Report of Activities
October 2006 – September 2007

alabama
cooperative
fish and wildlife
research unit

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Griffin Shreves III

Alabama Cooperative Fish and Wildlife Research Unit

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U.S. Geological Survey
Alabama Department of Conservation and Natural Resources, Wildlife and Freshwater Fisheries Division
Auburn University
Wildlife Management Institute
U.S. Fish and Wildlife Service

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Program Direction Statement

The Cooperative Fish and Wildlife Research Unit program facilitates cooperation among the U.S. Geological Survey, Biological Resources Division; universities; state fish and wildlife agencies; and private organizations in programs of research and education related to fish and wildlife resource management. The objectives of the program are: 1) to conduct research on fish and wildlife ecology and to investigate the production, utilization, management, protection, and restoration of populations of fish and wildlife; 2) to provide technical and professional education and continuing education primarily on the graduate and professional level in the fields of fish and wildlife management, teaching, research, demonstration and administration; and 3) to make facts, methods, and new findings discovered through research available to scientists, landowners, sportsmen, outdoor recreationists, conservationists, extension workers, teachers, and local, state and federal agencies. The Unit shall also continue to work closely with the U.S. Fish and Wildlife Service to be informed of, and where requested, assist with the development of that agency's initiatives ecosystem management system. The operations of the Alabama Unit are governed by a Coordinating Committee operating under a formal cooperative agreement signed by the U.S. Geological Survey, Biological Resources Division; Auburn University; the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries; U.S. Fish and Wildlife Service, and the Wildlife Management Institute.

The Alabama Unit has identified four areas in which to concentrate its research efforts: 1) determining the effects of forest management techniques on wildlife species, 2) investigating the ecology and management of stream corridors, 3) investigating the status, life history and habitat requirements, and of endangered or threatened species to obtain information necessary for the development of comprehensive recovery plans, and 4) investigating the ecology and management of fish and wildlife species on landscape scales. The Unit will not be restricted to these areas of investigation; however, it will work towards the development of comprehensive research programs in each.

Effects of Forest Management on Wildlife Populations

Approximately 70% of non-urban land in Alabama is forested, much of it managed intensively for the production of forest products. Wildlife populations can be valuable components of forestlands. However, in some forests wildlife may be quite scarce. The abundance of wildlife in woodlands depends upon available food and cover resources that are in turn determined by forest management practices. Timber management can have major impacts on wildlife populations, and information is required to enable adequate evaluation of these impacts and to permit provision for support of wildlife species in the timber program. Many questions need to be answered relative to the relationships between wildlife species or groups and timber management practices. The response of wildlife to such factors as rotation schedule, species composition of forests, burning and thinning schedules, snag retention or removal, and size of clear cuts, needs to be determined. Area sensitive species need to be identified and their area requirements determined. Response of wildlife species to reforestation efforts requires evaluation. Wildlife is of high economic and aesthetic value and represents an important component of our forest ecosystem. It is important that we obtain the necessary information to ensure the retention of wildlife populations as forest management intensifies.

Ecology and Management of Stream Corridors

A typical southeastern stream corridor is a wetland complex composed of flowing-water aquatic habitats, adjacent riparian habitats, and periodically flooded bottomland habitats. Also, any particular stream corridor is just a segment of a drainage system with a sequence of corridor zones associated with streams from headwaters to large rivers. Stream corridors are important sources of renewable resources such as commercial and recreational fisheries, aquatic-oriented wildlife, and terrestrial wildlife utilizing productive bottomland areas. In addition, stream corridors are highly valued recreation and aesthetic areas due to high biological productivity and landscape diversity.

Stream corridors have always been, and continue to be, the focus of many forms of economic and land developments that exert some effect on these systems. Impacts to stream and river systems basically stem from two general factors, altered hydrologic conditions (i.e., water quality and quantity) and physical alterations of streams and associated lands (e.g., agricultural plots, backwater draining, navigation improvements). Both land and water changes tend to influence the integrity of instream, riparian, and bottomland communities since all these habitats are dependent on water/land relationships. The natural flowing-water processes of erosion and deposition impose a dynamic character to instream, riparian, and bottomland habitats and their associated fish and wildlife communities. Human modifications to stream corridors tend to intensify this dynamic character and frequently require continual human intervention to maintain artificial stream corridor conditions.

The most pressing areas of research involving stream corridors concern the interactions between fish and wildlife communities and the physical and chemical processes of flowing waters. The Unit intends to develop research that integrates fish and wildlife resource characteristics and functions with the hydrologic processes that influence stream corridor habitats. Specific areas for development include: renewable resource management, conservation of species, preservation of communities, impact assessment and prediction of effects, and mitigation and restoration.

Endangered Species

One hundred sixteen* species or subspecies that occur in Alabama have been declared endangered or threatened by the federal government (Threatened and Endangered Species System, USFWS); included are **98** animals and **18** plants. Information on the status, habitat requirements, and life history of these taxa is required to permit identification and declaration of critical habitat and to enable the formulation of management practices providing for their protection and, where possible, eventual recovery. Three hundred three species appear on the list of species of greatest conservation need in Alabama. Addressing the needs of these species now may prevent the need for listing them as threatened or endangered in the future. Research needs vary greatly by taxon; however, the Unit is capable of enlisting a diversity of expertise in addressing identified needs. Research in this area will be developed primarily in response to specific requests for assistance by cooperating agencies.

Landscape Ecology

Traditionally, research in wildlife and fisheries has focused on population or community dynamics on relatively small or undefined spatial scales, with the size of a study area defined by protocols for collecting data or by management units such as forest stands or

agricultural fields. Recent work in the field of landscape ecology strongly suggests that many ecological processes of interest to wildlife and fisheries researchers and managers occur on a variety of spatial scales, ranging from local (e.g., stand-scale) to regional (e.g., landscape-scale) dynamics. Landscape processes often are an emergent ecological property that cannot be directly extrapolated from observations collected on small scales. Inferences from small-scale or aspatial studies could be misleading in addressing the large scale ecological effects of increasing urbanization, changes in land use, and habitat fragmentation evident on modern landscapes.

Recent advances in technology are making spatially explicit data covering large areas widely available at relatively low cost. These data and the tools required to access and interpret them are rapidly becoming essential and affordable to wildlife and fisheries biologists. The Unit will develop research that quantifies and evaluates large-scale, landscape processes for wild populations and the ecological communities that sustain them. The Unit will also be involved in other landscape approaches, including the development and application of spatially explicit, individual-based behavioral models and the use of landscape characteristics to predict the distribution of wild populations.

*Text in bold represents a revision.

EFFECTS OF FOREST MANAGEMENT ON WILDLIFE POPULATIONS

Mapping the distribution of longleaf ecosystems for herpetofauna conservation (new)

Funding Source: U.S. Fish and Wildlife Service

Principal Investigator: James B. Grand

Co-principal Investigator: Mark MacKenzie (Auburn University)

Research Assistant: Kevin Kleiner

Duration: August 2007 – August 2010

Over the last two centuries, the longleaf pine ecosystem has been dramatically altered by logging, replanting with other pine species, and fire suppression. Current estimates, suggest that longleaf occupies 5% of its pre-European settlement extent. This reduction in habitat has affected numerous birds, reptiles, and amphibians. The best known example of this is the red-cockaded woodpecker (*Picoides borealis)*, a federally endangered species that inhabits old growth longleaf pine woodlands. A reduction in the amount of habitat available to this species has led to corresponding reductions in population size.

