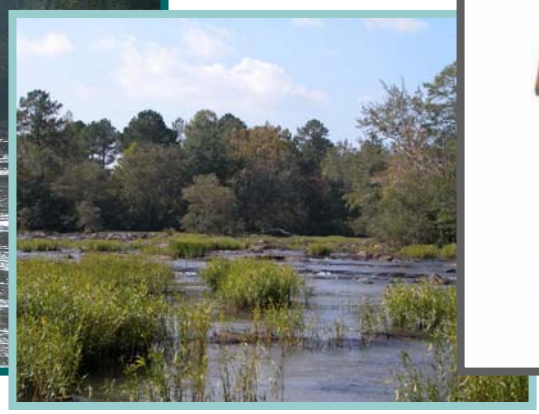
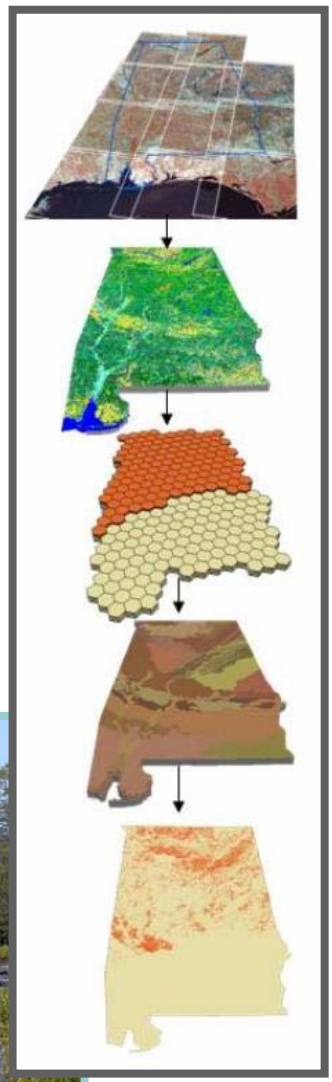
Alabama Cooperative Fish and Wildlife Research Unit





Report of Activities

October 2004 – September 2005

Alabama Cooperative Fish and Wildlife Research Unit

Report of Activities
October 2004 – September 2005

Cooperating Agencies
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 fifteen* 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 **97** 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. 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

Ecology and management of black bears in the Southern Appalachians: responses of bears to forest management

Funding Source: Earthwatch/the Center for Field Research

Principal Investigator: Mike Mitchell, Roger A. Powell (North Carolina State University)

Student: Melissa Reynolds , Lara Brongo

Duration: May 1999 - March 2006

The objectives of this project are: (1) to use field sampling and GIS to develop and evaluate fine-grain habitat maps for each year of research on black bears (*Ursus americanus*) in the PBS 1981-1999, (2) to analyze field data collected in timber harvests, model changes in habitat associated with harvests and building of roads, and assess responses of bears to these changes, and (3) to employ population and home range models to predict and evaluate demographic and behavioral responses of bears to changes in habitat. Work to date has resulted in spatial and temporal depictions of habitat quality and food resources for the PBS from 1981 to 1994. For these years we have also evaluated patterns in survivorship, use of space, and relationships between home ranges and habitat quality for the bear population. We have developed and tested spatially explicit, individual-based models of optimal home range selection that indicate a strong relationship between the size and shape of home ranges and the spatial distribution of food resources in the sanctuary.

Status – Field work on this project ended in 2002 and Melissa and Lara have been processing and analyzing data since. Lara successfully defended her Masters research in September 2004. Her work evaluated demography of the Pisgah bear population over a 22- year period. She was able to model vital rates (population growth rate, survival, and reproduction) for the population and show changes in the rates over time. During a period when poaching pressure was high, the population suffered high adult mortality and declined. Following a law enforcement operation adult survival increased, as did population growth rate. Recent evidence suggests, however, that survival and population growth are again declining, although the cause is not known. Lara was able to demonstrate the population growth for the bears was most sensitive to adult survival, refuting previous work that found juvenile survival to be most important. As a side project, Lara also found that baited trapping biased results of a bait station index conducted in the vicinity of trap sites. Two manuscripts from her work have been published in peer-reviewed journals, a third is in work. Melissa successfully completed her prelims in summer 2004 and continues her work linking habitat quality to demography for bears, and landscape-scale effects of forest management on their habitat. She has submitted 2 manuscripts to peer-reviewed journals and has 4 other manuscripts and 1 book chapter in work. Manuscripts published from this project to date include 1 book chapter, presentation and test of a habitat suitability index (HSI) for black bears in the Wildlife Society Bulletin, an evaluation of the response of black bears to forest management in the Journal of Wildlife Management, and a presentation of optimal home range models in Ecological Modeling.

Changes to small mammal populations as a consequence of fuel reduction treatments in longleaf pine ecosystems

Funding Source: USDA Forest Service

Principal Investigator: Mike Mitchell

Student: Nick Sharp

Duration: May 2001 - December 2005

After decades of fire suppression, a need exists for safe methods of returning fire-dependent forest ecosystems to a natural condition and reducing the risk of catastrophic and costly wildfires, particularly for systems near human population centers that have unnaturally high fuel loads. Little is known about the response of animal communities in fire-dependent forests to burning, or whether alternatives to fire can satisfactorily emulate the positive effects of fire on these communities. This uncertainty has led to a nation-wide study sponsored by the USDA Forest Service addressing the effects of fire reintroduction and alternatives in fire-dependent ecosystems throughout the United States. Our portion of this project focuses on the longleaf pine (*Pinus palustris*) ecosystem, once the largest fire-dependent forest system in North America. The field site is located at the Solon Dixon Forestry Education Center near Andalusia, Alabama. Fifteen stands have been selected for this study and divided equally among 5 treatments (control, fire, fire and thin, thin only, and herbicide) to be sampled over the next 3 years. Following pre-treatment sampling, each stand will be manipulated according to its treatment and responses of vegetation, birds, small mammals, reptiles, amphibians, and insects will be monitored over time.

Status – Fieldwork on Phase II of this project began in 2002; the fourth season of fieldwork was completed in 2004. Stand treatments were applied between the 2001 (pre-treatment) and 2002 (post-treatment) summer field seasons except for herbicides which were applied after the 2002 field season. Trapping for small mammals was performed during summer and winter field seasons of each year. To provide baseline information on small mammals native to longleaf ecosystems, trapping was also conducted in Conecuh National Forest using the same schedules and protocols. The small mammal communities sampled in the experimental stands appear to be simple, consisting largely of cotton mice (*Peromyscus gossypinus*) with smaller numbers of golden mice (*Ochrotomys nuttalli*). Nick's work with the mark/recapture data he collected has shown that stand-scale treatments did affect small communities somewhat; cotton mouse abundance increased, golden mouse abundance decreased on sites that were treated with a combination of burning and understory clearance (i.e., thinning, herbicide). This effect on small mammal communities was relatively unimportant, however, compared to landscape-scale effects, with distance to nearest source populations having the strongest influence on the population dynamics observed. Nick successfully defended his MS thesis this past year and is currently preparing 2 manuscripts for submission to peer-reviewed journals. He also presented results of his work at the annual meeting of The Wildlife Society.

