Cache River-Cypress Creek Wetlands: 20-year Hydrologic and Sediment Research Contribution to Wetland Management

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The Cache River-Cypress Creek Wetlands is a RAMSAR wetland of international importance and northern most extent of cypress-tupelo gum tree stands in the country. The wetland receives high sediment load from the tributary watersheds which have contributed to the degradation of these sensitive habitats. The Illinois State Water Survey has been monitoring the sediment transport and sedimentation processes in the Cache River Basin since 1985. Big Creek was identified as a major contributor of sediment due to changes in land use practices and major channel alterations over the last one hundred years. The high sediment trap efficiency in the wetlands is due to the complex hydraulics of the Lower Cache River brought about by the natural setting and over a century of major channel alterations that divided the Cache River basin into two distinct watersheds. The monitoring data has been used to calibrate hydrologic and hydraulic models to characterize the Big Creek watershed. Those results have assisted resource managers formulate solutions and secure funding to implement major restoration efforts. Recently, a geomorphic assessment of Big Creek was conducted to improve our understanding of the on-going channel adjustment and erosion responses to historical land and channel management practices. This information is being used to determine the sediment transport characteristics of Big Creek to further channel restoration efforts and contribute information for post project appraisals. Results from the long-term monitoring, modeling, and geomorphic assessment and their contribution to management decisions will be presented.

Piezometers as Tools for Floodplain Hydrology Monitoring, Research, and Education Programs at Congaree National Park

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Congaree National Park (CNP) represents the largest and best-preserved tract of old-growth bottomland hardwood floodplain forest remaining in the Southeastern United States. The dynamics and role of floodplain hydrology in forest ecology is a core focus of the Old-Growth Bottomland Forest Research and Education Center (The Center) at CNP. The Center is uniquely situated to capitalize on floodplain hydrology research, management, and education goals by installing a 10-piezometer transect from the northern floodplain margin South 1.7 km to Cedar Creek, South Carolina's only stretch of Outstanding National Resource Waters. Piezometers are constructed of 1" pvc and have 1.5 m screens seated at depths of 4-5 m. Sampling sites are selected from various ecological communities, disturbance gradients, and geomorphic settings, and are situated to be both easily accessible and flexible for use as forest ecology research sites. A second, sub-parallel transect is planned.

The piezometers optimize several opportunities for collecting, using, and sharing data. The infrastructure and data will be available to academic researchers studying the floodplain groundwater table, flooding dynamics, forest ecology, and biogeochemical cycling. Data should serve as a reference point for pristine, non-tidal floodplains in the Southeastern Coastal Plain and beyond. Monitoring of short term, intra-annual, and longer inter-annual trends will inform park resource management. Piezometer-based interpretive and educational programs will expose park visitors to the basics of forest hydrology, while citizen scientist programs will get volunteers more involved in actual well installation and data collection. Both outreach opportunities will help improve science literacy and environmental stewardship.

Restoration and Management Practices for Canebrake Establishment

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Arundinaria is a native North American bamboo forming large monotypic stands or canebrakes with historic distribution encompassing floodplains the southeastern US. Cane's fluvial proximity has provided ecosystem services such as unique wildlife habitat for rare species, carbon storage, and enhancement of water quality by filtering excess sediments and nutrients from runoff. However, land conversion and altered disturbance regimes have limited cane to 2% of historical accounts. Canebrake restoration efforts face difficulties such as infrequent seeding and low viability, limited availability of seedling or rhizome planting stock, and inefficient establishment and management techniques. To address these problems, we are developing cane propagation and field-scale restoration and management techniques on the Cypress Creek National Wildlife Refuge and in the Cache River watershed in southern Illinois. We will summarize a series of studies that compared survival and growth of planted cane for up to six growing seasons at nine different sites (> 7 acres). We will also focus on a recent study that compared planted cane rhizomes (N=2160), planted randomly in rows, using a tree planter at two sites, to determine if collection date (fall 2006/ spring 2007), planting date (fall/ spring), collection source (3 putative genotypes) and cold storage affect field survival and growth. Results and discussion address if survival and growth performance (height, diameter, and spread) of cane relate to; container-grown and bare rhizome stock; using pre-planting weed control, prescribed fire, and fertilization; rhizome morphology (length, diameter, buds, roots); collection source; and planting site over time. Management recommendations will be given.