The gopher tortoise (*Gopherus polyphemus*) and the black pine snake (*Pituophis melanoleucus lodingi*) are also longleaf ecosystem inhabitants whose abundance is in decline. Successful management of both the gopher tortoise and the black pine snake requires knowledge of the current distribution of the longleaf pine ecosystem. Currently, the course scale spatial distribution of longleaf pine can be obtained from the USDA Forest Service's Forest Inventory and Analysis Program (FIA, Prasad and Iverson 2003). While useful for visualizing where longleaf exists and perhaps planning at a regional scale, this product is not of sufficient resolution for site specific wildlife conservation and management. Another source that has the potential to provide the spatial distribution of longleaf pine is remote sensing. In 2005, John Hogland, a graduate student at Auburn University working with the Alabama Gap Analysis Project, created a fine-grain (30 meter) probability distribution of longleaf pine ecosystems (Hogland 2005). Currently, this is the only large extent, fine grain map of the current distribution of the longleaf pine ecosystem. The goal of this project is to assess what is mapped and what can be improved in the Hogland Longleaf Pine Ecosystem Map for the purpose of enhancing the ability to manage and conserve the gopher tortoise and black pine snake. Additionally, we intend to relate gopher tortoise burrow density to the improved predicted probability map.

Status - We have begun the process of collecting additional data for map assessment and potential improvement. Recently acquired data includes Forest Inventory and Analysis (FIA) plot data in Alabama and Florida, Mississippi Institute for Forest Inventory (MIFI) plot data, and U.S. Forest Service Continuous Inventory of Stand Condition (CISC) data. Additionally, an existing crosswalk of the Soil Survey Geographic Database (SSURGO) soil classes to a longleaf suitability index has been identified and we are currently planning to assemble the individual county soil maps and stratify by this layer in any subsequent image classification

Ecological assessment of habitats occupied by breeding birds at Redstone Arsenal, Alabama (new)

Funding Source: Department of Defense

Principal Investigator: Troy Best (Auburn University)

Graduate Students: Lisa A. McWilliams and Charles A. Kilgore

Duration: April 2007 – December 2008

The state of Alabama has one of the richest faunal biodiversities in the United States (Mirarchi 2004). There are 420 species of birds comprising the official American Ornithological Society state list (Mirarchi 2004). This is almost half the total species recognized for the continental United States by the American Birding Association.

Redstone Arsenal encompasses a variety of habitats within its 38,248 secured acres. It contains extensive wetland areas associated with the Tennessee River, several local springs, woodlands, and fields. The varied habitats attract a large percentage (~290 species) of Alabama's avifauna either as residents, migrants, or rare visitors (Porter 2001). The area's variable water levels of ponds, sinks, and cypress swamps, much of which is maintained by the Wheeler National Wildlife Refuge, attract many winter waterfowl, herons, egrets, and shorebirds (Porter 2001). The Redstone Arsenal area also attracts many raptors and passerines of both woodland and field species.

Twenty-eight species of birds are of special concern in Alabama. Many species of these birds of special concern may occur in the Redstone Arsenal area of the Tennessee Valley region. Alabama provides critical breeding, wintering, or migratory habitats necessary for the overall success of these species.

Considering the need for information on avian diversity and ecological associations in the region, an assessment of species present, distribution, breeding activity, habitats occupied, etc., is highly desirable. These data would be useful in developing management plans for the Redstone Arsenal, and would provide baseline data for comparisons and future research. This study will be a significant contribution to overall assessment of presence, distribution, breeding activities, and habitat associations of avian species of special concern in Alabama.

Status – Preliminary data on occurrence of birds at Redstone Arsenal were gathered during 2006 and 2007 incidental to research on bats. These data formed the basis for a preliminary report submitted to Redstone Arsenal in September 2007. During January-August 2008, field work will be conducted at Redstone Arsenal to assess species present, distribution on the facility, breeding activity, and habitats occupied. A final report will be submitted by 31 December 2008.

ECOLOGY AND MANAGEMENT OF STREAM CORRIDORS

Development of a monitoring plan to assess potential effects of co-generation plants on fish communities (completed)

Funding Source: Alabama Division of Wildlife and Fresh Water Fisheries

Principal Investigator: Elise Irwin

Research Associate: Kathryn Mickett

Duration: October 2004 – September 2006

The Mobile River Basin harbors fish communities that are diverse and high in endemism. Conservation of these resources has been identified as a priority by state and federal agencies. In addition, water resources are increasingly impacted by population growth, land-use changes, and other anthropomorphic impacts. However, monitoring plans that are sensitive to detecting changes in fish assemblages relative to impacts on water resources quality and quantity have not been developed and tested. The goal of this project is to develop a monitoring protocol to assess impacts to fish communities from proposed co-generation (COGEN) plants. Co-generation plants are power generating facilities that produce electricity and heat, usually in the form of steam. There are 24 ADEM permits for COGEN plants on record and all are located in proximity to streams in Alabama. It is unclear how much water will be withdrawn from streams for COGEN plants; however, water withdrawals may have negative impacts on fish communities (M. Freeman unpublished data). Specific objectives will be to: 1) Develop a monitoring protocol that incorporates detection, site occupancy rates and extinction/colonization probabilities for fishes; 2) Collect baseline data from multiple proposed COGEN sites using the developed protocol; and 3) Compare PAE data with backpack electro-fishing data collected by ADCNR.

Status - The final report for this project is complete. In 2005, we sampled 20 sites to collect baseline data from seven proposed or operational combined-cycle plants (formerly referred to as “co-generation” plants). In 2006, we concentrated sampling effort at six sites around three combined-cycle plants with active permits. A total of 72 fish species were collected and identified; occupancy rates (range: 0 to 1) and detection probabilities (range: 0 to 0.87) varied by sampling location and by species. Temperature was monitored and water samples collected at the discharge for two plants operated by Tenaska Energy in Autauga County, Alabama. Because of their potential for impact, we recommended that plants currently in operation should be monitored closely. A long-term monitoring protocol should include: 1) random selection of sample sites within a local basin, 2) repeated sampling over a short period of time, 3) measurement of habitat and environmental variables at each site, 4) annual sampling of selected sites, 5) calculation of species occupancy rates and rates of occupancy change (i.e., extinction and colonization), 6) identification of variables with the greatest impacts on populations, and 7) adjustment of management based on influencing variables.