Changes to avifaunal populations as a consequence of fuel reduction treatments in Longleaf Pine ecosystem

Funding Source: USDA Forest Service

Principal Investigator: Mike Mitchell, Doug Robinson (Oregon State University)

Research Assistant: Ghislain Rompré

Duration: June 2002 – December 2005

This study is the companion to the small mammal project described above. The objective of this research is to evaluate the responses of bird populations breeding in the longleaf pine communities to fire and fire alternatives. Results form this work should provide insights into bird communities that inhabit longleaf forest, how they respond to fire, and whether alternatives to fire can reduce fuel loads while still providing adequate habitat. The study consists of two parts: 1) assess the diversity and abundance of birds responding to the treatments using point count censuses, and 2) assess demographic responses of birds to treatments through monitoring nest productivity (number of young fledged per nest initiated) and density (through spot-mapping of bird territories) of nesting birds.

Status – Field work has been completed on this project. From 1 April to 1 July 2004, over 60 bird species were detected by spot-mapping and 155 nests from 25 species were found. We completed 3 rounds of point counts in all stands, generating more than 5,000 observations of birds. We found a high number of nests for two species (eastern towhee *Pipilo erythrophthalmus*, n = 30, Northern Cardinal, *Cardinalis cardinalis*, n = 41). Other nests found were from a variety of species including mourning dove, *Zenaida macroura*, Carolina wren, *Thryothorus ludovicianus*, pine warbler, *Dendroica pinus*, and indigo bunting, Passerina *cyanea*. Two of the 3 stands that were thinned and burned in 2002 and 2003 had Bachman's sparrows (*Aimophila aestivalis*) appear briefly, but none stayed to breed. This threatened species was absent prior to treatments due to dense shrubby understory. Three nests were parasitized by brown-headed cowbirds (*Molothrus ater*) again in 2004 compared with 3 in 2003 and only one in 2002. Overall, daily survival rate (DSR) was similar to previous years, at 0.42. Further analyses will investigate Mayfield DSR for each treatment and determine its influence on breeding success. Further data analyses are currently underway.

Effects of growing season prescribed fire on productivity and survival of northern bobwhite populations

Funding Source: Alabama Division of Wildlife and Freshwater Fisheries, Auburn University, Quail Unlimited

Principal Investigator: Barry Grand

Student: Travis Folk

Duration: August 2001 – August 2005

Over the last 3 decades northern bobwhite (*Colinus virginianus*, hereafter bobwhite) populations have declined precipitously throughout the Southeastern and Midwestern United States. In the southeast, forested lands offer some of the best opportunities for bobwhite management. In stands of pine and mixed pine-hardwoods with low (<50%) canopy cover, frequent (1-3yr) controlled fires can be used to maintain the early successional, mainly herbaceous, understory vegetation required by breeding bobwhites. This habitat is typified by the "native" stands of longleaf pine (*Pinus palustris*) described by early explorers. Traditionally, prescribed fire has been applied during the winter months to reduce damage to desirable plant and animal populations. However, there is increasing support for the use of prescribed fire in longleaf pine forests during the growing season, because it may mimic the natural occurrence of lightning-caused wildfires and may favor the native condition of longleaf pine ecosystem preferred by some characteristic threatened and endangered species. This approach to forest ecosystem management may have adverse effects on populations of ground nesting birds including bobwhites, which may suffer nest losses and mortality when fire occurs during the growing season. The objective of this research is to determine the effects of controlled growing season fires on the productivity, survival, and growth rate of bobwhite populations in the longleaf pine ecosystem.

Status– The final field season was completed in September 2004. In total, 374 bobwhites were radio-marked and approximately 21,000 locations were collected for these individuals over the 2 and one-half year duration of the project. Analyses of survival, movement, and female success of bobwhites are in progress. Age-based periodic population models were developed to represent summer and winter seasons for bobwhite populations in Wisconsin and Alabama, the latitudinal extent of their range. Prospective and retrospective analyses were conducted to evaluate the functional and observed relationship of vital rates to population growth rate within each population. Additionally, retrospective analyses were used to evaluate the influence that latitude had on population dynamics of bobwhites in Wisconsin and Alabama. A manuscript detailing these results as well as novel methods for analyzing periodic matrix models was submitted for publication in fall 2004. A manuscript describing the reproductive success of bobwhites in the Conecuh National Forest is in internal review. Analysis of the survival and movement data is underway and should be complete by the end of 2005.

ECOLOGY AND MANAGEMENT OF STREAM CORRIDORS

Redeye bass population status and critical habitat delineation in the Tallapoosa River and its tributaries (*completed*)

Funding Source: Alabama Division of Wildlife and Freshwater Fisheries

Principal Investigator: Elise Irwin

Research Associate: Jeff Jolley

Research Assistant: Daniel Neil, Allen Nicholls, Brad Hopkins

Student: John R. Knight, Taconya Piper

Duration: October 2002 – September 2004

Redeye bass (*Micropterus coosae*) provide an abundant, yet rarely utilized fishery resource in piedmont streams of Alabama. Little is known regarding population status or critical habitat needs for sustainable populations. Data are needed regarding population status, distribution, age/growth, movement and critical habitat requirements to effectively manage this potentially valuable sport fish. Development and validation of a model that predicts either population size or fishery potential of redeye bass in streams of Alabama would be a useful management tool. The objective of this project is to assess the size and age-class structure, and movement, and to define critical habitats for redeye bass populations in the Tallapoosa River and associated tributaries.

Status –Ninety-five redeye bass were aged with spines and otoliths. Sagittal otoliths and spines (second and third dorsal) were extracted for aging. Fish up to age 7 were collected based on otoliths. Spines tended to underage fish, the oldest fish was age 5. Ages estimated with the two structures were within one year 94.7% of the time and were the same 66.3% of the time. Spines may be a viable option for non-lethal ageing. A radio telemetry study to assess habitat use and movement is in progress in Hillabee Creek. Radio tag retention by redeye bass was 100% (tags were retained 30 days with no infection). Ten fish were collected, and subsequently tagged, in August 2003 within a large bedrock shoal on Hillabee Creek. Fish were located 3-4 times weekly and exhibited variable movement patterns. Six fish appeared to be resident in nature and four fish moved considerable distances downstream, and either returned (2 fish) or remained downstream (2 fish). All Fish were associated with instream and canopy cover. Fish were generally associated with large substrata (e.g., from cobble to bedrock). In summer 2004, 10 redeye bass were tagged in the main stem of the Tallapoosa River (regulated reach near Wadley, AL). Fish exhibited similar movement patterns and habitat use to the resident Hillabee Creek fish; however, movement in response to sustained high flows from Hurricane Ivan was apparent. The final report was submitted in December 2004.