Phosphorus Retention by Wetland Plants in Agricultural Drainage Ditches: A Greenhouse Study

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Drainage ditches which support wetland vegetation can be used as natural treatment units to remove pollutants from agricultural runoff. Use of vegetation for retention of phosphorus (P) has potential for being an inexpensive technology for reducing downstream contamination since wetland plants may reduce seasonally-available nutrients. When compared to non-vegetated drainages, habitat advantages are obvious. Our experiment was designed to document the uptake and release of P by three wetland macrophytes (*Juncus effusus, Carex lurida and Dichanthelium acuminatum*). These three plants are commonly found growing together in the drainage ditches of the south, central USA. A one year greenhouse experiment is being conducted to quantify P retained by the selected plants in the agriculture drainage ditch system scenario. Species dynamics may play a role when the plants are growing together. If the rates of absorption of nutrients are different for each species, the more efficient species may take up the maximum amount of P and the other plants may supplement the retention of P. The primary goal of this study is to identify the plant or groups of plants that can be utilized most effectively for P retention so as to reduce P load in agricultural runoff and lessen potential downstream eutrophication problems

Migratory Bird Stopover Use of Reforested Lands: a Portable Radar Study

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In 2006, the U.S. Geological Survey's National Wetlands Research Center, and Farm Services Agency (FSA) collaborated on a study to evaluate the conservation benefits of the Conservation Reserve Program (CRP) as it relates to migratory bird habitat in the Lower Mississippi Valley (LMV). Specifically, we monitored autumn migratory stopover patterns on CRP easements and adjacent agricultural fields in northeastern Louisiana by using a marine weather radar system during September and October, 2006. Most migratory landbirds are nocturnal migrants and use stopover habitat for rest and refueling during the day. Migration resumes just after sunset, and these evening departures are easily detected by radar. We measured the number of migrants during exodus with a portable, vertically aligned, X-band radar system (Furuno, FR-8100D, 10 kW) operated at a 1.8 km setting with 24 rotations per minute and a pulse length of 0.08 μs. The radar unit was placed between CRP and agricultural fields so that radar observations of birds were collected simultaneously. The number of radar targets exiting each habitat type was compared. Preliminary and ongoing radar data analysis shows higher numbers of birds over the CRP easements compared to the agricultural fields. Final results from this study will create a better understanding of the conservation effects CRP lands may have on migratory birds in the LMV.

Restoring Former Agricultural Wetlands in LMAV with Mixed Bottomland Hardwood Species: Effects of Species Mixes and Early Management Practices

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Afforestation is regarded as a necessary first step in hardwood ecosystem restoration. In the flood plains of the LMAV, over 3 million ha of retired agricultural lands are available for bottomland hardwood afforestation. Concern about intra-specific competition with single species afforestation and constraints on seedling availability in the future have generated interest in the potential of mixed-species afforestation, yet little is known about the survival and growth of such stands in their early stages. This study examines the survival and early growth of six bottomland hardwood species mixes in the LMAV under early fertilizer and herbicide treatments. A 6 X 2 X 2 factorial arrangement of treatments (species, fertilizer and herbicide) was used on sites in Greenville and Cleveland, Mississippi. Bare-root (1- 0) seedlings were planted in winter 2006 with NPK fertilizer pellets applied in adjacent holes to planted seedlings at time of planting and two post-emergent herbicide treatment were applied 2 and 5 months after planting. Survival and/or growth differed significantly with species, fertilizer, herbicide application and their interactions on both sites. Mean survival ranged from 90 sph for cottonwood monoculture to 854 sph for red mulberry, after two growing seasons. Most significant growth in height occurred on fine-textured Cleveland soils and was associated with Cottonwood, oak mix, NRCS and green ash/oak mix stands. Fertilizer and herbicide treatments affected growth on the Cleveland site, and survival on Greenville site. Mixed-species afforestation has the potential to better ensure successful bottomland hardwood restoration and overcome adverse site and/or climatic conditions.

Patterns of Vegetation & Avifaunal Diversity in Georgia River Floodplains

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Improved management of river floodplain ecosystems requires increased understanding of community ontogenesis and maintenance, as well as accurate knowledge of existing assemblage patterns. To establish longitudinal patterns of species co-occurrence, surveys of vegetation and breeding bird assemblages were conducted along five river corridors in Georgia: the Flint, Ocmulgee, Oconee, Altamaha, and Satilla. A total of 92 sites were placed regularly at 10-rivermile intervals, skipping impounded reaches. Results of the surveys will be presented, with focus upon species and guild distributions, and concordance between bird and plant assemblages. The prevalence of particular communities will be assessed through a comparison of intra- and inter-basin patterns. Apparent reliance by birds upon vegetation physiognomy and floristics in selecting breeding habitat, will also be addressed.