Relations between occupancy rates, fish health and water quality parameters for fishes inhabiting Wheeler NWR (new)

Funding Source: U.S. Geological Survey, U.S. Fish and Wildlife Service

Principal Investigator: Elise Irwin

Research Associate: Kathryn Kennedy

Duration: August 2007 – December 2008

Wheeler National Wildlife Refuge (WNWR) located in North Alabama adjacent to Wheeler Reservoir on the Tennessee River encompasses 35,000 acres, and includes several satellite Refuges. During recent Biological Review of WNWR, recommendations were made to complete an assessment of occupancy rates and overall fish health in relation to water quality for nongame fishes on refuge lands. In addition to Wheeler Reservoir, streams that drain to the reservoir are located on refuge lands and current information is lacking regarding fish populations in these systems. Refuge personnel are also concerned about overall health of the aquatic systems on the Refuge and are interested in the incidence of disease or other abnormalities expressed by fishes inhabiting aquatic systems on the Refuge. It is hypothesized that water quality is compromised in several water bodies on the Refuge, therefore warranting a quantitative assessment of how water quality parameters may be affecting both fish occupancy rates and overall fish health.

The objective of this project is to estimate occupancy rates and health for fish species inhabiting Wheeler Reservoir and streams located on refuge lands. Specifically, we will 1) provide Refuge staff with probability of occurrence for each species in water bodies on the Refuge 2) conduct a fish health assessment for fishes encountered during the survey, 3) measure water quality parameters and other covariates that may affect occupancy and fish health at each site, and 4) investigate relations between physical and chemical characters of the streams and reservoir and fish population characters.

Status - We will begin sample collection of stream and reservoir fishes in spring 2008. A list of potential fishes will be developed from historic databases and expert opinion. Potential survey sites will be selected in a systematic random fashion and visited during a short temporal period (5-7 days) for collection of fish species. Water and sediment samples will be collected and analyzed; resulting parameters and other water characteristics collected *in situ* (e.g., temperature, conductivity) will be used as covariates for occupancy estimation and model selection. A modified fish health assessment index (HAI) will be calculated for a subsample of individuals of each fish species from each site. This health assessment considers gross abnormalities, parasites, and condition of internal organs. The health index values will be analyzed relative to water and sediment chemistry and other variables using categorical regression trees.

ENDANGERED/DECLINING POPULATIONS

Assessment of habitats in areas historically used by Ivory-billed Woodpeckers in southern and western Alabama and the Florida panhandle

Funding Source: US Fish and Wildlife Service

Principal Investigator: James B. Grand

Co-principal investigators: Geoffrey Hill

Duration: August 2006 – July 2008

The recent re-discovery of Ivory-billed Woodpeckers (IBWO) in Arkansas has spawned interest in surveys of suitable habitat within the former range of the species. In the mid- to late-1860s IBWO were shot along the Tombigbee River in Marengo County and the Warrior River west of Greensboro in Alabama. In 1907, one was reported killed in the Conecuh swamps north of Troy. Numerous birds were collected in river-swamps of the Florida panhandle during that time period. Large tracts of bottomland hardwoods and river-swamps still exist in the Tombigbee, Mobile, Tensaw, Black Warrior, Conecuh/ Escambia, Pea/Choctawhatchee, Appalachicola/Chipola, Rivers in Alabama and panhandle Florida.

IBWO are reclusive, wary, and easily confused with related Pileated Woodpeckers, which frequent habitats similar to those once occupied by IBWO. Due to presumably low numbers, reclusive behavior and similarity to Pileated Woodpeckers intensive monitoring techniques capable of recording evidence for later review are required. The objectives of this project are to: research and document historical and recent reports of IBWO along the rivers in Alabama and in panhandle Florida, estimate the extent or remaining mature, bottomland hardwood forest in suitable areas of Alabama and panhandle Florida with the historic range of IBWO using remotely-sensed data, conduct field searches for IBWO in areas of suitable habitat, and characterize the habitats associated with all potential IBWO observations and sign.

Status – We have gathered substantial evidence that Ivory-billed Woodpeckers persist in the forests along the Choctawhatchee River south of Interstate 10. At this point we know far too little about the foraging behavior of Ivory-billed Woodpeckers in this part of Florida to recommend any sort of detailed forest management such as girdling trees as has been done in Arkansas. We do feel confident in stating that these are shy birds that require large tracts of forest for survival. Our recommendations for management of the forested areas where we have found evidence for the existence of Ivory-billed Woodpeckers are: 1) Minimize disturbance on lands owned by the Northwest Florida Water Management District. 2) Exclude use of off-road vehicles from NWFWMD lands except on designated roadways. Hunting and fishing should be permitted because there is no evidence that these activities disturb Ivory-billed Woodpeckers and restricting such activities would alienate the many local people who enjoy such recreation. 3) Acquire areas of forest wetland not already owned by NWFWMD and land adjacent to forested wetlands. 4) Allow pine plantation on NWFWMD lands to mature, die, and be replaced by native vegetation through natural succession. As pine stands mature and die, foraging habitat for Ivory-billed Woodpeckers will likely be created.

Conservation genetics of the federally endangered Alabama leather flower, Clematis socialis

Funding Source: U.S. Fish and Wildlife Service

Principal Investigators: Robert Boyd and Leslie Goertzen (Auburn University)

Graduate Students: Irene (Rena) Miller

Research Technicians: Jennifer Trusty (Post-doctoral Associate)

Duration: April 2006 - December 2007

The endangered Alabama Leather Flower, Clematis socialis (USFWS1989) is found in five populations in three Alabama counties, Cherokee, Etowah and St. Clair, as well as in Floyd County, Georgia (Garrett 1004). In order to ensure the long-term preservation of this rare plant species, conservation programs based on informed management decisions are necessary. The success of these programs is dependent on knowledge of the genetic diversity within and among natural populations of these species. Expanding human populations in Alabama have directly impacted Clematis socialis through the loss of habitat to urbanization and by road building activities. What is unknown is how to best ensure the long-term survival of this species in the remaining populations. An analysis of the genetic diversity within and among populations of rare species is an important tool that can help direct conservation efforts. Maximizing the genetic diversity in ex-situ populations of this Clematis species is the best protection we can provide against future environmental challenges. In addition, reintroduction to extirpated sites will benefit from data on which genotypes were most likely found (and adapted) to that site and the amount of genetic diversity necessary to maintain the re-introduced populations into the future.

Status – To date, ten populations of Clematis socialis (nine in Alabama and one in Rome, Georgia) have been sampled, for a total of 145 individuals. Genomic DNA was extracted from all individuals and stored at -20°C at Auburn University. Genetic diversity within the nine AL populations has been estimated by two methods: examing ISSR marker (microsatellite flanking regions) length variation; and nucleotide diversity of SCAR markers (sequence-characterized amplified regions). Overall, Clematis socialis populations are highly variable with relatively little differentiation of individuals by population location. This could suggest gene flow (pollen or seed movement) among populations in the recent past, despite their apparent geographical distinctness. It may also indicate the recent fragmentation of a once more widespread species.

Irene Miller, graduate student, has now characterized genetic diversity within the ex situ C. socialis collections maintained at the Cincinnati Zoo. We are preparing a manuscript on the success of that ex situ conservation effort by examining its diversity within the context of C. socialis genetic diversity overall.