***Development of a monitoring plan to assess potential effects of Co-generation plants on fish communities* (*new*)**

Funding Source: Alabama Department of Conservation and Natural Resources

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 electrofishing data collected by ADCNR.

Status - We have identified 68 potential sampling sites for monitoring. We considered 11 potential CoGen sites located within a 100 mile radius of Auburn; using ArcGIS we placed a 10 mile buffer around each site. We then located road crossings for streams within the buffer using a GIS transportation layer. This will allow for selection of sampling sites based on proximity of the proposed plants (e.g., upstream and downstream). Potential sampling sites on other streams within each subwatershed will be considered, particularly for their potential as reference streams. In April we conducted reconnaissance visits to the 68 sites. Because we are using pre-positioned area electrofishers, site characters must allow for stream depths and widths conducive to the gear. Sites were selected based on access, stream characters and position in the subwatershed relative to the proposed plant. Sampling was delayed based on the wet summer and fall hurricanes and began in October 2005. Sampling will be complete by mid-November 2005 and will be repeated in spring/summer of 2006. In addition, detection probabilities for approximately 87 species of fish in the Alabama River Basin have been calculated (Irwin and Hayer, unpublished data). Mulberry and Hillabee creeks were primary sites of collection of fish where multiple sampling occasions over a short temporal period allowed for calculation of detection probabilities (θ) using Program MARK. These detection probabilities will be incorporated into the monitoring program.

ENDANGERED/DECLINING POPULATIONS

Evaluating changes in the Tulotoma magnifica population in the Coosa River and its tributaries during 1992 through 2004 (completed)

Funding Source: U.S. Fish and Wildlife Service

Principal Investigator: Dennis DeVries (Auburn University)

Duration: June 2004 – December 2004

The ornate viviparid snail (*Tulotoma magnifica*) was listed as endangered in January 1991, given the dramatic reduction in its distribution and range. At the time of its listing, *T. magnifica* was known to occur in four tributaries (Ohatchee Creek [Calhoun County], Kelly Creek [Shelby and St. Clair counties], Weogufka Creek [Coosa County], Hatchet Creek [Coosa County], as well as in the main stem of the Coosa River between Jordan Dam and Wetumpka (Elmore County). During the past decade, biologists from the U.S. Fish and Wildlife Service, the Alabama Power Company, the Alabama Department of Conservation and Natural Resources, and Auburn University have identified small populations in Choccolocco Creek (Talladega County), Yellowleaf Creek (Shelby County), Weoka Creek (Elmore County), and in the main stem Coosa River below Logan Martin Dam. Our objective is to quantify the changes in population status of *T. magnifica* in the main stem of the Coosa River and six of its tributaries during the 12-year period between 1992 and 2004. In addition, we will evaluate whether changes may be due to changes in flow conditions during this period.

Status – During summer and fall 2004 we sampled throughout the six sites where *T. magnifica* has the largest known populations—Ohatchee Creek, Kelly Creek, Choccolocco Creek, Weogufka Creek, Hatchet Creek, Weoka Creek, and the Coosa River between the Moccasin shoal and Corn Creek shoal. The final report was completed and submitted to USFWS in 2005. These results represent the most complete description of *T. magnifica* distribution and abundance since the work conducted in the late 1980s by Hershler et al. (1989).

Mating opportunities of female gopher tortoises on the Solon Dixon Forest Education Center (*completed*)

Funding Source: U.S. Fish and Wildlife Service

Principal Investigator: C. Guyer (Auburn University)

Research Assistant: Jimmy Stiles, Sierra Stiles

Student: Valerie Johnson

Duration: September 1998 –December 2004

The gopher tortoise (*Gopherus polyphemus*) is federally protected in the western portion of its range and protected by state legislation throughout the remainder of its distribution. Long-term conservation of the gopher tortoise depends upon distinguishing areas where management efforts can maintain or increase population density from those where populations are likely to decline. Many areas of conservation concern contain tortoises at low population densities (< 1/acre). Populations on these sites may not be viable because animals are so widely spaced that reproduction fails. Because tortoises are so long-lived, such populations could persist in the landscape for decades. Only a study conducted on the Jones Ecological Research Center near Newton Georgia, a site characterized by low-impact management and high tortoise population density (3.0/acre) is available to document potential rates of tortoise interactions. Photographic evidence documenting activity patterns and social interactions were used to determine opportunities for mating at a relatively pristine site. This research is designed to determine mating opportunities for female tortoises on the Dixon Forestry Education Center in south-central Alabama. Relatively low-impact forest management characterizes this site and an apparently viable population (as evidenced by a size structure indicative of high recruitment) of intermediate density. We will examine density dependence of tortoise interaction rates by comparing data collected on the Dixon Center with those already collected on the Jones Center in SW Georgia, the Wade Tract in S Central Georgia, the Conecuh National Forest (S AL), Camp Shelby (SE MS) and International Paper Company lands in Mobile County AL.

Status – Project covered five years of research designed to examine the effect of tortoise density on patterns of movement and socialization. This information is vital to allow land managers to determine the tortoise density at which conservation strategies should switch from management of tortoises *in situ*, presumably because a viable population is present, to a strategy of moving animals to reserve areas, presumably because this will allow animals from non-viable areas to participate in a viable population. This represents a key need of conservation officers in that portion of the geographic range where the gopher tortoise receives protection under the Endangered Species Act. Because tortoises affect so many other taxa within the longleaf pine ecosystem, conservation of these turtles should provide an umbrella for the preservation of other sensitive indicator taxa (Guyer and Bailey 1993). Additionally, implementation of conservation measures throughout the rest of the geographic range of tortoises should allow recovery of this taxon throughout its range without requiring federal protection range-wide.

Patterns of movement of male gopher tortoises on the Solon Dixon Forest Education Center

Funding Source: U.S. Fish and Wildlife Service

Principal Investigator: Craig Guyer (Auburn University)

Research Assistant: Jimmy Stiles, Sierra Stiles

Duration: August 2004 – December 2005

The gopher tortoise (*Gopherus polyphemus*) is federally protected in the western portion of its range and protected by state legislation throughout the remainder of its distribution. Long-term conservation of the gopher tortoise depends upon distinguishing areas where management efforts can maintain or increase population density from those where populations are likely to decline. Data regarding the distances that male gopher tortoises travel in order to find mates are important for documenting the potential for populating persistence and for designing reserve areas for tortoises. Because data regarding movements of animals are affected by local population density, studies from a variety of tortoise populations spanning the range of known populating densities are needed. The data gathered from this study will be vital to development of strategies for creating conservation reserves for tortoises. Such reserves require sufficient space for resident animals to grow and reproduce. Comparison of movement data for tortoises at the Dixon Forestry Education Center with those from other sites will indicate whether such reserves can be of consistent size throughout the range of the tortoise or whether reserves must be designed to fit the unique history of local population density.