Bottomland Hardwood Old Growth: Myth or Matter of Perspective

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In the United States, old-growth forest research has focused primarily in the West where many acres of such forests remain. Less is known about old-growth forests in the eastern United States due to the scarcity of such forests because of a longer period of human occupancy and anthropogenic disturbances. Interest in eastern United States old growth has increased recently due to a desire to return forests back to a "natural state" and to explicit management objectives for complex forest structure characteristics, such as multiple age classes, tree diameters, and canopy strata. This increase in interest is especially true for bottomland hardwood forests due to the possible re-discovery of the ivory-billed woodpecker (*Campephilus principalis*) and its need for large, decadent trees for foraging. These trees are presumed to be part of old-growth forests. Unfortunately, we have little quantitative information on the species composition and structure of bottomland hardwood old-growth forests, especially in the Lower Mississippi Alluvial Valley. Therefore, the objective of this paper is to discuss the state of bottomland hardwood old-growth forests. Questions to be reviewed include: (1) Would words, such as "complex" better describe these forests than "old growth"?, (2) "Does bottomland hardwood old growth actually exist?", and (3) What are the general characteristics of bottomland hardwood complex forests based on work in bottomland and other forest types. Composition and structural characteristics of several bottomland hardwood complex forests that are widely considered as "old growth" will also be discussed. We will conclude with a list of criteria that we consider important for determining bottomland hardwood complex forests.

Shallow Bathymetric Mapping of Floodplain Wetlands to Assist Management Decisions

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Understanding how topography structures habitat heterogeneity is an important factor for successful wetland planning, management, and restoration. Wetlands by nature are relatively "flat" compared to the surrounding landscape. These areas often do not have adequate elevation information because surveys lack detail or are non-existent. Priorities, logistics, and expenses are often limiting factors in obtaining this information. LIDAR is often too expensive to obtain and the vertical accuracy is $\pm$ 15 cm at best. Ground surveys through timber are typically slow and expensive. Utilizing handheld GPS and known water levels, we have developed a cost effective method of shallow bathymetry within small flooded wetlands. Tying this topographic information to the site hydrology can provide valuable information for wetland managers, i.e. flood coverage and frequency, habitat availability, and vegetation distribution. In this presentation we will illustrate the collection and use of such data and management implications for two green tree reservoirs in southeast Missouri and a passively managed early successional wetland connected to the Mississippi River.

Evidence for a Hydrologic Control on Nutrient Removal in the Atchafalaya River Basin, LA

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The Mississippi and Atchafalaya Rivers are the major sources of freshwater and nutrients to the Gulf of Mexico. Increased nutrient loads from these rivers, primarily in the form of nitrate, have caused increased eutrophication in the Gulf. Previous research suggests that the Atchafalaya Basin removes some of these nutrients before they discharge into the Gulf. As sedimentation associated with the Atchafalaya River fills in lake habitat, lakes transition to cypress swamps, and ultimately to bottomland hardwood forests. As this natural succession occurs, there may be a change in the amount of nutrients that are removed. We recently initiated studies to quantify nutrient removal in the Atchafalaya Basin based on storage in the soil and biomass, and via denitrification in the three distinct habitat types: lake, cypress swamp, and bottomland hardwood forest. Comparing nutrient removal rates in each of the three habitat types will indicate how habitat change in the Basin affects nutrient cycling, and consequently eutrophication in the Gulf. Here, we report preliminary results from our dendrochronology study. Chronologies constructed at several sites within the Basin indicate that the growth response of trees is similar both within stands and across forest types. Evidence suggests that hydrology partially determines the capacity for nutrient removal.

Future studies will increase the sample size to further explore the relationship between habitat type and nutrient removal.