Endangered bats (Mammalia Chiroptera) at Redstone Arsenal, Alabama

Funding Source: Department of Defense

Principal Investigator: Troy Best (Auburn University)

Graduate Students: Sara Gardner, Charles Kilgore, Lisa McWilliams

Undergraduate Student: Amber C. Dunn

Duration: June 2005 –December 2007

Relatively little is known about the 15 species of bats in Alabama, but considerable research has been conducted within the past decade (e.g., Best et al., 1993, 1997; Best and Hudson, 1996; Durden et al., 1992; Gobel, 1996; Henry, 1998; Henry et al., 2000; Hilton, 1994; Hilton and Best, 2000; Kiser, 1996, 2000; Milam, 1996; Thomas, 1994; Thomas and Best, 2000). Bats occurring on Redstone Arsenal are of special interest because two endangered species are known from the area, the gray bat and the Indiana bat. In preparing management plans, it would be useful to know if both of these species are present and what habitats they may occupy.

Considering the need for information on bats in the region, a field survey of species present, distribution, habitats occupied, etc., would be highly desirable. These data would be useful in developing management plans for the Redstone Arsenal, and they would provide baseline data for comparisons and future research. This study would be a significant contribution to overall assessment of presence, distribution, and habitat associations of endangered bats in Alabama.

Status – The final year of data collection was completed in late summer 2007 and the annual report was submitted to Redstone Arsenal in September 2007. More than 200 sites were sampled and five species of bats were captured, including several endangered gray bats. A M.S. student in the Department of Biological Sciences currently is assessing relationships between distributions of bats and habitats where bats were captured and not captured. Completion of this thesis is expected in summer 2008.

Immune, stress and reproductive measures in gopher tortoises at Camp Shelby, Mississippi (completed)

Funding Source: Department of Energy

Principal Investigator: Mary Mendonca (Auburn University)

Graduate Student: Paula Kahn

Duration: April 2006 –July 2007

This study will focus on characterizing the immune response as well as sex steroid and adrenal steroid hormone profiles in gopher tortoises from a variety of anthropogenically impacted and non-impacted habitats at Camp Shelby, MS. It is part of a larger project conducted by Dr. Marshall Adams from the Oak Ridge National Laboratory (ORNL) and supported by the Strategic Environmental Research Program (SERDP) of the Dept. of Defense. The primary objective of this SERDP project is to develop and apply a suite of sensitive and quick-responding biomarkers and bio-indicators for Threatened and Endangered Species (TES) which are subjected to a variety of environmental stressors on military installations. To assess the health and fitness of gopher tortoises residing in areas subjected to different types and levels of stressors, bio-molecular, biochemical, physiological, immunological, histopathological, reproductive, and population-level responses are being measured from non-impacted reference areas and at areas experiencing different levels of military activities. The primary product of this study will be a bioassessment tool that can be used by environmental managers at military facilities to rapidly assess the possible effects of various military training and testing activities on the health of keystone TES such as the gopher tortoise.

Status – Project completed and final report submitted to Oak Ridge National Laboratory.

LANDSCAPE ECOLOGY

ACT Aquatic GAP and water quality modeling (completed)

Funding Source: Alabama Division of Wildlife and Freshwater Fisheries

Principal Investigator: Elise Irwin and Diane Hite (Auburn University)

Research Associate: Gareth Turner

Duration: October 2004 – September 2006

The Southeastern Aquatic GAP project was initiated to identify conservation areas in river basins where aquatic biodiversity and endemism are higher than other temperate rivers. As part of a regional assessment of the Alabama-Coosa-Tallapoosa (ACT) and Apalachicola-Chattahoochee-Flint (ACF) basins, we have developed techniques to incorporate geospatial data to analyze aquatic species distribution in relation to local and landscape features and identify conservation potential of specific subwatersheds. Two portions of the ACT have been completed under a previous contract with the U.S. Geological Survey; this project will assess an additional 27,700km² of large river basin habitat (25% of Alabama's riverine habitat) for conservation potential in Alabama. The resulting database will include species and community data for over 184 freshwater fishes and all mussel species from the ACT. Limited data on crayfishes and aquatic herpetofauna are also available for model construction. Completion of the ACT Aquatic GAP will allow for development of decision support systems (DSS) to help natural resource managers make informative decisions for land and riverine management and landscape level conservation planning. In addition, we will develop water quality-land use economic models that will be valuable for assessing restoration activities. Water quality models will also be applied to relate faunal distributions to landscape and land use variables (including economic assessment of land use and potential for land use change). These will be exceptional contributions to the DSS.

Status – Based on watershed characters, we constructed predictive models for the distributions of 79 fish species. Important predictive landscape variables included stream reach and watershed characters such as stream order, stream density (km/ha), road density (km/ha) and stream reach elevation (m). In addition, juxtaposition of habitats was important in prediction of species presence, including isolation of stream reach and link magnitude. Finally, Land Use/Land Cover (LULC) variables (e.g., % row crop agriculture or forested land) and parent geology (e.g., % felsic orthogneiss or cataclastic rock) were significant variables for predicting presence of many species. Total model error rates were low (< 23% overall) and given that error rates are an estimate of the uncertainty in prediction of species occurrence (in the form of a probability), these error rates can be directly incorporated into conservation decision making. The final report for this project is complete; it may be accessed at: http://www.outdooralabama.com/research-mgmt/State%20Wildlife%20Grants/ACT%20GAP%20Final%20Report.pdf. Maps depicting these predicted distributions were generated for use in conservation planning and decision-making, and are located at www.southeastaquaticgap.org/research.htm.

Gap Analysis for Alabama

Funding Source: U.S. Geological Survey

Principal Investigator: James B. Grand, Elise Irwin, Mike Mitchell, and Mark MacKenzie (Auburn University)

Project Coordinator: Amy Silvano

Research Assistant: Kevin Kleiner, Ben Taylor, Gareth Turner

Student: John Hogland

Student Workers: James Grand

Duration: August 2000 – December 2007

Alabama spans five physiographic provinces from the Coastal Plain through the Interior and Appalachian Low Plateaus, more than any other state. Within these provinces unique and often rare communities and diverse assemblages of plants and animals exist. Without adequate planning for conservation based on sound scientific information these communities may ultimately disappear. Gap analysis is directed towards identifying native animal species and natural communities that are underrepresented in conservation efforts. The objectives of the project are: (1) to promote cooperative approaches toward the development and use of Gap data, (2) to map the existing natural and semi-natural land cover; (3) to produce maps of the predicted distributions of every vertebrate species; (4) to map the ownership of public and private conservation lands; (5) to categorize all lands according to management status; (6) to produce a database of the total surface area and relative representation for each class of land cover and animal species relative to land stewardship categories; (7) to produce a written report of the mapping, assessment, analysis methods, results, accuracy, and limitations; and (8) to develop a plan for the maintenance and updating of the information.

Status – All products for the gap analysis have been completed, including the land cover map, vertebrate predicted distribution maps, and stewardship maps. Provisional versions of these data sets are currently available to the public for download from our website (www.auburn.edu/gap). A gap analysis of land cover and vertebrate species has been compiled and richness maps for each major taxa group and overall species richness have been generated. Metadata for each GAP component has been completed and a written report of our methods is currently underway. The final methods report will be turned into our National GAP office for review by year end 2007 and all GAP products will be considered provisional until the reviews have been completed.