Status – Three isolated female tortoises were located on the Solon Dixon Forestry Education Center. These females were trapped, affixed with a radio transmitter, and released to the burrow from which they were captured. Captures were made in May and these individuals have been relocated five times a week since that date. Two male tortoises have been captured from the area and these individuals are also being followed by radio telemetry. No other individuals are known from the surrounding area, which has been surveyed for a distance of 1000 m from each known active burrow. Visitation of tortoises to the females is being monitored by digital cameras that take pictures every time a tortoise enters or exits a burrow occupied by a resident female. To date, no unmarked visitors have been observed. Therefore, we are confident that data from these individuals will improve our ability to describe the movement patterns and visitation rates of gopher tortoises at population densities near their lower limit. These data will be added to similar data collected at five other sites over the past seven years. The larger data set will allow me to project the density at which visitations rates are indistinguishable from zero, an estimate of the density at which populations are unlikely to be viable.

Gopher tortoise relocation at Ft. Benning: Effects on stress, immunocompetence, and reproduction

Funding Source: Department of Defense

Principal Investigator: Mary Mendonca (Auburn University)

Student: Paula Kahn

Duration: May 2003 – December 2005

The relocation of endangered and threatened animals has become a common practice in the United States due to increased human populations and subsequent developmental progress. The gopher tortoise (*Gopherus polyphemus*) is one of the species that is affected by relocation policies. This tortoise is a threatened species indigenous only to the southeastern United States. *G. polyphemus* is considered a keystone species in its environment, with other animals depending on the use of the tortoise burrows for their protection from predators and harsh weather conditions, and therefore for their survival. However, while tortoises are being moved out of physical harm's way, they may be suffering physiological consequences that have yet to be determined. Ideally, to ensure that relocation of tortoises is successful, long-term monitoring of movement and physiological condition needs to take place. Since this is not a viable option in many cases, we have established some proven biomarkers that will indicate the success of relocation in terms of stress, immunocompetence, and reproductive capacity. These biomarkers can be assessed during and after relocation to monitor tortoises' progress in adapting to their new environment. In the absence of data on long-term mortality and/or ultimate reproductive success of relocated animals, these biomarkers are proposed as a short-term measure of those stresses which could ultimately result in such consequences.

Status – Our analyses have indicated that relocation does not increase stress in tortoises, as evidenced by changes in corticosterone levels (a hormone used as a biomarker of stress). However, we did find that tortoises living in impacted habitats do have significantly higher corticosterone levels at baseline than those living in non-impacted habitats. We also found that relocation does not affect at least one immune response in tortoises, as indicated by their swelling response to PHA (phytohemagglutinin), a biomarker of T cell function. In terms of disease status, we found that URTD status (positive vs. negative and symptomatic vs. asymptomatic) does not correlate with any of the measures of stress or immunocompetence. This may be related to the fact that tortoises demonstrated remarkable changes in their URTD titers throughout the study seasons, as determined by an ELISA. As a result, we believe that testing these tortoises for URTD by simply using an ELISA is not an effective method for characterizing disease status. Overall, in the 30 day period that we measured tortoises' stress and immunocompetence, we did not find significant effects of relocation on physiological parameters. However, it is important to note that possible effects may have been present prior to the 30 day testing, and long term effects may arise in the future. Therefore, long term monitoring of this threatened species is critical to determine if such long term effects may exist. Several manuscripts are in the process of being prepared to disseminate these results.

LANDSCAPE ECOLOGY

Assessing the scientific basis for standards/practices at multiple spatial scales--East

Funding Source: National Council for Air and Stream Improvement (NCASI), National Commission on the Science of Sustainable Forestry (NCSSF)

Principal Investigator: Mike Mitchell

Research Associate: Scott Rutzmoser

Student: Michelle Smith

Duration: August 2002 – December 2008

Forest managers, policymakers, and the public need better information about the relationship between biodiversity and the structure of forest stands and landscapes. At present, results of stand-level studies suggest that biological diversity is positively related to the structural/compositional complexity of stand-level habitat and that biological diversity is diminished when stand structures are simplified. Some ecological theories (e.g., the "intermediate disturbance hypothesis") however, suggest that diversity at larger spatial scales may be positively associated with habitat heterogeneity. Yet, few studies have evaluated these relationships at multiple spatial scales, from the stand through the landscape level, or considered variables that may influence competitive exclusion. This project will make use of 3 large-scale wildlife habitat studies in highly forested landscapes in Arkansas, South Carolina, and West Virginia. These studies have characterized (or are currently characterizing) relationships between forest structure and presence of selected wildlife taxa at multiple spatial scales. Furthermore, the three sites encompass a range of vegetation types, structures, and physiographic settings across the Southeast.

The project included two workshops and a synthesis/analysis of data. The first workshop brought together collaborators to present methods and results, organize the synthesis, identify strategies for building a combined dataset, and select appropriate analytical methods. The second workshop presented the synthesis results to the same group for peer-review and comment. Preliminary results show a strong association between community structure for birds and heterogeneity of forest ages and types at multiple scales. The expected result of this study is an analysis of relationships among biodiversity, forest structure, and other ecological factors (e.g., productivity) at multiple spatial scales. It will provide a foundation for the design of forest management approaches that sustain biodiversity, and it will help identify criteria and indicators for use in evaluating the performance of sustainable forestry programs.

Status – Funding for a PhD student to continue and further develop landscape analyses using the NCSSF data set was recently awarded from NCASI. Michelle began working toward her PhD on this project last Fall and will be investigating fundamental ecological processes that influence landscape patterns, how these processes and patterns vary with spatial and temporal scale, as well as developing landscape models for predicting the effects of forest management on biodiversity.

Aquatic Gap: Regional Analysis of Biodiversity in the ACT/ACF Basins (completed)

Funding Source: U.S. Geological Survey

Principal Investigator**:** Elise Irwin, James Peterson (GACFWRU), Byron J. Freeman (University of Georgia), Liz Kramer (University of Georgia)

Collaborator: Mary Freeman (USGS, PWRC)

Research Associate: Deanne Moosman

Research Assistant: Kevin Kleiner

Student: Cari Ann Hayer

Duration: September 2001 - August 2005

We developed Aquatic GAP applications for two centers of aquatic biodiversity, the Alabama-Coosa-Tallapoosa (ACT) and Apalachicola-Chattahoochee-Flint (ACF) river basins. The ACT and ACF basins span broad ranges of physiographic settings and harbor exceptionally high levels of species richness and endemism, providing ideal opportunities for testing current (MORAP) and new approaches and refining them to predict species occurrences and community attributes in relation to physical variables. Our project is based on the fundamental assumption that watershed characteristics (e.g., soils, vegetation, elevation, relief, land use) and geomorphic history directly influence stream structure and function and that these, in turn, influence the aquatic community. These influences, however, occur in systems with high natural variability that must be assessed and quantified. Further, we assumed that the ultimate goal of this project was to develop products that could be used by natural resource managers for decision-making; hence, they should include quantifiable measures of uncertainty. Therefore, we will develop probabilistic models using historic and current empirical data on the distribution of aquatic species in the basin to ultimately provide a decision support system for resource managers.

