PROJECT TITLE

COMPARATIVE EVALUATION OF WILDLIFE HABITAT IN A 25-YEAR-OLD RESTORED BOTTOMLAND FOREST IN RESPONSE TO THREE SILVICULTURAL TREATMENTS: WITH EMPASIS ON LONGTERM FOREST MANAGEMENT

PRINCIPAL INVESTIGATOR:

Joydeep Bhattacharjee, PhD
Plant and Restoration Ecology
Department of Biology
University of Louisiana, Monroe
LA- 71209-0520

E-mail: joydeep@ulm.edu
Telephone: 318-342-1946

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1. PROJEC T NEED

Bottomland hardwood forest (BHF, Rarity Rank: S4/G4G5) ecosystems in the southeastern US have been called an "ecosystem in crisis" (Creasman et al. 1992). The Louisiana State Wildlife Action Plan (Lester et al. 2005) lists the bottomland hardwood forests as home to 34 species of concern, including 17 species of birds, 5 species of mammals, 5 species of amphibians, 4 species of reptiles, and 3 species of butterfly. Records from the recent past (Haynes et al. 1988) show that about 70% of the BHFs in Louisiana have been lost to agriculture. To counter the alarming loss of BHF, the Louisiana Department of Wildlife and Fisheries initiated a conservation effort in 1961, through which over 90,000 hectares of the BHF have been purchased for restoration. One of the most important factors that determine the complexity of vegetation structure of these BHF is their unique hydrology (Wharton et al. 1982). These hydrological characteristics provide important ecosystem functions including maintenance of water quality and providing productive habitat for a variety of wildlife species that are of conservation concern in Louisiana (Southeastern shrew, Rusty Blackbird, Prothonotary Warbler, Timber Rattlesnake, etc.)

One of the major threats facing these unique forested areas is habitat modification, mainly due to altered hydrological regimes and ingression of invasive species, such as Chinese tallow (*Triadica sebifera*), Japanese honeysuckle (*Lonicera japonica*), balloon vine (*Cardiospermum halicacabum*), Wright's morning glory (*Ipomoea wrightii*), alligatorweed (*Alternanthera philoxeroides*), etc. These species can out-compete native species for limited resources, and can become pervasive, dominating entire habitats.

Ongoing research in the Plant Ecology Lab at ULM suggests that parts of the naturally regenerating areas may be experiencing "arrested succession," a state when trailing vines and herbaceous cover on the ground selectively disadvantage the recruitment of desirable woody species. Such states of arrested succession reduce diversity of tree species which are important in forming suitable habitats for birds and wildlife (e.g. den-trees for birds and mammals; WAP, pg. 77) and in forming a multi-canopy forest. Therefore, it is critical that intensive surveys be conducted in the WMA (Wildlife Management Area) to delineate and identify such areas and closely monitor them year round.

Further, as plant communities are dynamic, it is important to monitor changes over time, and to evaluate changes in wildlife habitat as a result. So, one of the first steps in assessing habitat will be a systematic survey of the plant community composition, diversity, abundance and degree of ingression by invasive species in the WMA. This will also help continually update the plant database for the WMA. Additionally, very little is known about the distribution of dwarf palmetto (*Sabal minor*) within the WMA, especially in light of the habitat heterogeneity offered by the species (WAP, pg. 78). Further, detailed information about the habitat would be extremely useful for formulating appropriate silvicultural techniques to restore/manage BHF for wildlife, which is a habitat conservation strategy for BHF identified in the WAP.

During the process of reforestation at Ouachita WMA, approximately 25, 1- ha. plots of land were left fallow (hereafter referred to as experimental sites) for natural succession. While these areas were left fallow for purposes of studying natural succession and comparing planted versus unplanted areas, data is available on only two of the 24 sites. Currently, these experimental sites contain several isolated adult trees and a range of herbaceous vegetation. Initial work in the ULM Plant Ecology Lab has focused on comparing differences between one such reforested area and an adjacent area left fallow. Expanding our efforts to sample more fields across the WMA would provide a detailed analysis of the differences between these restoration methods and help in the development of reforestation techniques that will optimize the habitat for species of conservation concern. It would be of great management importance to evaluate the onset of arrested succession in these sites, and to investigate if these experimental sites provide improved habitat for wildlife, especially species of conservation concern. Therefore, we plan to develop a conservation strategy beginning with identifying habitats and assessing their importance to species of conservation concern.