River Connectivity as a Determinant of Fish Communities in Oxbow Lakes of the Yazoo River Basin

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The Yazoo River Basin of Mississippi includes several rivers that drain an area heavily impacted by agriculture that includes hundreds of fluvial lakes created by the meandering of the rivers. We studied 17 of these oxbow lakes distributed over the lower half of the Yazoo River Basin to document fish assemblage patterns and identify environmental variables that might influence these assemblages. Results of multivariate analyses showed that the degree of connectivity to adjacent rivers played a major role on the environment and fish communities. Lakes with direct connectivity tended to be deeper, less turbid, produce less phytoplankton biomass, and had greater fish species richness that included more riverine species. Conversely, as connectivity with the river was reduced or lost, lakes became shallow, more turbid, had higher phytoplankton biomass, and a less speciose lacustrine fish community dominated by centrarchid species. Seemingly, after lakes separate from the river, they trap sediments from annual floods and over years become progressively shallower; this sequence in turn modifies such characteristics as area and substrate composition. These results suggested that the river connectivity could be an important factor in determining not only fish community composition but also in shaping physicochemical conditions of these floodplain lakes. Effects of changes in connectivity of floodplain lakes; the loss or addition of connections to main rivers should be considered in lake restoration efforts. Management goals may be attainable by increasing or decreasing lake connectivity and thereby influencing fish migration, dispersal, and introductions, and modifying the overall physicochemical environment.

Wood Duck Duckling Mortality and Survival in Mississippi and Alabama Floodplain Ecosystems

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Floodplain ecosystems in southeastern United States provide critical habitats and resources for resident and migratory populations of North American wood ducks (*Aix sponsa*) yet little is known about mortality and survival of wood ducks in these systems. We studied radiomarked hen and duckling wood ducks that used palustrine and riverine wetlands in Noxubee National Wildlife Refuge (NNWR) in Mississippi in 1996-1999 and the Tennessee-Tombigbee Rivers and Waterway (TTRW) in Alabama in 1998-1999. We estimated cause-specific mortality rates for 234 and 90 mortality events of ducklings at NNWR and TTRW, respectively. Mortality of radiomarked ducklings (*n*) was caused primarily by avian and aquatic predators at NNWR in 1996-1999 and TTRW in 1998-1999. Other agents of mortality at both areas included snakes, mammals, exposure-related, and unknown causes. A composite estimate of duckling mortality among years and areas was avian (0.459; $n = 155$), aquatic (0.234; $n = 79$), snake (0.062; $n = 21$), mammalian (0.053; $n = 18$), exposure-related (0.021; $n = 7$), and unknown causes (0.130; $n = 44$). Our study was the first to quantify agents of mortality and habitat-specific survival rates of wood duck ducklings (Davis et al. 2007; *Journal of Wildlife Management* 71:507-517). Managers may increase local wood duck survival and recruitment by promoting suitable brood habitats (i.e., scrub-shrub wetlands) without aggregations of nest boxes that may attract predators and dispersing nest boxes amid or adjacent to these habitats.

Stand Structures in Riparian Floodplain and Upland Forests along Thorn Creek in Northeastern Illinois

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Upland forests – riparian floodplain forests – streams (rivers) ecosystems are considered to be the functioning components of a forested watershed. The interactions and connections between these components in terms of energy, mass and nutrients construct an important linkage of terrestrial and aquatic environments and form the integrity of the ecosystems. Despite ecological relevance of the linkage of terrestrial and aquatic ecosystems, there is a lack of quantitative information about the difference in patterns, structure and dynamics between these components. We investigated the structural characteristics in riparian floodplain and upland forests in northeastern Illinois. The tree species composition, dimensions (diameter, height and volume) distribution, and the structure of snag and coarse woody debris between the specific forest types were compared. Importance values showed that White oak, Red oak and Ironwood were the most important tree species in the upland forests, while Sugar maple, Elm and Basswood made the most contribution in the floodplain community. On average, basal area of living trees was larger in floodplains (6.7 m2/ha ± 3.2 m2/ha; average ± standard variation) than uplands (6.1 m2/ha ± 1.5 m2/ha); and the number of snags was higher in uplands (10.4 snags/ha) than floodplains (7.4 snags/ha). However, the basal area of snags was higher in floodplains (0.65 m2/ha) than uplands (0.63 m2/ha). The number and volume of coarse woody debris in floodplains were 46.5 piece/ha and 6.1 m3/ha, respectively, which were higher than in uplands (43.9 piece/ha and 5.8 m3/ha, respectively). The structural differences between the two forest types are expected to affect the ecological and biological processes in the ecosystems.