Status – We provided technical review for the 12-digit hydrologic unit codes in the Tallapoosa Basin and will complete review for the ACT. The faunal database is complete and models related to watershed features (all layers complete) have been constructed. We constructed KNN models for 63 species in the Tallapoosa River basin. The species-specific models of species presence within sample reaches in the Tallapoosa River Basin were relatively accurate with classification error rates for presence, absence, and across categories (overall error) averaging 16.2%, 21.5%, and 20.5%, respectively. Predictions at the subwatershed level were conducted using the best model for each species. Maps depicting probability of presence were generated for each species. Our modeling efforts have provided valuable insight into the factors influencing species distribution and community structure in portions of the ACF and ACT Basins (This study; Freeman et al. 2003; Peterson et al 2003). The final report was completed in draft form in December 2004; still pending comments from National GAP.

ACT Aquatic GAP and water quality modeling

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 – We are nearing completion of the landscape data layers; the Piedmont region is not complete. The faunal database for fishes is 50% complete; however, the mussel data are not yet available. We anticipate having all data complete and reviewed by February 2006 and modeling will ensue.

Gap Analysis for Alabama

Funding Source: U.S. Geological Survey

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

Project Coordinator: Amy Silvano

Research Assistant: Kevin Kleiner, Ben Taylor

Student: John Hogland

Duration: August 2000 – December 2006

Alabama spans five physiographic provinces from the Coastal Plain through the Interior and Appalachian Low Plateaus, more than any other state. Within these provinces exist unique and often rare communities and diverse assemblages of plants and animals. 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 – Throughout 2005, we have been in the process of mapping ecological systems (hereafter, Systems). The field work associated with Systems level mapping has been completed and mapping of non-natural vegetation such as clear cuts, plantations, and successional scrub/shrub is nearly finished. All natural vegetation has been isolated from the non-natural vegetation and supervised classification methods including Categorical and Regression Tree (CART) analysis, patch recognition, and logistic regression have been identified as the primary mapping procedures to develop the System level map. Our graduate research assistant completed a study mapping the occurrence of Longleaf Pine throughout the Southern Region, the final product of which will be incorporated into the final Systems level map. Ancillary data development in support of Systems level mapping is approaching completion. All National Wetland Inventory (NWI) data has been digitized and compiled for the entire Southeastern GAP extent and detailed soils data for 3 of 6 partial counties has been digitized. In addition, all wildlife habitat association models for project have been completed.

Development of a decision support tool and procedures for evaluating dam operation in the Southeastern United States

Funding Source: U.S. Fish and Wildlife Service

Principal Investigator: Elise Irwin and James Peterson (GACFWRU)

Research Associate: Kathryn Mickett

Duration: June 2002 – December 2005

This project will create a template on which to base future efforts incorporating decision analysis and adaptive management into the Federal Energy Regulatory Commission dam re-licensing process by developing a model for implementation of adaptive flow management for Harris Dam on the Tallapoosa River, Alabama. To do so, we will address the following objectives: (1) determine stakeholder values and objectives; (2) develop models relating aquatic community (specifically, fish and mussels) responses to changes in habitats and flow regime; (3) develop decision models for evaluating the impacts of current and alternative dam operating procedures on (stakeholder) valued outcomes; and (4) develop explicit recommendations for alternative dam operating procedures that will produce the information for resolving key uncertainties about the effect of dam operation on the aquatic community.

Status - The workshop, "Adaptive Management Below Dams" was held April 29 through May 1 2003. Guest speakers James Nichols (USGS, Patuxent), Mike Conroy (GACFWRU), and James Peterson (GACFWRU) gave presentations in their fields of expertise. Several important stakeholder groups were represented at this workshop, including (but not limited to) USFWS, ADCNR, Alabama Power, Alabama Rivers Alliance, Middle Tallapoosa River Conservation Association, Upper Tallapoosa Watershed Committee, and Lake Wedowee Property Owners' Association. An interactive forum was facilitated to address common issues among all participants of the workshop. Points of discussion included objectives and values, governance, and decision-making principles. Following this inclusive interactive discussion, a similar forum was opened involving participants with a stake in the adaptive management process at R.L. Harris Dam. The product of this forum was an official stakeholders group with proposed purposes and objectives. Since this initial meeting, there have been three meetings of the R.L. Harris Stakeholders Board. A website (www.rivermanagement.org) has been created and an official charter has been drafted and accepted. An initial decision support computer model has been created with the program NETICA. This model is currently, and will continue to be, under modification as discussion of the board continues and new data become available. Decisions have recently been made to apply a flow adjustment at R.L. Harris that matches the gage reading at Heflin. Flow management was implemented in Spring 2005 and monitoring protocols have also been implemented.

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

Funding Source: Alabama Department of Conservation and Natural Resources, Wildlife and Freshwater Fisheries Division

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

Research Associate: Nick Sharp

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

Research Assistant: Megan Binkley, Helen Czech, Jeff

Duration: January 2005 – December 2007

Little is known 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 using 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 at 88 points twice during May 15-June 30 2005. Line transect methods were used to survey reptiles and amphibians during April-July and again in August-November 2005 at the same 88 points. A combination of live traps and pit-fall arrays is being used to sample small mammals at 44 points 15 September-15 November 2005. These data will be summarized during winter 2005-06, and sampling procedures will be repeated in 2006. A vegetative inventory and classification will also be conducted at all 176 points in spring and summer 2006. At that time the validity of the available land cover and land form maps will be assessed.

Carbon sequestration and natural longleaf pine ecosystems

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

Principal Investigator: Ralph Meldahl (Auburn University), John Kush (Auburn University)

Duration: July 2003 – June 2007

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 burn 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 – 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 (see below). Work has begun on collecting soil samples. Phase II should be completed by the end of 2005. Hurricane Ivan caused severe damage to the Escambia Experimental Forest. This will have an impact on the plots we will be able to use in Phase III of the study. The search continues for another graduate student to work on more of Phase II and all of Phase III.

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

Funding Source: U.S. Fish and Wildlife Service

Principal Investigator: John Kush (Auburn University), Ralph Meldahl (Auburn University)

Student: John Gilbert , Anshu Shrestha, Arpi Shrestha

Duration: September 2004 – June 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 – Two stands were extensively sampled in 1999 as part of a project for the then Fort McClellan Army Base. Based on discussions with personnel at the MLNWR, these two stands were re-measured to examine the status of longleaf pine 6 years after they were initially measured. Several sites have been identified for sampling and measurement plots will be installed during the 2005 autumn. Since data collection was initiated during the 2005 summer there have been no publication or presentations. Work has begun on a publication to compare the 1999 data with the 2005 data.