Additionally, majority of the restored BHFs are even-aged and relatively homogenous in species composition (dominated by oaks). Where tree survival is high, crown closure significantly reduces sunlight penetration into the ground, resulting in a sparse understory lacking the floral species richness found under "broken" canopies. The desired forest conditions (DFC's) to provide wildlife habitat, as described by LMVJV Forest Resource Working Group, include a structurally diverse layering of vegetation. Forest canopy openings are essential to maintaining desired levels of habitat heterogeneity through the formation of well-defined midstory and understory layers (Twedt and Loesch, 1999).

As seen today, most of the restored forests are relatively monotypic and homogenous. Stands which are relatively diverse through natural establishment of other woody species often still have oak-dominated canopies, sine the "new-comers" generally occupy lower crown positions (overtopped or intermediate). Oaks are strong competitors and under closed-canopy conditions may preclude the advancement of most non-oak species into higher crown positions (co-dominant and dominant).

While mature forests are more susceptible to natural events that create canopy gaps (e.g. tree-fall/blow-down, senescence of large-crowned trees, etc.) resulting in desired structural diversity, restored BHFs sites will likely take extended periods of time to mature enough to "generate" their own gaps. To expedite the onset of desired forest conditions that occur through natural forest development, stand manipulation may be warranted. Large-scale manipulation to create DFCs can be accomplished most efficiently through the commercial harvest of forest products. Commercial viability is determined in large part by a minimum threshold for volume and stem quality: Habitat can be managed/ manipulated through the removal of only pulpwood-quality trees, however, silvicultural options for forest management increases, as volume and timber quality increase. In light of carbon budgets, the presence of quality sawtimber not only enhances silvicultural options but may lead to more enduring sequestering of carbon. Since high quality sawtimber is used in products with extended usefulness such as flooring, panels and structural lumber. Therefore improved silvicultural options give managers more flexibility in prescribing and implementing treatments to enhance wildlife habitat, at the same time reducing carbon offsets.

Thinning generally increases growth but can reduce the quality of residual trees. Low intensity thinning may offer the best balance by increasing growth while maintaining bole quality, but it may not yield the desired habitat response or longevity. Low intensity thinning allows the residual tree canopies to "close" relatively quickly, precluding the extended period of increased sunlight necessary for the establishment and or advancement of non-oak tree reproduction and vegetative strata.

Variable retention thinning (*sensu* the positioning of the residual trees more so than the percent of the stand being retained), will meet three objectives simultaneously: 1) enhance the wildlife habitat, 2) increase the growth and vigor of residual trees, and 3) maintain enough stocking to continue development of quality timber. By retaining trees in varying cluster sizes, while removing non-target cluster trees, residual trees will be released from competition should create conditions conducive to the establishment of vegetation with differing degrees of shade tolerance (Twedt and Loesch, 1999). Further, some canopy openings should be large enough to create favorable conditions for the development and persistence of understory and midstory vegetation and promote the regeneration of non-oak species.

2. OBJECTIVES

The objectives for this study are two-fold. First, we will systematically assess the habitat conditions of the Ouachita WMA using the 1-ha. plots as experimental sites, develop and implement a management plan to protect, increase and restore vegetation diversity of the WMA, which will increase the carrying capacity and habitat conditions for the species of conservation concern. Secondly, we will provide resource managers clear implications of the efficacy and longevity of three silvicultural treatments (explained in the Approach section below).

Specifically, our goals are to:

1. Compare habitat conditions after 27 years between the restored areas and the 1-ha. experimental plots that have been left fallow.

2. Develop and implement a plan to control invasive woody species, in the experimental 1-ha plots and the restored forested areas. The degree of invasive species encroachment in both areas will also be mapped (GIS) and monitored over time.
3. Monitor, compare and contrast the habitat response to each of the three treatments and determine the treatment that results in the greatest total volume growth.

4. Assess the health, vigor and bole quality of select residual trees ~10 years post treatment (long term goal).

3. EXPECTED RESULTS AND BENEFITS

One of the major benefits of this research will be the compilation of a comprehensive habitat assessment in the Ouachita WMA, especially in natural and reforested areas within the WMA. Since the presence of several species of concern for the state was documented by Dixon 2005 (timber rattle snake) and Carroll 2005 (several species of birds, mentioned above) from the Ouachita WMA, it is essential to assess the current habitat conditions for these species and document any changes.

Based on the results of the three selective thinning (treatments) resource managers will be able to determine the optimal "residual tree cluster size and arrangement" that will; i) result in a forest stand that is diverse in plant communities and has vertical stratification, ii) provide the most persistent understory and midstory vegetation, iii) result in the most diverse canopy structure with native species in upper crown class positions, iv) results in the lowest occurrence of non-native species (especially Chinese tallow tree), v) finally yield the greatest timber value and presumed management flexibility.

Such assessments provide valuable guidelines in management recommendations. In addition, the comparison of habitat types between restored and naturally regenerating forests will be critical in understanding reforestation efforts in the long term.