Bird Habitat Associations on the Lower Missouri River Floodplain

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Floodplain habitat provides important migration stopover and breeding habitat for birds in the southeastern and midwestern United States. Despite the ecological importance of floodplain habitat for birds, few studies have examined how the breeding bird assemblage changes with different stages of floodplain forest succession in the United States. We conducted 869 point counts in open areas dominated by wet prairie/forbs, 673 point counts in early successional forests, and 864 point counts in mature forests from 2002 to 2004 to describe the spring migrating and summer breeding bird assemblage in the lower Missouri River floodplain. We recorded 131, 121, and 141 species in the three respective habitats, a number higher than most locations in the midwestern United States and comprising >15% of all of the species in North America. Species diversity generally increased from west to east along the river, differed in important respects among land cover classes, but overlapped between seasons (migration and breeding) and years. Perhaps surprising was the high number of species of high conservation concern (n = 20) observed in wet prairie/forbs, emphasizing the conservation importance of this habitat. These data provide important insight into the comparative composition of avian floodplain biota and can be used to ascertain the conservation value of agricultural land abandoned and subsequently acquired as a consequence of the mid-1990s floods on the lower Missouri River.

The Effect of Microtopography on Drainage Patterns, Hydroperiod, and Tree Species Distribution within the Cache River Floodplain, Arkansas

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Tree species distribution within a riverine forested wetland is controlled by the hydroperiods imposed upon the landscape by riverine flooding, drainage patterns, and soil permeability. Soils with high clay and silt content and low permeability are typical in the Mississippi River alluvial valley and tend to retain water, creating local ponding conditions with the potential for wetland hydroperiods very different from those predicted by the adjacent river stage. I analyzed the effect of microtopography on hydroperiods and forest composition within the Cache River floodplain, Arkansas. Contour elevation data from USGS topographic maps was supplemented by a laser level survey to produce a detailed digital elevation model of the study area. Water level gages were installed to accurately measure the depth and duration of flooding in locations chosen to reflect potential areas of ponded water left perched at varying elevations within the forested wetland by receding floodwater. Forest composition was quantified in plots centered at points in a regularly spaced grid superimposed upon the study area. Tree species distribution was categorized by hydroperiod and compared qualitatively to previous vegetation surveys of the Cache River and other literature values of tree species flooding tolerance. Observed hydroperiods within distinct ponded areas were compared to the hydroperiods which would be predicted by the hydrograph of the Cache River. The greatest differences between observed and predicted hydroperiods occurred during the growing season (April-September), highlighting the difficulty of using river hydrographic data to predict hydroperiod and subsequent tree species distribution within the Cache River floodplain.

Efficacy of Chemical Site Preparation for Competition Control in Hardwood Afforestation Areas

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Successful establishment of hardwoods in retired agricultural areas of the Southeast is dependent upon a number of factors. Of principal importance are seedling quality, seedling handling, site preparation, planting quality, and competition control. Competing vegetation on retired agricultural areas is typically comprised of a mixture of grasses, sedges, and forbs, and the planting site may also be occupied by vines, shrubs, or tree species. The use of chemical site preparation is becoming increasingly popular in these afforestation efforts and may be essential for survival of the planted seedlings in some situations. However, competition control during the first growing season is critical for survival in most old field plantings. This study was conducted to evaluate the competition control provided by chemical site preparation treatments both on the pretreatment vegetation and as residual control of herbaceous vegetation during the first growing season. Chopper EC®, Arsenal AC®, and One Step were applied to a retired agricultural field in Louisiana which was fully occupied by a mixture of grasses, forbs and woody species. Herbicides were applied in August and oak seedlings (cherrybark and Nuttall) were planted on the area the following December. Competition control evaluations were completed on a monthly basis during the first growing season. Since all herbicides in the study have soil activity and potential for residual effects on the planted oaks, the seedlings were evaluated for any symptoms of herbicide damage. Results will be presented for initial treatment efficacy, residual herbaceous control during the first growing season, and crop tolerance for the oak seedlings. The information has the potential to both save millions of dollars in establishment costs and enhance survival in these afforestation efforts.

Evaluation of Minimum-length Limits for Crappies in a Large River-floodplain System

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Sport fisheries management has been infrequently attempted in large river-floodplain systems in the United States (U.S.). We collected black crappie *Pomoxis nigromaculatus* (Lesueur) and white crappie *P. annularis* (Rafinesque) from floodplain lakes within the lower White River, Arkansas. Data from 16 representative lakes were used to define basic stock structure statistics for the population and evaluate whether minimum-length limits could potentially improve crappie fisheries. Modeling efforts focused on predicting yield, mean size, number harvested, and size structure of crappies in response to a 254-mm minimum length limit compared to no length limit. Additional modeling assumed different levels of recruitment variability. Modeling indicated that implementation of a 254-mm minimum length limit for crappies would reduce the number harvested by half and minimally increase crappie yield when exploitation was high. Modeling also suggested the length limit would increase mean size (length and weight) harvested, with more substantial increases observed when recruitment was held constant. In the presence of high recruitment variability (population size CV>75%), length-limit implementation exhibited similar trends with yield and harvest as with low recruitment variability (population size CV<50%), and produced minimal improvement in population size structure. However, within this modeling scenario, greater variability was observed in all predicted population statistics over long-term time scales, which suggested that years of high-quality crappie fisheries would be balanced with as many poor years. Modeling results from the lower White River were generally similar to previous efforts for these species done in reservoirs and small impoundments.