OTHER PROJECTS

***Renesting, nest depredation, and gosling survival of dusky Canada geese on the Copper River Delta, Alaska* (*completed*)**

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

Principal Investigator: Barry Grand, Mike Anthony (USGS), Tom Fondell (USGS)

Duration: January 1997 – December 2004

The Copper River Delta, Alaska (CRD) contains the largest known concentration of breeding dusky Canada geese (*Branta canadensis occidentalis*). Elevation and hydrologic changes following the 1964 earthquake resulted in large-scale habitat changes and shifts in the predator community on the area. Subsequently, populations of this subspecies have declined to their lowest recorded levels since surveys began in the 1970's. The current fall population is approximately 10,000 birds. The management plan for dusky Canada geese requires complete closure of sport hunting for sympatric wintering Canada geese if the population falls below a threshold level of 8,000 birds (Pacific Flyway Council 1996). Population estimates are based on aerial surveys corrected for visibility using ground-based surveys for nests. Significant renesting would lower the visibility correction factor and further reduce estimates of the size of the breeding population. Information on cause specific nest depredation, renesting effort, gosling survival, and adult female survival will be critical to determining why productivity remains low and what management options can reverse the decline. The objectives of this study are: (1) to determine the timing and extent of renesting by dusky Canada geese in the CRD, (2) to examine the cause-specific rates of nest depredation for duskies in high density nesting areas, (3) to determine the survival rate and causes of mortality for adult females and goslings hatched in high density nesting areas.

Status – Field studies examining the variation in productivity across the Delta were completed in 2003. Two manuscripts detailing the variability in nest success, renesting effort, and variation in clutch size are *in press*.

Modeling the recovery rates of avian populations

Funding Source: U.S. Geological Survey

Principal Investigator: Barry Grand

Post-doctoral Researchers: Jennifer Arnold, David Koons

Student: Dave Koons ,

Research Assistants: Nitin Yogi, William Trimble, Jeff Baker, Shaun Tanger, Danielle Warren, Carrie Johnson

Duration: April 2001- March 2006

At least 29 species of birds are known to use the near shore waters of the Beaufort Sea, which makes them potentially vulnerable to catastrophes resulting from industrial activities associated with offshore oil and gas extraction. The goals of this project were to identify the available data on vital rates of selected species, determine the best methods available for modeling the recovery of avian populations from catastrophic mortality events and where possible develop the population model structure for target species, and provide natural resource professionals with an easy to use, well-documented tool for examining population level impacts of oil spills.

Status – The literature database has been completed and reviewed. A preliminary version of the database and modeling software was distributed to funding agencies and cooperators in June 2005. The final version will be ready for distribution in early 2006. One manuscript describing the effect of catastrophic perturbation on short term population dynamics has been published. Two publications describing the implications of population momentum following perturbation have been prepared one is *in press*, and the other is in revision. Another publication describing an innovative method for predicting the sensitivity of animal populations to perturbation or management actions is in preparation. The final report describing the database, software, and efforts to cast population models for the 29 species of interest is in internal review. More details about the project and the software are available at www.ag.auburn.edu/alcfwru/avsmdl/.

Ecology and management of feral hogs on Fort Benning, Georgia

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

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

Student: 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. Hogs are also opportunistic omnivores, consuming a wide variety of plant and 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 – During May-July 2004, we captured and marked 92 feral hogs, and during May-July 2005, we captured and marked 89 hogs to facilitate mark-recapture efforts. These data will be used to examine demographic processes, including survival and population growth rate. During May-July 2005, we affixed GPS collars to 15 female hogs to collect data pertaining to movement and social fluidity. We retrieved 11 of these collars (4 collars were lost during the study), and affixed GPS collars to 15 different female hogs. Currently, we are collecting data from trapped and harvested animals to examine dietary habits and reproductive propensity: 176 hogs have been collected for this analysis (84 from our lethal control area). All of these data are being assessed on 2 separate study areas on Ft. Benning. One area is being treated with lethal control, with the intent to reduce the population as low as possible: the other area will serve as a control. We plan to compare population, movement, habitat use, dietary, and reproductive data on both sites to assess whether density influences any of these life-history aspects.

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

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 – Experimental blocks were established in April 2004 in the Kennedy (n = 2) and

the Bradley (n = 2) Units of ENWR. Each block contained twenty-four experimental plots (5 x 5 m). Treatments consisted of herbicides (n = 2), application rates (n = 4), and application dates (n = 3) that were assigned randomly to experimental plots within each block. Renovate® or Habitat® herbicides were mixed with 0.025% nonionic surfactant and applied in April, July, and September of 2004. Renovate® was applied using 935L ha^{-1} or 2.4L per plot of water and included low (4.8L ha^{-1} or 12mL per plot), medium (9.6L ha^{-1} or 24mL per plot), and high (14.4L ha^{-1} or 36mL per plot). Habitat® was applied using 467L ha^{-1} or 1.2L and included low (1.2L ha^{-1} or 3mL per plot), medium (2.4L ha^{-1} or 6mL per plot), and high (3.6L ha^{-1} or 9mL per plot). Percent cover of all vegetation was estimated weekly after treatment in 2004 and monthly in 2005 from spring drawdown in April until fall flooding in November. Vegetation in experimental plots was sampled in October 2004 to estimate biomass of alligatorweed and native plants. Results indicated July application of either triclopyr amine or imazapyr at the highest application rate provided the greatest control of alligatorweed. April application of medium or high herbicide rate resulted in greatest native plant biomass. Using triclopyr amine resulted in greater native plant biomass than using imazapyr. Vegetation will be sampled again in October 2005 to determine effects one year after treatment.

PRODUCTIVITY

Publications

Brongo, L. L., M. S. Mitchell, and J. B. Grand. In press. Effects of trapping with bait on bait-station indices to black bear abundance. Wildlife Society Bulletin.

Brongo, L. L., M. S. Mitchell, and J. B. Grand. *In press*. Long-term analysis of a population of black bears with access to a refuge. Journal of Mammalogy.

Ditchkoff, S., and M.S. Mitchell. *In press*. Ft. Benning Military Reservation: Wild Pig Management Case Study. Feral Pig Symposium, South Carolina.

Flint, P.L., Grand, J.B., Fondell, T.F., and J.A. Morse. *In press*. Population dynamics of greater scaup breeding on the Yukon-Kuskokwim Delta, Alaska. Wildlife Monographs.

Fondell, T.F., J.B. Grand, D.A. Miller, and R. M. Anthony. *In press*. Renesting by dusky Canada geese on the Copper River Delta, Alaska. Journal Wildlife Management.

Freeman, M.C., E.R. Irwin, N.M. Burkhead, B.J. Freeman, H.L. Bart. 2005. Status and conservation of the fish fauna of the Alabama River System. American Fisheries Symposium 45:557-585.

Grand, J.B., T.F. Fondell, D.A. Miller, and R.M. Anthony. *In press*. Nest survival of dusky Canada geese: Use of discrete-time models. Auk.