Biodiversity of terrestrial vertebrates on the J.D. Martin Skyline Wildlife Management Area and adjacent lands

Funding Source: Alabama State Lands Division

Principal Investigator: James B. Grand, Eric Soerhen, and Yong Wang (Alabama A&M University)

Research Associate: Nick Sharp and Shannon Allen

Student(s): Alan Hitch (Ph.D.), Florence Chan (M.S. - AAMU)

Research Assistant(s): Megan Binkley, Helen Czech, Jeff Sorrell, Carrie Johnson, James Fuller

Duration: January 2005 – August 2008

Little has been published regarding the composition and habitat requirements of terrestrial vertebrate communities using the forests of the southwestern Appalachian Ecoregion in Alabama. This region represents the southernmost extent of the range for many species native to Appalachian Mountains. Thus, the native fauna and flora includes many vertebrates that are found nowhere else in the state. Recent land acquisitions in Jackson County bring the total acreage under state management on the Wildlife Management Area and Forever Wild lands to over 28,000 acres. We propose to perform a comprehensive inventory of terrestrial vertebrates using these lands based on methods that incorporate rigorous statistical design, and estimation of detection rates, which often obfuscate the results of wildlife inventories. Inventory data will be used to develop probabilistic models of wildlife habitat relationships that can in turn be used to map the distribution of the dominant ecological systems and animal communities on the area. These results will ultimately be used to develop a GIS for use in planning conservation and management based on high probability of use by high priority species and areas of high biodiversity. This is a collaborative project with the Alabama Lands Division Natural Heritage Program, and Alabama A & M University.

Status – Based on strata derived from models of landform and solar exposure a stratified-random selection of 176 points was selected for sampling over the 2005 and 2006 field seasons. Point counts methods were used to survey breeding birds twice during May 15-June 30 2005 and 2006. Line transect methods were used to survey reptiles and amphibians during April-July and again in August-November 2005 and 2006 at the same 88 points. Live traps were used to sample small mammals at 88 points 15 September-15 November 2005 and 2006. Vegetation was inventoried and classified all 176 points. These data will be used to validate land cover maps developed from the AL-Gap Project, and develop habitat relationship models after accounting for detectability of animals. Data and models will be used to develop a GIS suitable for making management decisions on the properties that were sampled. This project was extended one year and expanded to include a survey to examine differences in productivity of selected bird species among habitats on the study area. The additional survey was completed during summer 2007. Analysis of the distribution and abundance data is underway.

Adaptive management and monitoring for restoration and faunal recolonization of shoal habitats

Funding source: Alabama Power Company, Alabama Division of Wildlife and Freshwater Fisheries

Principal Investigator: Elise Irwin

Research Associate (s): Kathryn Mickett and Gareth Turner

Student (s): Taconya Piper (Ph.D.), Ben Martin (M.S.)

Duration: October 2006 – September 2011

High imperilment rates of fishes and mussels in the state of Alabama are related to impoundment and regulation of riverine flows. Specifically, the inundation and disruption of natural flow regimes of shoal habitats in medium sized rivers was hypothesized to be the primary cause for imperilment of 53% of fishes in Southeastern Rivers. In Alabama, loss of functional shoal has likely affected 64% of fish species of greatest conservation need (GCN). Restoration and protection of functional shoal habitat in the remaining unimpounded (i.e., free flowing) fragments of rivers of the State is a critical element of conservation of aquatic species. However, effects of specific flow regimes (i.e., magnitude, duration and timing and their combinations) on shoal habitats and ultimately on biotic processes are not well known. Mixed results regarding success of implementation of minimum flow regimes have illuminated the need for process oriented research that evaluate effects of flow regimes on aquatic fauna that depend on functional shoal habitat. In addition, these data would be transferable to the many shoal dependent GCN species in other river basins. Therefore, we propose to evaluate effects of experimental flow regimes on shoal dependent aquatic fauna in the Piedmont region of Tallapoosa River. Specific objectives are to: 1) Compare fish and invertebrate assemblages and population structure between flow-managed and naturally flowing river reaches (including all GNC species); 2) Assess habitat stability (i.e., shoals) and persistence for GCN species and other species of concern; and 3) Determine applicability of flow management and habitat restoration for other river systems.

Status - Extinction/colonization rates were estimated from a long-term (1981-1991) historical data set collected by backpack shocking after Harris Dam was constructed. Results indicated that for most species, group (regulated vs. unregulated) was not an important covariate for explaining the variation in the data. In addition, extinction and colonization were estimated as either equal or constant over all time periods, with colonization always greater than extinction when rates were constant. This suggests potential recovery for some species since the dam was constructed. Monitoring of flow management changes at Harris Dam has been conducted in both the spring and fall of 2005-2007. Results from 2005 indicated group (regulated vs. unregulated) and/or distance from the dam as important factors in explaining the variance in occupancy for several species, including black redhorse, speckled madtom, lipstick darter, and muscadine darter. In addition, spawning windows for fishes are being evaluated for GCN species from both assessment of reproductive condition of adults and collection and aging of juveniles. Data from 2006 and 2007 are currently being processed.

Inventory and conservation planning for species of greatest conservation need on Alabama DCNR lands

Funding Source: Alabama Division Wildlife and Freshwater Fisheries

Principal Investigator: James B. Grand

Co-principal investigators: Mike Gangloff, Craig Guyer, Elise Irwin, Carol Johnston, Mark MacKenzie, Ed Loewenstein

Project Coordinator: Amy Silvano

GIS Specialist: Gareth Turner

Graduate Students: Carrie Johnson, Patricia Spears, Dan Holt, Kevin White (Appalachian State), and 4 vacancies.

Duration: October 2006 – December 2011

During this five-year project the Alabama Cooperative Fish and Wildlife Research Unit will coordinate the development of multi-species Inventory and Conservation Plans (ICPs) for selected lands managed by the Alabama Department of Conservation and Natural Resources. The project will potentially include lands in six ecological regions, and could affect 303 species of greatest conservation need (GCN), of which 118 are listed as threatened or endangered. During the first year, a steering committee will be established, lands and species for inclusion in the plan will be identified, information needs assessment will begin, and an outreach plan will be developed. Subsequent years will be used to gather information and develop decision support tools, conduct outreach programs, and develop the ICPs.

The overall goal is to provide a science-based plan for the conservation of GCN species and the habitats they depend on as they occur or could occur on ADCNR managed lands. Additional goals are to establish a protocol and a baseline for monitoring GCN species, to provide a basis for the development of new ICPs, to provide guidance for the improvement of populations of GCN species, to improve upon our understanding of the issues affecting the conservation of GCN species, and to foster relationships among public and private stakeholders.

Status – The first year of the project has been dedicated to the identification of study sites, development of survey design, and assembly of GIS data. Two meetings were held with DCNR Steering Committee to select study areas and refine the project objectives. As a result, 13 study sites were selected on DCNR lands. Numerous meetings have been held with the Co-PIs to develop and refine the survey design and protocols and review the available GIS data. A stratified random sampling approach was selected for both aquatic and terrestrial surveys. Aquatic surveys will be stratified based on stream order and watersheds. Terrestrial surveys will be stratified using Alabama GAP land cover data and allocated based on expected species diversity. Six graduate students have been recruited for the project and two positions are vacant. Surveys will begin in January of 2007 on 4 study sites in southern Alabama.

