crayfish ecologically redundant?

**Management Implications:**

1. Results will indicate whether the invasive coldwater crayfish performs different functions to the native coldwater crayfish that is being displaced.
2. Results will give insight into affects of crayfish on stream ecosystem structure and function.
3. Results will provide managers information regarding negative impacts, or lack thereof, of introduced crayfish.

**Project Summary:**

In fall 2009 30, 100-L mesocosm were established to investigate the ecological redundancy of *Orconectes eupunctus* and *O. neglectus*, measured as leafpack decomposition, algal growth

on tiles, chlorophyll a on tiles, and in addition crayfish growth and mortality. The experimental treatments were eight individuals per species per mesocosm (N = 10) and a no-crayfish control (N = 10). The mesocosms were set up and maintained during approximately three weeks before crayfish were added. The tiles were placed in the mesocosms two weeks before crayfish introduction and the leafpacks were added one week prior to crayfish introduction.

Large amounts of algae were observed on both the substrate and mesocosm walls during the initial period and throughout the 30 d experiment. Data analysis revealed only very small amounts of chlorophyll-a and algal biomass on tiles. We are currently evaluating alternative techniques for growing algae on tiles: keeping the mesocosms in total shade during the initial period, and introducing algal covered tiles onto algal free substrate and mesocosms. For the latter, growth of algae has been monitored on 60 tiles in a pool separate from the mesocosm using a low-nutrient solution. Moderate algal growth has been observed on tiles after six weeks, and the light limited mesocosms have maintained algae-free substrate. We concluded that the heavy accumulations of algae during the initial experiment was because the substrate was heavily seeded with algal endospores, likely attributed to the substrate being housed in the greenhouse for almost two years and being used in previous experiments. Therefore, replacing or cleaning the substrate prior to experimentation might be required to limit initial algal growth in the mesocosms and to establish more appropriate baseline conditions while focusing crayfish feeding on tiles.

Some interesting findings from the experiment was the apparent facilitation of algal growth (chlorophyll-a) by crayfish, where both species were significantly different from the control, having higher concentrations of chlorophyll-a. In addition, leafpack decomposition was not significantly different between the two species.

# PRODUCTIVITY



*Virginia Rail at Fish Point Wildlife Area, MI*

## HONORS AND AWARDS

**Magoulick, D.D.** – USGS STAR Award, 2009

## COURSES TAUGHT

**Krementz, D.G.** – Wetland Ecology – Spring 2009

**Lehnen, S.E.** – Seminar: Using Program R for Data Analysis – Spring 2009

## PUBLICATIONS AND PROFESSIONAL PAPERS PRESENTED

### Scientific Publications

Kelley, Jr., J.R., S.J. Williamson, M. Banker, D.R. Dessecker, **D.G. Krementz**, D.G. McAuley, W.L. Palmer, T.J. Post. 2009. Implementing the American woodcock conservation plan. Transactions of the North American Wildlife and Natural Resource Conference. In press.

Darrah, A.J., and **D.G. Krementz**. 2009. Distribution and habitat use of king rails in the Illinois and Upper Mississippi River Valleys. *Journal of Wildlife Management*. 73:1380-1386.

**Dekar, M.P., D.D. Magoulick** and G.R. Huxel. 2009. Shifts in the trophic base of intermittent stream food webs. *Hydrobiologia* 635:263-277.

Larson, E.R., **D.D. Magoulick**, C. Turner and K.H. Laycock. 2009. Disturbance and species displacement: different tolerances to stream drying and dessication between a native and invasive crayfish. *Freshwater Biology* 54:1899-1908.

**Ludlam, J.P. and D.D. Magoulick**. 2009. Effects of fish and crayfish on benthic communities during stream drying: Importance of spatial and temporal variation. *Journal of the North American Benthological Society* 28:371-382.

DiStefano, R.J., **D.D. Magoulick**, E.M. Imhoff, and E.R. Larson. 2009. Imperiled crayfishes use hyporheic zone during seasonal drying of an intermittent stream. *Journal of the North American Benthological Society* 28:142-152.