Roost Site Selection of a Rare Bat in an Old Growth Bottomland Forest

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Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) is a rare species that is thought to be declining. In the southeastern Coastal Plains, the bat is associated with large hollow trees in bottomland hardwood forests. We studied Rafinesque's big-eared bat in Congaree National Park, the largest remaining tract of old growth bottomland hardwood forest in the US, to determine roost site selection under optimal conditions. Roost trees were located by tree searches and radiotelemetry. For each roost and random tree we recorded species, decomposition state, DBH, tree height and opening characteristics and established 0.1 ha plots with a roost or random tree at the center. During 2006 and 2007, we located 43 day roosts throughout the park. Rafinesque's big-eared bats showed strong selection for *Nyssa aquatica* for roosting. Roost trees were significantly larger and more decomposed than random trees. The area surrounding roost trees had significantly greater basal area, and trees within the plots had greater DBH, height, and number of openings than random plots. Species composition of roost plots also differed from random plots and contained fewer water elm (*Planera aquatica*), oaks (*Quercus* spp.) and swamp tupelo (*Nyssa sylvatica*). Our results suggest that Rafinesque's big-eared bats selected large *Nyssa aquatica* in older bottomland hardwood forests. Thus, effective forest management for this species includes conservation of mature forest with abundant cavity trees.

Small Mammal Community Associations with Topographic Complexities on a Wetland Restoration Site in Southeast Arkansas

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Commonly practiced on lands enrolled in the Wetlands Reserve Program (WRP) is excavation of shallow basins and creation of associated mounds. These structures increase microtopographic complexities which serve a variety of purposes, including development of diverse water regimes, vegetative communities, and wildlife habitat. Our objective was to investigate microhabitat associations of small mammals on the Bob White Memorial Wetlands Research and Teaching Station (BWMW). The BWMW consists of 146 ha and is located in the Mississippi Alluvial Flood Plain in Chicot County, Arkansas. It was enrolled as a permanent WRP easement in 2001. Sherman live traps spaced at 15 m intervals were used in 4 (7x7) 0.8-ha trapping grids located in basin-mound complexes to sample small mammal communities. Trapping and habitat measurements were conducted monthly (February-August, 2007). Species captured included the marsh rice rat (*Oryzomys palustris*), hispid cotton rat (*Sigmodon hispidus*), house mouse (*Mus musculus*), *Peromyscus* spp., fulvous harvest mouse (*Reithrodontomys fulvescens*) and the least shrew (*Cryptotis parva*). The hispid cotton rat and marsh rice rat comprised >80% of the individuals captured. Marsh rice rats were found at lower elevations, with house mice and *Peromyscus* spp. preferring higher elevations. Marsh rice rats were associated with water and cattails, presence of the fulvous harvest mouse was related to woody plants and vines and the least shrew with forbs and ground litter. Spatial distributions of small mammals as related to microhabitat characteristics were influenced by the complexity of the vegetative and physical environment associated with the basin and mound structures.

Restoration of the Flat Fork Valley

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The Tennessee Stream Mitigation Program is in the process of restoring approximately three miles of Flat Fork and three of its tributaries which are on Tennessee's 2006 303(d) list for numerous impairments. The primary goals of this restoration project are to improve water quality and aquatic and riparian habitat within the Flat Fork valley.

These goals can be accomplished by succeeding in the following objectives:

- reduce bed and bank erosion resulting in elevated non-point source sediment loads downstream;
- reduce thermal impacts caused by a lack of shade from forest canopy;
- improve water quality by excluding unrestricted livestock access and provide a riparian buffer on both stream banks;
- improve natural sediment movement by removing multiple impoundments;
- improve in-stream habitat by restoring natural stream channel dimension, pattern and profile using relict floodplain meander scrolls;
- enable the stream to be self-adjusting and self-maintaining;
- and provide for the recovery of natural stream functions.