OTHER PROJECTS

Ecology and management of feral hogs on Fort Benning, Georgia (completed)

Funding Source: U.S. Department of Defense, Fort Benning, Georgia

Principal Investigator: Stephen S. Ditchkoff (Auburn University), James B. Grand, Mike Mitchell

Students: Laura Hanson, Buck Jolley, Bill Sparklin

Duration: September 2003 – May 2007

Self-sustaining populations of feral swine have inhabited Fort Benning, Georgia, since at least the 1950s. Originating from free-ranging domesticated hogs and European boar (*Sus scrofa*) introduced for hunting, these populations recently have grown to the point where sightings are common and areas affected by their foraging are extensive. Because hogs forage by vigorous rooting, they can strongly affect their environment by disturbing soil, impeding regeneration of trees, disrupting understory plant communities, and altering habitat for numerous animal species. Of particular concern on Fort Benning, evidence is building that hog populations have the potential to strongly affect threatened and endangered animal and plant species such as the gopher tortoise (*Gopherus polyphemus*) and relict trillium (*Trillium reliquum*).

The goal of this project is to investigate the efficacy of removal for reducing the impact of feral hogs on threatened populations and sensitive habitats on the Fort Benning military installation. Currently, management of hogs on Fort Benning includes trapping and removal, as well as an open hunting season (over 2,000 hogs were harvested by hunters from 2001 to 2003). Future management efforts include increasing trapping efforts and broadening hunting opportunities, but the extent to which such efforts will be effective is unknown. The capacity for growth in a hog population is prodigious. Feral hogs breed throughout the year, and mature females can produce several litters of up to 16 piglets per year. The level of mortality needed to offset this potential depends on the size and demographic processes (i.e., annual survival, fertility, population growth rate) of the population, none of which are known. These processes must be understood before the number of removals needed to meet management goals can be estimated.

Status – We captured and marked approximately 300 feral hogs to facilitate mark-recapture efforts. These data indicate that feral hog populations are likely more sensitive to juvenile recruitment and survival than adult survival, where effort is normally targeted. We affixed GPS collars to approximately 35 female hogs, and examined aspects of their spatial ecology. These data indicate that female-juvenile sounders on the study area exhibit spatial patterns that are strikingly similar to species that are territorial, suggesting that traditional control efforts (shooting and trapping individuals) may not be the most effective approach. We also collected food habits data from over 200 individuals, and documented that feral pigs consume significant numbers of herpetofauna, and possess the potential to impact sensitive species.

M.S. Theses have been completed by Laura Hanson (2006) and Buck Jolley (2007). Bill Sparklin will complete his thesis during fall 2007.

Evaluation of Triclopyr Amine for controlling alligator weed (Altemanthera philoxeroides) and restoring native plants to wetlands at Eufaula National Wildlife Refuge (completed)

Funding Source: U.S. Fish and Wildlife Service, Eufaula National Wildlife Refuge, SePRO Corporation

Principal Investigator: Gary R. Hepp (Auburn University)

Student: Shannon Allen

Duration: August 2003 – August 2006

Eufaula National Wildlife Refuge (ENWR; 4526 ha) is located on the northern segment of Lake Eufaula, an impoundment of the Chattahoochee River. The primary management objective of ENWR is to provide habitat for waterfowl and other water birds. Alligator weed is an invasive nonindigenous species that has become a dominant plant in ENWR waterfowl impoundments. It provides little or no nutritional value and displaces native plants normally used as a food source, thereby degrading habitat quality for migrating waterfowl. In this study, I am evaluating application rates and application timing of the herbicides triclopyr amine (Renovate®) and imazapyr (Habitat®) for controlling alligator weed and restoring native plants to the waterfowl impoundments at ENWR.

Status – In moist-soil managed wetlands, we tested effects of application rate (high, medium and low) and timing (April and July) of triclopyr amine and imazapyr on controlling alligator weed and restoring native plants. In the year of treatment, imazapyr controlled alligator weed better than triclopyr amine when applied in April, but both herbicides applied in July were equally effective at controlling alligator weed. High application rate of herbicides in April controlled alligator weed better than the low application rate, but application rates of herbicides in July did not differ. In the year of treatment, application of triclopyr amine resulted in greater native plant biomass than imazapyr. High application rate of herbicides in April resulted in greater native plant biomass in the year of treatment than low application rate, but native plant biomass did not differ between application rates in July. One year after treatment, high application rate of herbicides resulted in less alligator weed than low application rate, and July application of either herbicide generally controlled alligator weed better than the April application. Application of imazapyr in July resulted in greater biomass of native plants one year after treatment than either imazapyr or triclopyr amine applied in April. This study demonstrates that single herbicide applications can be effective at controlling alligator weed and restoring native plants to managed wetlands.

Results were published in the journal *Wetlands*.

Abundance and habitat use of King Rails at Eufaula National Wildlife Refuge (completed)

Funding Source: U.S. Fish and Wildlife Service

Principal Investigator: Gary Hepp (Auburn University)

Student: Evan Wheeler

Duration: March 2006 – September 2006

Wetland losses have affected many bird species that depend on these habitats. Population levels of several species of marsh birds, including rails and bitterns, for example, appear to be declining. However, little is known about the ecological requirements of these secretive birds, and monitoring programs to determine their continental status are currently lacking. Many of these marsh birds are listed by the U.S. Fish and Wildlife Service as Birds of Management Concern (BMC). In fiscal year 2005-2006, the king rail (*Rallus elegans*) was placed on the focal species list, identifying this as a species in need of immediate attention by the conservation community. In this study, we initiated a survey to determine examine the status of king rail, black rail (*Laterallus jamaicensis*), least bittern (*Ixobrychus exilis*), and common moorhen (*Gallinula chloropus*) at Eufaula National Wildlife Refuge, and describe habitats used by these marsh birds.

Status - Survey points (n= 37) were established in the Bradley, Houston, and Kennedy Units of Eufaula National Wildlife Refuge. We conducted two complete surveys in each of three months (April, May and June) in 2006. Marsh bird sampling protocols established by Courtney Conway (USGS, Arizona Coop. Fish and Wildlife Research Unit) were used for the surveys. Morning surveys were conducted and began 30 min before sunrise and continued for approximately 3 hr. At each survey point, sampling began with a 5 min passive period followed by a 30 sec period in which calls of each species were broadcast. Call-broadcast surveys have been shown to increase detectability of individual marsh bird species. Each individual observed or heard during the survey period and estimated distance to the individual from the survey point were recorded.

Black rails and least bitterns were not recorded during the survey period. Thirty-nine king rails were observed or heard during the surveys. Only 10% (n = 4) of king rails were detected during the passive portion of the survey. Seventy-five common moorhens were observed or heard during the surveys, and 29% (n = 22) were detected during the passive portion of the survey. Incorporating broadcast calls to the survey substantially increased detection of these secretive marsh birds. Data analysis will continue, and the relationships between vegetation and water depth parameters will be determined.

A final report was submitted to the U.S. Fish and Wildlife Service.