Larson, E.R. and **D.D. Magoulick**. 2009. Does juvenile competition explain displacement of a native crayfish by an introduced crayfish? *Biological Invasions* 11:725-735.

## Theses and Dissertations

**Dekar, M.P.** 2009. Spatial and temporal variation in the structure of stream food webs: Investigating the effects of shifting basal resources and predation from a top predator, the river otter (*Lontra Canadensis*). Ph.D. Thesis, University of Arkansas.

**Ludlam, J.P.** 2009. Effects of fish and crayfish on ecosystem structure and function during stream drying. Ph.D. Thesis, University of Arkansas.

## Papers Presented

**Magoulick, D.D.,** S.W. Hodges, M.K. Scot, C.M. Bare, **M.P. Dekar,** and G.R. Huxel. 2009. Forecasting effects of global climate change on fish refuge use and species persistence. IUCN Symposium on Challenges and opportunities in conserving the indigenous freshwater fishes of Australia, Adelaide, Australia.

**Magoulick, D.D.** and **J.P. Ludlam.** 2009. Effects of disturbance and consumer identity on stream ecosystem structure and function. North American Benthological Society, Grand Rapids, Michigan

**Magoulick, D.D.,** S.W. Hodges, M.K. Scott, C.M. Bare, **M.P. Dekar,** and G.R. Huxel. 2009. Effects of stream drying on fish refuge use and species persistence: forecasting effects of global climate change. Griffith University, Brisbane, Australia & University of Washington.

**Magoulick, D.D.** and **J.P. Ludlam.** 2009. Effects of consumers and drying disturbance on stream ecosystem structure and function. Charles Darwin University, Darwin, Australia.

**Magoulick, D.D.,** E.R. Larson, M.R. Rabalais, C. Turner and K.H. Laycock. 2009. Disturbance and species displacement: Differential effects of stream drying and predation on native and invasive crayfishes. University of Melbourne, Australia.

**Magoulick, D.D.** 2009. Impact of invasive crayfish on native crayfish. U.S. Fish and Wildlife Service webinar series.

## Posters Presented

Banks, B.T., **J.P. Ludlam,** and **D.D. Magoulick.** 2009. Effects of crayfish density on benthic periphyton. 93<sup>rd</sup> Annual Meeting of the Arkansas Academy of Science, April 3-4, 2009, Clarksville, AR.

**Krementz, D.G. K.Asante,** and L.W. Naylor. 2009. Satellite tracking mallards from Arkansas during spring and fall migration. North American Duck Symposium.

## **Committees/Task Forces/Recovery Teams**

**Ludlam, J.P.** – Scientific advisor with Black Creek Land Trust, Darlington, South Carolina

**Bolenbaugh, J.R.** – President, The Wildlife Society, University of Arkansas, 2008-2009

**Krementz, D.G.** – Priority Information Needs for American Woodcock Funding Strategy Workshop, 2009

**Krementz, D.G.** – West Gulf Coastal Plain/Ouachita Landbird Technical Working Group, 2009

**Krementz, D.G.** – Facilities Committee, 2008-2009

**Krementz, D.G.** – Woodcock Harvest Strategy Working Group, 2008-present.

**Krementz, D.G.** – Chair of Webless Committee of the Mississippi Flyway Technical Section. 1999-present.

**Magoulick, D.D.** – Graduate Studies Committee, 2005-present

**Magoulick, D.D.** – Graduate Studies Committee, Vice Chair, 2006-present

## **TECHNICAL ASSISTANCE**

### **Training Offered**

**Krementz, D.G.** and S. King. 2009. King rail ecology and management. National Conservation Training Center Webinar Series.

**Magoulick, D.D.** 2009. Impact of Invasive Crayfish on Native Crayfish. U.S. Fish and Wildlife Service web seminar series.

### **Training Received**

**Krementz, D.G.** – Program R seminar, University of Arkansas, 2009

**Magoulick, D.D.** – Program R seminar, University of Arkansas, 2009