4. APPROACH

This first part of the project will be conducted at 9 sites (18 pairs, planted vs. natural regeneration) within the WMA. Each of these locations has areas that were reforested and has adjacent 1-ha plots that were left fallow. We will sample each 1-ha fallow plot and a 1-ha area of the adjacent reforested land. A map of the proposed sampling locations on the WMA is attached.

In each area, we will use a belt transect to quantify the diversity and abundance of herbaceous vegetation. Additionally, we will use a point-centered quarter method to quantify the trees in the site. For each specific site, we will create a master-list of plants. This would be accomplished by doing frequent walk-through surveys in each site. This would also allow for a more thorough analysis of the plant diversity in the site and would enable us to document any rare plant species in Ouachita WMA. Any rare plants encountered would be reported to the Louisiana Natural Heritage Program.

Any invasive species encountered during the surveys will be categorized by 'degree of threat' (high, moderate and low), depending on the lifecycle pattern of the species and the given environmental conditions in the area. Location of invasive plant species (vines, shrubs or trees) in the specified sites will be marked using a GPS, and the cover by such species will be carefully monitored on a regular basis. Based on the level of threat and area covered by invasive species, management recommendations (spot-treatment using chemicals or if patches are large enough to carry out controlled burns) will be formulated.

The second part of the project (selective thinning) will be conducted in the sites marked ST1 and ST2 in the map (Appendix 2). The three levels of thinning are:

<u>Treatment "F" -</u> The removal of approximately 50% of the stems (~105 trees/ac) and the retention of ~105 tpa arranged somewhat sporadically in groups of ~5. The groups will contain one "crop tree" marked with BLUE paint. There will be ~21 highest quality trees selected at a predetermined pattern which facilitates access of harvesting machinery. The equipment operator is to leave 4 adjacent trees around each marked tree and cut and remove all others.

This treatment combined with the ~30% pre-treatment mortality will result in the crop trees being released from 3.7 (46%) of the 8 trees planted adjacent to it. The growth rate of all residual trees should be enhanced as each tree, including the crop tree, will be competitively released on all sides. This could prevent or delay natural pruning of lower limbs and result in poor quality boles. However, this treatment may be more applicable in stands that have already self-pruned significantly.

<u>Treatment "N" -</u> The removal of approximately 50% of the stems (~105 trees/ac) and the retention of ~105 trees arranged somewhat sporadically in groups of 7-9. The groups will contain one "crop tree" marked with ORANGE paint. There will be ~14 highest quality trees selected as group centers, at a

predetermined pattern which facilitates access of harvesting machinery. The equipment operator is to leave 8 trees around each marked tree and cut and remove all others. In most instances there will only be 5-7 of the original trees left to retain around the crop tree, therefore, if only immediately neighboring trees are retained around each crop tree, group size would average ~7+ trees.

This treatment combined with the ~30% pre-treatment mortality will result in the crop trees being released from 1.7 (21%) of the 8 trees planted adjacent to the crop tree. This treatment will result in crop trees remaining surrounded by greater number of neighboring trees—the remaining trees will act as "trainers" and presumably enhance the quality of the crop tree. The growth rate of all trees should be enhanced somewhat but less so than in treatment "F". This treatment may be more applicable in stands which still have live limbs on the future butt log and could benefit from further self-pruning.

Treatment "OS" - This will be an operator selected treatment, the specifics to be determined at a later time based on further consultation with LDWF personnel.

"C" - Control - This will include areas with no trees harvested and will likely continue to remain in a closed canopy condition with minimal understory vegetation. The "midstory" of the control site is currently comprised of overtopped non-oak tree saplings and some poles as well as the lower limbs of the dominating oak component. As the these limbs senesce and stem exclusion continues the stand will probably remain for many years as a single layered, monotypic, increasing stressed forest of more limited wildlife value than the treated stands.

The expected results of each treatment are based on the assumption that ~30% of the originally planted trees are either missing or severely retarded in growth. A schematic was used to predict the pattern of residual trees and the number of immediately neighboring trees which will be removed during harvest. It is assumed that any individual tree is competing directly with 8 adjacent trees, if survival was 100%. The schematic indicates that very few trees remain completely surrounded by the original 8 neighbors.

All work will be carried out by the PI and graduate students in ULM Plant Ecology Lab. Two graduate students will be committed to this project during the summer of 2012 so that data can be collected for two full years, beginning in the summer of 2012 and continuing through the summer of 2014.

A table of tentative timeline of the proposed research activities.