Population status and host plant population status of the Gulf Coast solitary bee, Hesperapis oraria

Funding Source: U. S. Fish and Wildlife Service

Principal Investigator: George Folkerts (Auburn University)

Research Assistant: Katie Glynn

Duration: March 2006 – March 2009

Hesperapis oraria was described in 1996 (Cane et al. 1996) from specimens ranging from Horn Island off the coast in Jackson County, Mississippi, eastward to St. Andrews State Park in Bay County, Florida. This species is the only representative of its genus east of the Mississippi River and thus represents a unique geographical disjunct from other species which inhabit the western U.S. and Mexico. As far as is known the species is restricted to coastal dune habitats and sandy barrier islands. Coastal Plain honeycomb head (*Balduina angustifolia)* is thought to be the sole pollen host for this species (Cane et al. 1996). Although the host plant ranges farther inland and occurs in coastal Georgia and throughout the Florida peninsula, no specimens of the bee have been taken in most areas of the host plant range. Thus, it is possible that the species is restricted to the area from which it is presently known. Nests of this species have not been reported in the literature and were not found during previous survey work. Thus, the conservation significance of many life history parameters of the species cannot be assessed. Since the last survey for this species was completed in 1995, Cane (1997) reported that ten populations, located during 1993-1994, survived the effects of Hurricane Opal (October 1995) which impacted essentially the entire known range of the species to some extent. Since that time, tropical storms or hurricanes have impacted portions of the known range of *Hesperapis oraria.* An additional factor that may have affected populations of *H. oraria* relates to the accelerated coastal development that has occurred throughout its range since the bee was discovered. In areas such as the Fort Morgan peninsula in Baldwin County, Alabama, development has markedly changed habitats in the last decade. Cane (1997) reported that a site from which the species was known at Romar Beach, Baldwin County, Alabama, had been destroyed by building construction.

Status – Visits to sites where the bee has been found or could be present were made August 18, 2007 – October 26, 2007. Because a few bees were seen on October 26, a final visit was made on November 3, 2007. No bees were seen on that visit. As far as is presently known, the only pollen host of *Hesperapis oraria* is the asteraceous plant *Balduina angustifolia*. Pollen loads examined from two bees captured on October 6, 2007 revealed only pollen from the known host plant. During the 2007 active season of the bee, the pollen host was far more abundant at all sites visited than it was during the 2006 season.

Carbon sequestration and natural longleaf pine ecosystems

Funding Source: U.S. Geological Survey, U.S. Fish and Wildlife Service

Principal Investigator: John Kush (Auburn University)

Graduate Student(s): Ram Thapa, John Gilbert, William Whitaker

Student Technicians: Anshu Shrestha, Arpi Shrstha

Duration: July 2003 – September 2008

Forested ecosystems have a significant potential for sequestering large amounts of carbon through land management. To fully realize the potential carbon sequestration capabilities of these ecosystems there is a need to develop strategies and methods for increasing carbon sequestration. A fire-maintained, longleaf pine dominated ecosystem may offer one of the best options for carbon sequestration among the forested ecosystems of the southeastern US while providing habitat for a number of threatened and endangered plant and wildlife species, including red-cockaded woodpeckers, gopher tortoises, indigo snakes, etc … (Hardin and White 1989, Landers et al. 1995, Jackson 1989). Among the southern pines, longleaf may offer the best opportunity for carbon sequestration. It is the longest-living of the southern pines, capable of growing to 500 years (Platt et al. 1988). It will continue to put on growth, even at older ages (West et al. 1993). Products from longleaf pine will sequester carbon longer than most since they are likely to be solid wood products like structural lumber and poles. In addition to the tree itself, a fire-maintained longleaf pine ecosystem supports a productive understory of grasses and herbaceous plants which themselves may offer more carbon storage than the trees. Objectives of the study are: Phase I – Develop a detailed literature review/bibliography of research literature related to longleaf pine, above and below ground biomass, and carbon sequestration; Phase II – Determine the relationships between prescribe fire treatment and above/below ground biomass and carbon sequestration; Phase III – Determine the relationships between root biomass/carbon sequestration and the density, site quality, and age of the longleaf pine overstory.

Status – The season of burn study plots on the Escambia Experimental Forest in Brewton, AL have been extensively sampled to address the status of carbon in the no-burn, spring, summer and winter season prescribed burn plots. Longleaf pine heights and diameters were measured. Longleaf pine biomass was calculated from these measurements using developed weight and volume equations. Herbaceous (forbs and grasses) and woody (tree and vine) vegetation and litter were collected from each plot. The vegetation and litter was oven-dried and weighed. A sub-sample of the dried vegetation from each component from each plot was ground up and analyzed for carbon. The resulting percent carbon was used to calculate the carbon sequestered in each component. The preliminary results were presented at a meeting in early 2005. Work was completed for the soil samples and the vegetation and soils data is being used by Ram Thapa for his master's degree. Because the laboratory analyses have come in under budget, a second year of soils samples have been collected for analyses. These data will be included in Ram Thapa's master's thesis. William Whitaker has started on a Master's degree working on Phase III of this project.

Monitoring of unexploded ordnance (UXO) sampling plots for impacts on forest development and longleaf pine restoration (completed)

Funding Source: U.S. Fish and Wildlife Service

Principal Investigator: John Kush (Auburn University)

Graduate Student: John Gilbert

Student Technicians: Anshu Shrestha, Arpi Shrestha

Duration: September 2004 – December 2006

Mountain longleaf pine (*Pinus palustris* Mill.) forests are a critically endangered component of the once vast longleaf pine forests of the Southeast. Stretching from coastal Virginia to the piney woods of east Texas, the longleaf pine forest has dwindled in acreage and integrity. Several small pockets of this once vast forest remain in the Coastal Plain, but in the mountain region only a small National Wildlife Refuge in northeastern Alabama contains a forest that approaches the landscape witnessed by European settlers – Mountain Longleaf National Wildlife Refuge (MLNWR). Several years of extensive field and laboratory work on what was once Fort McClellan indicates that the new MLNWR holds a significant acreage of mountain longleaf pine forest, at least 12 old-growth tracts, lush herbaceous communities, and several management predicaments. These results strengthen the previous contentions that MLNWR contains the finest extant of mountain longleaf pine. MLNWR's longleaf pine forests provide the "missing link" to scientists, land managers, and conservationists in the mountain region, providing the only information on 1) age and stand structure and dynamics of frequently burned old-growth forests, 2) composition of pristine plant communities, and 3) landscape extent of mountain longleaf pine forests.

Most longleaf pine forests on the refuge are adversely impacted by hardwood encroachment resulting from lack of fire. While the reintroduction of prescribed fire will benefit these forests, many areas have evolved beyond the point in which fire alone can restore the forest. These lands require hardwood/mid-story control along with fire. By implementing a monitoring program in various forest types the overall effects of this remediation approach can be measured. It also may be possible to recommend slight modifications to the current methodology that would improve and add benefits to future forest structure.