Hartke, K.M., J.B. Grand, G.R. Hepp, and T.H. Folk. *Accepted pending revision*. Sources of variation in survival of breeding female wood ducks in Alabama and Georgia. Condor.

Jolley, J. C. and E. R. Irwin. 2004. Food habits of catfishes in tailwater and reservoir habitats in a section of the Coosa River, Alabama. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 57:124-140.

Koons, D.N., J.B. Grand, B. Zinner, R.F. Rockwell. *In press*. Transient population dynamics: Relations to life history and initial population state. Ecological Modeling.

Koons, D.N., J.B. Grand, R.F. Rockwell. *In press*. Population perturbation analysis: the influence of population momentum. Journal of Wildlife Management.

Kush, J.S., R.S. Meldahl, C.K. McMahon, and W.D. Boyer. 2004. Longleaf pine: A sustainable approach for increasing terrestrial carbon in the southern United States. Environmental Management. 33(Supplement 1):S139-S147.

Meldahl, R.S., and J.S. Kush. Carbon sequestration and natural longleaf pine ecosystems. *In:* Proceedings of the Thirteenth Biennial Southern Silvicultural Conference, February 28-March 4, 2005, Memphis, TN. USDA Forest Service GTR-SRS (In pres).

Miller, D.A., J.B. Grand, T.F. Fondell, and R. M. Anthony. *In press*. Predator functional response and prey survival: direct and indirect interactions affecting a marked prey population. Journal Animal Ecology.

Mitchell, M.S., S.H. Rutzmoser, T.B. Wigley, C. Loehle, J.A. Gerwin, P.D. Keyser, R.A. Lancia, R.W. Perry, C.J. Reynolds, R.E. Thill, R. Weih, D. White, Jr., P. Bohall Wood. *In press.* Relationships between avian richness and landscape structure at multiple scales using multiple landscapes. Forest Ecology and Management.

Reynolds, M.J., M.S. Mitchell, and J.B. Grand. *Submitted.* Linking resources with demography of bears. Journal of Wildlife Management.

Reynolds, M.J., M.S. Mitchell, and J.R. Grand. *Submitted.*. Linking individual fitness and demography with behavior: a black bear example. Ecological Applications.

Sakaris, P.C., A. M. Ferrara, K. J. Kleiner and E.R. Irwin. 2004. Movements and home ranges of alligator gar (Atractosteus spatula) in the Mobile Tensaw Delta, Alabama. Proceedings of the Southeastern Association of Proceedings of the Southeastern Association of Fish and Wildlife Agencies 57:102-111.

Sakaris, P.C., E.R. Irwin, J.C. Jolley, and D. Harrison. Comparison of native and introduced flathead catfish populations in Alabama and Georgia: growth, mortality and management. *Accepted with revision:* North American Journal of Fish Management.

Tucker, J.W., W.D. Robinson, and J.B. Grand. 2005. Influence of fire on Bachman's Sparrow, an endemic North American songbird. Journal of Wildlife Management 68:1114-1123.

Presentations

Allen, S. Evaluation of herbicides for controlling alligator weed (*Alternanthera philoxeroides*) and restoring native plants at Eufaula National Wildlife Refuge. Southeast Exotic Plant Pest Council Meeting, 4 May 2005, Birmingham, AL.

Allen, S. Evaluation of herbicides for controlling alligator weed (Alternanthera philoxeroides) and restoring native plants at Eufaula National Wildlife Refuge, Graduate Student Forum, 10 March 2005, Auburn University, AL.

Folk, T.H., J.B. Grand, and R.R. Holmes. Temporal and latitudinal variation in Northern Bobwhite population dynamics. 27 August 2005, American Ornithologist Union Annual Meeting, Santa Barbara, CA.

Irwin, E. R. December 2004. Why catfish are better than bass and walleye: a decadal perspective. Department of Fisheries and Allied Aquacultures Seminar Series. Auburn University, Auburn, Alabama.

Irwin, E. R. October 2004. Adaptive management below dams; R. L. Harris and the Tallapoosa River, a case study. Advanced Fishery Management Class, Department of Fisheries and Wildlife, South Dakota State University.

Irwin, E. R. and K. D. Mickett. May 2005. Adaptive management of the Tallapoosa River below Harris Dam. Tallapoosa Watershed Project WAP Annual Meeting. Camp ASSCA, Alexander City, Alabama.

Irwin, E. R. October 2004. Why catfish are better than bass and walleye: a research perspective. American Fisheries Society Student Subunit, Department of Fisheries and Wildlife, South Dakota State University.

Irwin, E. R. Science based management: an optimist's perspective. November 2004. Science Based Management Symposium (Keynote). Annual Meeting of the Southeastern Association of Fish and Wildlife Agencies. Hilton Head, South Carolina.

Irwin, E. R., G. Turner and P. Hartfield. January 2005. Alabama sturgeon habitat in the alabama river: integration of laboratory habitat selection studies and field measurements. Evolution, ecology and management of Scaphirhynchus Symposium. St. Louis, Missouri.

Irwin, E. R., J. Peterson, B. Freeman, M. Freeman and E. Kramer. November 2004. Aquatic GAP in the ACT/ACF: science-based management of aquatic resources. Science Based Management Symposium. Annual Meeting of the Southeastern Association of Fish and Wildlife Agencies. Hilton Head, South Carolina.

Irwin, E. R., J. Peterson, B. J. Freeman, E. Kramer, and M. C. Freeman. September 2004. Aquatic GAP: Regional Analysis of Biodiversity in the Tallapoosa River Basin. Alabama Water Resources Conference. Orange Beach, Alabama.

Irwin, E. R., M. Y. Taylor, K. D. Mickett, and P. Sakaris. January 2005. Habitat selection of juvenile shovelnose sturgeon. Evolution, ecology and management of Scaphirhynchus Symposium. St. Louis, Missouri.

Loehle, C., T.B. Wigley, M.S. Mitchell, and S.H. Rutzmoser. A test of landscape-scale indicators of sustainable forestry using bird point-count data from four landscape studies in the Southeast USA. Annual Meeting, Society of American Foresters, 2004.

Meldahl, R.S., and J.S. Kush. Carbon sequestration and natural longleaf pine ecosystems. *In:* Abstracts Thirteenth Biennial Southern Silvicultural Conference, February 28-March 4, 2005, Memphis, TN.

Mickett, K. D. and E. R. Irwin. November 2004. Science for changing flows: adaptive management of the Tallapoosa River below R. L. Harris Dam. Science Based Management Symposium. Annual Meeting of the Southeastern Association of Fish and Wildlife Agencies. Hilton Head, South Carolina.

Mickett, K. D. and E. R. Irwin. September 2004. Development of an integrated rapid assessment technique for detection of acid mine drainage. Annual Alabama Water Resources Conference. Orange Beach, Alabama.