Previous channelization, dredging, realignment and straightening have left the Flat Fork channel extremely incised with vertical, eroding banks, poor bed features, and unstable patterns. Multiple stream crossings on Flat Fork function as mini-dams that impede sediment transport capability, cause massive bed and bank scour, degrade aquatic habitat and exacerbate flooding. This paper focuses on strategies that incorporate fluvial geomorphic processes (analytical) and form (analog) based design approaches using native plant and substrate materials to remedy the causes of physical degradation to Flat Fork, its tributaries and floodplain.

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The Apalachicola River is located in the Florida Panhandle and is the largest river in Florida. It is home to many species of endangered mussels, anadromous striped bass (*Morone saxatilis*) and the endangered Gulf sturgeon (*Acipenser oxyrinchus destotoi*). Battle Bend is located at Navigational Mile 28.8 and was once part of the main channel of the river until the U. S. Army Corps of Engineers (USACE) excavated a cutoff in 1968 which bypassed this bend in the river. Over the next two decades, sediment deposition created a blockage in the lower arm of Battle Bend that restricted fish passage and angler access into the backwater pool of the severed bendway. Navigation maintenance activities (dredging) contributed to the entrenchment of the river channel which resulted in the loss of important floodplain habitat along the river corridor.

The purpose of this project was to re-establish a channel 200' wide by 1,000' long at the lower arm of Battle Bend. Sediment removal from Battle Bend was accomplished using excavators with spoil material loaded onto barges for transport. Reconnection of this old cutoff river channel will improve its water quality during low flow conditions and enhance its function as an important backwater habitat for spawning, feeding and/or nursery areas for many important Apalachicola River fishes. Material was transported by barge 14 miles downstream to Bloody Bluff, then, trucked 15 miles to the disposal site. Total material to be excavated was about 64,000 cubic yards at a total project cost of $1.94 million dollars.

Effects of River Connectivity on Floodplain Lake Fish Communities of the Lower White River, Arkansas

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Floodplain lakes have been extensively studied in tropical ecosystems, but little is known about the influence of connectivity on floodplain lake fish communities in temperate ecosystems. Relationships between floodplain lake connectivity and fish communities within the White River National Wildlife Refuge, Arkansas were investigated and temporal patterns in fish communities were characterized. Forty-one floodplain lakes were sampled using a combination of gear types collecting over 70 fish species. Environmental variables including water quality, lake morphometrics, and quantitative measures of connectivity were measured for each lake. Canonical correspondence analysis identified temperature, lake shape, type of connection, and start date of connection as most important in the structuring of floodplain lake fish communities. Three-floodplain lake classification types were generated with large, deep, long, narrow lakes with great temporal connection via a slough or bayou having greater abundances of rheophilic species. Intermediate size, shape, depth, and connectivity lakes were associated with rheophilic and lacustrine species; while small, shallow, round lakes with low temporal connection due to overbank connection were associated with more lacustrine species. Results indicate that connectivity is more important in influencing floodplain lake fish communities than previously documented.

Wood Duck Duckling Mortality and Survival in Mississippi and Alabama Floodplain Ecosystems

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Floodplain ecosystems in southeastern United States provide critical habitats and resources for resident and migratory populations of North American wood ducks (*Aix sponsa*) yet little is known about mortality and survival of wood ducks in these systems. We studied radiomarked hen and duckling wood ducks that used palustrine and riverine wetlands in Noxubee National Wildlife Refuge (NNWR) in Mississippi in 1996-1999 and the Tennessee-Tombigbee Rivers and Waterway (TTRW) in Alabama in 1998-1999. We estimated cause-specific mortality rates for 234 and 90 mortality events of ducklings at NNWR and TTRW, respectively. Mortality of radiomarked ducklings (*n*) was caused primarily by avian and aquatic predators at NNWR in 1996-1999 and TTRW in 1998-1999. Other agents of mortality at both areas included snakes, mammals, exposure-related, and unknown causes. A composite estimate of duckling mortality among years and areas was avian (0.459; $n = 155$), aquatic (0.234; $n = 79$), snake (0.062; $n = 21$), mammalian (0.053; $n = 18$), exposure-related (0.021; $n = 7$), and unknown causes (0.130; $n = 44$). Our study was the first to quantify agents of mortality and habitat-specific survival rates of wood duck ducklings (Davis et al. 2007; *Journal of Wildlife Management* 71:507-517). Managers may increase local wood duck survival and recruitment by promoting suitable brood habitats (i.e., scrub-shrub wetlands) without aggregations of nest boxes that may attract predators and dispersing nest boxes amid or adjacent to these habitats.