Status – The sample of UXO plots on the MLNWR on what are considered longleaf pine sites, southerly aspects, indicates that there is a considerable amount of longleaf pine in the overstory. There were very few longleaf pine seedlings observed on the UXO plots. The major concern for the MLNWR should be the lack of longleaf pine regeneration. The minimal basal area of longleaf pine for natural regeneration is 30 square feet/acre. Less than one-half of the UXO plots have an adequate stocking of longleaf pine to accomplish that. The further loss of longleaf pine in the overstory across MLNWR would make natural regeneration of longleaf pine impossible at the stand level. The only way to get regeneration would be artificial regeneration. Based on the work being done with UXO, it does not seem plausible to plant longleaf pine on the Refuge.

PRODUCTIVITY

Publications

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Graduate Theses and Dissertations

Jolley, David. 2006. Reproduction and herpetofauna consumption of feral pigs at Fort Benning, Georgia. M.S. Thesis. Auburn University, Auburn, Alabama.

Kahn, Paula. 2006. The physiological effects of relocation on gopher tortoises (*Gopherus polyphemus).* Ph.D. Dissertation. Auburn University, Auburn, Alabama.

Awards

James B. Grand – USFWS Regional Director's Conservation Award

Invited Lectures

Shoals, fishes, and flows: decision support and adaptive management below R. L. Harris Dam. Auburn University October 2006 (Irwin)

Adaptive management of R.L. Harris Dam: Tweaking flows for fishes and landowners. Auburn University September 2007 (Irwin)

Inventory and conservation planning for species of greatest conservation need on Alabama DCNR managed lands. Warnell School of Ecology, University of Georgia September 2007 (Grand)

Outreach/Technical Assistance

Dr. Grand

Public Talk – Superfund Committee of the Alabama Chapter of the National Wild Turkey Federation – Estimating size and structure of wild turkey populations in Alabama. Cedar Bluff, AL June 2007

Public Talk – Alabama Chapter of the National Wild Turkey Federation Board – Estimating size and structure of wild turkey populations in Alabama. Aliceville, AL August 2007.

Dr. Irwin

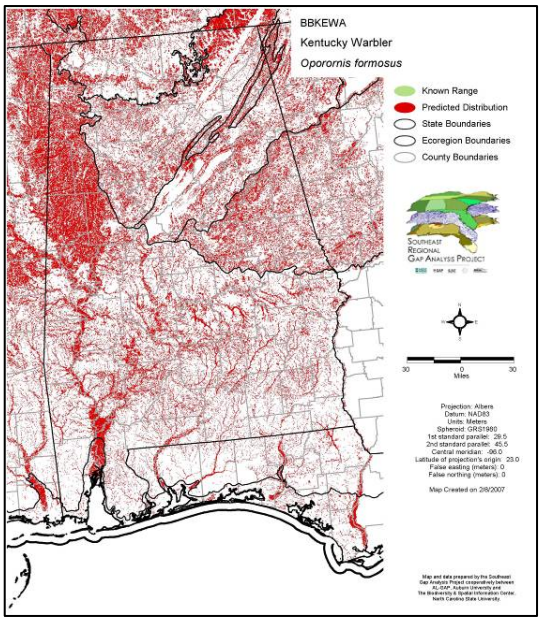
Presentation at adaptive management stakeholders meeting: Results of 2005 monitoring. Alexander City, AL August 2007.

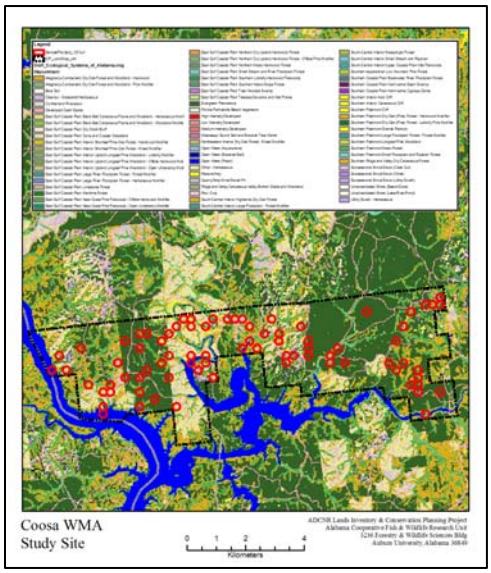
Becoming an Outdoors Woman: Taught Fly Tying and Fly Fishing to participants in workshops. Columbiana, AL March 2007.

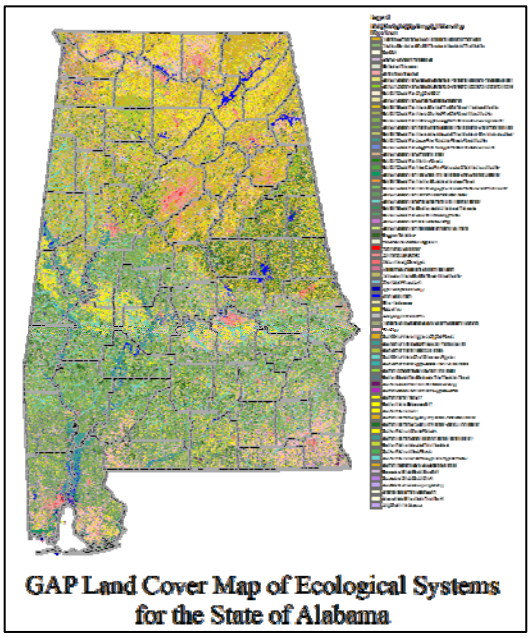
Teaching

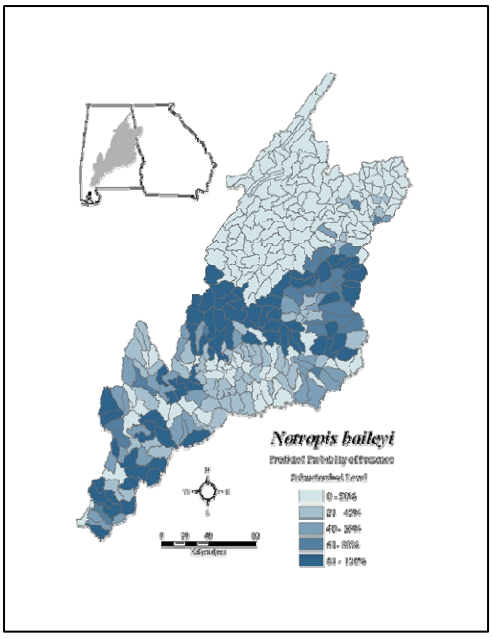
Dr. Grand

Spring 2007 – Quantitative Conservation Biology
Fall 2007 – Analysis of Wildlife Populations


BBKEWA
Kentucky Warbler
Oporornis formosus
Known Range
Predicted Distribution
State Boundaries
Ecoregion Boundaries
County Boundaries
Southeast Regional Gap Analysis Project
30 0 30
Miles
Projection: Albers
Datum: NAD83
Units: Meters
Spheroid: GRS1980
1st standard parallel: 29.5
2nd standard parallel: 45.5
Central meridian: -96.0
Latitude of projection's origin: 23.0
False easting (meters): 0
False northing (meters): 0
Map Created on 2/6/2007


Coosa WMA
Study Site
0 1 2 4
Kilometers


GAP Land Cover Map of Ecological Systems
for the State of Alabama


Notropis baileyi
0 - 20%
21 - 40%
41 - 60%
61 - 80%
81 - 100%
0 20 40 80
Kilometers