Reynolds, M.J., L.L. Brongo, M.S. Mitchell, and J.B. Grand. Linking resource availability with demography of a population of black bears in the southern Appalachian Mountains. Carnivores 2004, November 14-17, 2004, Santa Fe, New Mexico.

Sakaris, P. C., E. R. Irwin, D. Harrison, and J. C. Jolley. January 2005. Flathead catfish on both sides of the Chattahoochee: Alabama natives versus Georgia fugitives. Georgia-AFS Chapter Meeting, Fort Gaines, Georgia.

Sharp, N.W. M.S. Mitchell, and J.B. Grand. 2005. Mouse population dynamics operate over multiple scales in a habitat undergoing restoration. 12th Annual Conference The Wildlife Society, September 25-27, 2005, Madison, Wisconsin.

Posters

Hayer, C. A. and E. R. Irwin. September 2005. Effects of Gravel Mining on Selected Fishes in the Mobile River Drainage, Alabama. (poster) 135th Annual Meeting American Fisheries Society, Anchorage, Alaska.

Mickett, K. D. and E. R. Irwin. September 2005. Development of a Decision Support Model for Adaptive Management of a Highly Regulated Southeastern River. (poster) 135th Annual Meeting American Fisheries Society, Anchorage, Alaska.

Sakaris, P. C. and E. R. Irwin. September 2005. Daily Aging of Age-0 Catfishes with Otoliths: Methodology and Validation Procedures. (poster) 135th Annual Meeting American Fisheries Society, Anchorage, Alaska.

Silvano, A., K. Kleiner, M. Taylor, M. Mitchell, E. Irwin, J.B. Grand, and M. MacKenzie. East Gulf Coast Plain Land Cover Mapping. May 2004. Troy State University GIS Symposium, Troy, Alabama.

Silvano, A., K. Kleiner, M. Taylor, M. Mitchell, E. Irwin, J. B. Grand, and M. MacKenzie. Alabama Gap Analysis Project; Managing Biodiversity with GIS. May 2004. Troy State University GIS Symposium, Troy, Alabama.

Graduate Theses and Dissertations

Black, D.D. 2005. A rapid biological/chemical assessment technique for characterizing streams impacted by acid mine drainage. M.S. Thesis Auburn University, Auburn, Alabama.

Hayer, C-A. 2005. Influence of spatial, temporal, and abiotic factors on detection probabilities for fishes in the Mobile River drainage, Alabama. M.S. Thesis. Auburn University, Auburn, Alabama.

Koons, D.N. 2005. Transient population dynamics and population momentum in vertebrates. Ph.D. Dissertation. Auburn University, Auburn, Alabama.

Sharp, N.W. 2005. Demography of small mammal populations in longleaf pine undergoing restoration. M.S. Thesis. Auburn University, Auburn, Alabama.

Taylor, M.Y. 2004. Habitat use and tag retention of juvenile shovelnose sturgeon, a surrogate species for Alabama sturgeon. M.S. Thesis. Auburn University, Auburn, Alabama.

Unpublished Reports

Ditchkoff, S.S., M.S. Mitchell, and J.B. Grand. 2004. Ecology and management of feral hogs on Fort Benning, Georgia. Annual Progress Report.

Freeman, M.C., J.T. Peterson, E.R. Irwin and B.J. Freeman. 2004. Distribution and status of at-risk aquatic taxa in the upper Tallapoosa River system, Alabama and Georgia. Final Report submitted to U.S. Fish and Wildlife Service, Athens, Georgia.

Irwin, E.R., E. Kramer, M.C. Freeman, G. Turner, D. Moosman, K. Mickett, P. Sakaris, C. Hayer, T. Piper and C. S. Straight, 2004. Aquatic Gap: Regional analysis of biodiversity in the ACT/ACF Basins: Tallapoosa River Basin. Final Report submitted to GAP Analysis Program, Moscow, Idaho.

Irwin, E.R., M. Taylor, K. Mickett, and G. Turner. 2005. Delineation of important habitat features for adult and juvenile Alabama sturgeon. Final report submitted to U.S. Fish and Wildlife Service, Jackson, Mississippi.

Irwin, E.R., P. Sakaris, J. Knight, and T. Piper. 2005. Redeye bass population status and critical habitat delineation in the Tallapoosa River and its tributaries. Final report submitted to Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama.

Irwin, E.R., P.C. Sakaris, and D. Moosman. 2004. Hydrologic variation in the lower Tallapoosa River: effects on recruitment and growth of striped bass and catfishes. Final Report. Alabama Department of Conservation and Natural Resources, Montgomery, Alabama.

Awards

Taconya Piper - Travel Award, American Fisheries Society. 2005.

Peter Sakaris - Best Student Paper Award, Georgia Chapter American Fisheries Society. 2005.

Invited Lectures

Adaptive management October 2004 (Irwin)

Black bear ecology and management. February 2005. (Mitchell)

Catfish ecology and management October 2004 (Irwin)

Introduction to Natural Resources. November 2004. (Mitchell)

Outreach/Technical Assistance

Dr. Grand

Spectacled eider recovery team – developed and presented population models to examine the potential effects of predator removal on spectacled eider populations on the Yukon-Kuskokwim Delta, Alaska in Seward, Alaska on 15 November 2005.

Yellow-billed Loon working group – developed and presented putative population models and approaches to assessing the effects of petrochemical industry development on Yellow-billed loons breeding the Naval Petroleum Reserve—Alaska, in Anchorage, Alaska on 28 January.

Alabama Wild Turkey Production Survey – led survey design, conducted surveys in piedmont ecoregion.

Alabama Quail Council, Technical Committee – developed preliminary maps of habitat recovery zones, estimated potential habitat acreages for conservation plan.

Dr. Irwin

Tallapoosa River Watershed Action Plan Annual Conference, Alexander City, AL 2005.

Maintains communication and data sharing with Stakeholders involved in the Adaptive management Project through http://www.rivermanagement.org

Training Provided

Dr. Irwin

Becoming and outdoors woman – October, March

Catfish Aging Workshop. A continuing education workshop on aging catfish with otoliths. Attended by 18 biologists and laypersons.

Organized Session for SEAFWA

Dr. Grand

Alabama Bobwhite Quail Workshops (3) – Assisted with program development in concert with ADCNR, AWF, and USDA, NRCS staff, delivered introductory remarks, and led workshop two-day workshops in Decatur (26-27 July), Millbrook (2-3 August), and Andalusia (10-11 August), Alabama. Attended by approximately 180 agency biologists, conservationists, and managers.

Modeling recovery of bird populations – Organized and presented a two-day workshop in Anchorage, Alaska (27-28 January) entitled “Understanding the impacts of catastrophes on marine bird populations: Using Aves Modeler for

population level analyses." Attended by approximately 25 biologists from DOI agencies and the private sector.

Teaching

Dr. Irwin

Spring 2005 – Special Topics in Lotic Ecology

Dr. Grand

Spring 2005 – Special Topics Population Analysis

Fall 2005 – Analysis of Wildlife Populations

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