Using Elevation Data to Improve GIS-based Estimates of Potential Habitat in Bottomland Systems: A Case Study with Swainson's Warblers at White River National Wildlife Refuge, Arkansas

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To identify habitat for species of conservation concern, biologists have increasingly used large-scale technologies such as Geographic Information Systems (GIS). Indeed, numerous efforts, including GAP analysis and the Partners in Flight prioritization process, have used these data to identify suitable habitat for priority species. However, these land-cover data are relatively-coarse filters and do not account for habitat variation within each land-cover type. Because floods remove understory vegetation in low-lying forests, elevation exerts a strong influence on habitat structure. Thus, adding elevation data to existing land-cover databases may improve the ability of biologists to estimate potential habitat in bottomland systems, particularly for understory-dependent species whose habitats are vulnerable to flooding. One such species, Swainson's warbler (*Limnothlypis swainsonii*; SWWA), is a conservation priority in the southeastern U.S. In the Mississippi Alluvial Valley, accounts of available habitat for SWWA generally include all of White River National Wildlife Refuge (WRNWR), a >60,000 ha section of mostly bottomland forest in eastern Arkansas. Using data from surveys of >2000 points in WRNWR between 2000 and 2005, we found that SWWAs occupied only relatively-high elevations in the refuge (mean = 47 m). Based on elevation, we estimate that only 23% of WRNWR is potentially suitable for SWWAs. However, because of variation in habitat structure even at relatively-high elevations, the actual amount of suitable habitat is <23% of WRNWR. We suggest that using elevation data with existing land-cover databases can help separate potentially-suitable from unsuitable habitat for conservation-priority species, and more effectively focus the management of bottomland systems.

Primary Productivity, Hydroperiod, and Nutrient Cycling in Four Floodplain Forest Communities on a Blackwater River.

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A characterization of a blackwater river floodplain forest in South Carolina was conducted to 1) provide a reference for better management and restoration of this forest type, 2) test the subsidy stress hypothesis, 3) relate variations in hydroperiod to primary productivity and nutrient cycling among years and communities, 4) identify ecological processes potentially responsible for differences in productivity among communities and years, 5) identify mechanisms that contribute to water quality improvement by these forests, and 6) identify potential limiting nutrients on the site. The forest communities exhibited the classic subsidy stress curves of productivity along a flooding gradient over a period which included a wide range of moisture conditions. Greatest productivity occurred on the community occupying middle elevations. Also in that community, amplitude in productivity increased when flooding returned after several dry years, and this was attributed to luxury consumption of P during dry years and a fertilization e effect by N subsidies arriving with subsequent floods. Several mechanisms of N sequestration were identified, including uptake by trees with induced N deficiencies through luxury P uptake, and there was evidence of a N limitation of productivity in this nutrient rich and productive floodplain forest. Because eutrophication of marine systems is related to N runoff from terrestrial sources, these forests may be important to sustainable water quality on the coast.

Floodplain Research at the Old-growth Bottomalnd Forest Research and Education Center, Congaree National Park, SC

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Congaree National Park encompasses approximately 27,000 acres of floodplain forest, including 15,010 acres of National Wilderness Area. Congaree was established to "preserve and protect for the education, inspiration, and enjoyment of present and future generations an outstanding example of a near-virgin southern hardwood forest situated in the Congaree River floodplain in Richland County, South Carolina". Congaree is home to nearly 90 species of trees, over 700 plant species, more than 180 species of birds, and provides critical habitat for various floodplain species.

As part of the South Atlantic Coastal Plain Biosphere Reserve, a Globally Important Bird Area, and a Wetland of International Importance, Congaree National Park provides an exceptional location for research and education. Ecological studies have been conducted within Congaree for over 50 years, with diverse projects including inventories, natural history work, and long-term ecological studies involving biological communities, geomorphology, surface water and groundwater hydrology, vegetation dynamics, and impacts from anthropogenic disturbances and natural catastrophic events. These data provide important baselines for current data interpretation and adaptive management.

In 2004, the park became home to the Old-Growth Bottomland Forest Research and Education Center, one of 17 Research Learning Centers across the Nation. The Center facilitates research, encourages science-based education, and is uniquely situated to capitalize on floodplain research, management, and educational opportunities. Congaree data sets, coupled with new technologies, park support, the connectivity to the National Park Service Network, and the close proximity to Columbia, South Carolina make Congaree National Park a desirable location for future collaborative floodplain science.