Research Activity	2012		2013			2014		
	Sum.	Fall	Spr.	Sum.	Fall	Spr.	Sum.	Fall
A. Set up the plots in both areas	X							
B. Sample vegetation /Habitat conditions (before thinning operations begin and continue thereafter)	X	X	X	X	X	X	X	
C. Continue with vegetation surveys of all plots.	X	X	X	X	X	X	X	
D. Primary data analysis and presentation of results at conferences (LAPB, LAS, ASB).							X	X

5. LITERATURE CITED

Carroll, A. D. 2005. A breeding bird and phenology study on two wildlife management areas in northeast Louisiana subjected to various silvicultural and hydrological practices. M.S. Thesis, Univ. of Louisiana, Monroe.

Creasman, L. N., J. Craig, and M. Swan. 1992. The forested wetlands of the Mississippi River: an ecosystem in crisis. The Louisiana Nature Conservancy, Baton Rouge, USA.

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Lester, Gary D., Stephen G. Sorensen, Patricia L. Faulkner, Christopher S. Reid, and Ines E. Maxit. 2005. Louisiana Comprehensive Wildlife Conservation Strategy (Wildlife Action Plan). Louisiana Department of Wildlife and Fisheries. Baton Rouge, LA.

Twedt, D. J. and C. R. Loesch. 1999. Forest Area and Distribution in the Mississippi Alluvial Valley: Implications for Breeding Bird Conservation. Journal of Biogeography 26:1215-1224.

Wharton, C. H., W. M. Kitchens, E. C. Pendleton, and T. W. Sipe. 1982. Ecology of bottomland hardwood swamps of the southeast: a community profile. United States Fish and Wildlife Service. Biological Services Program, Washington D.C., USA.

BUDGET

	Fiscal Year 2012-2013*			Fiscal Year 2013-2014*	
	SWG	ULM		SWG	ULM
Salaries and Benefits					
Bhattacharjee (PI): Stipend Graduate Student (2 students during FY '12-'13 and 1 during '13-'14)	$1,500.00 $3,200.00 $3,200.00	 $4,500.00 $4,500.00		$2,000.00 $3,850.00	 $4,500.00
Travel					
To and from field site	$2,000.00			$2,000.00	
Supplies and Equipment 4-wheeler (ATV)	$6,700.00				
Other Supplies				$1800.00	
Indirect Costs					
42% of Modified Total Direct Costs	$4,158.00	$3,780.00		$4,053.00	$1,890.00
Fiscal Year Totals	$20,758.00	$12,780.00		$13,703.00	$6,390.00
Total from SWG	**$34,461.00**				
Total from ULM	**$19,170.00**				
TOTAL PROJECT COST	**$53,631.00**				

* Please note that these budget periods as written correspond with an anticipated start date of 1 June 2012; therefore they run 1 June to 31 May of each year of the grant.

BUDGET JUSTIFICATION

Personnel

Dr. Joydeep Bhattacharjee, Principal Investigator- Dr. Bhattacharjee will be responsible for supervision and implementation of the entire project. The PI is requesting a summer stipend of $1,500.00 for the first year and $2,000.00 for the second year including fringe benefits (calculated at 25%) from SWG to compensate for his time dedicated to the project.

Graduate student- There will be two graduate students working on this project for the FY '12-13 and there will be one student for the FY '13-14. The graduate student(s) will be enlisted to work on this project. The major responsibilities of the students will include establishing the research sites and plots, monitor vegetation and data collection and analysis. Salary of $3,450 (x2) in year 1 and $3,850 (x1) in year 2 including fringe benefits (2.5%) is requested from SWG for the graduate student(s). This amount will cover the student's effort during the summer and a partial amount during the academic term. The remainder of the students effort on this project during the academic term ($4,500/ year including fringe) will be provided by ULM as a match.

Equipment/Supplies

The only major equipment for purchase will be an ATV (4-wheeler). Of the 10 sites to be sampled, direct access to 8 of them will not be possible year round as they flood and remain flooded for an extended period of time. While most studies on bottomland habitats recognize the importance and impact of flooding, very little is known about the actual habitat conditions, as flood waters run in and when flood waters recede. There are speculations about the mortality of native vegetation due to prolonged and un-natural hydrological regimes that may potentially put a large number animal species out of habitat during periods of flood. Also little is known about re-generation potential of native and invasive species once flood waters recede. All of these are important factors for consideration especially while managing for wildlife habitats. Therefore, an ATV will allow us to carryout year-round monitoring of our research site, gathering valuable data in the process. This will be the first study to document habitat changes due to flooding in the WMA.

Funds are also requested to purchase a Trimble Unit (Juno) GPS to carefully map the research sites including the canopy patches created during selective thinning operations.

Monies for other miscellaneous project specific supplies such as rubber boots, PVC pipes, seed traps, stationaries etc. have been requested.

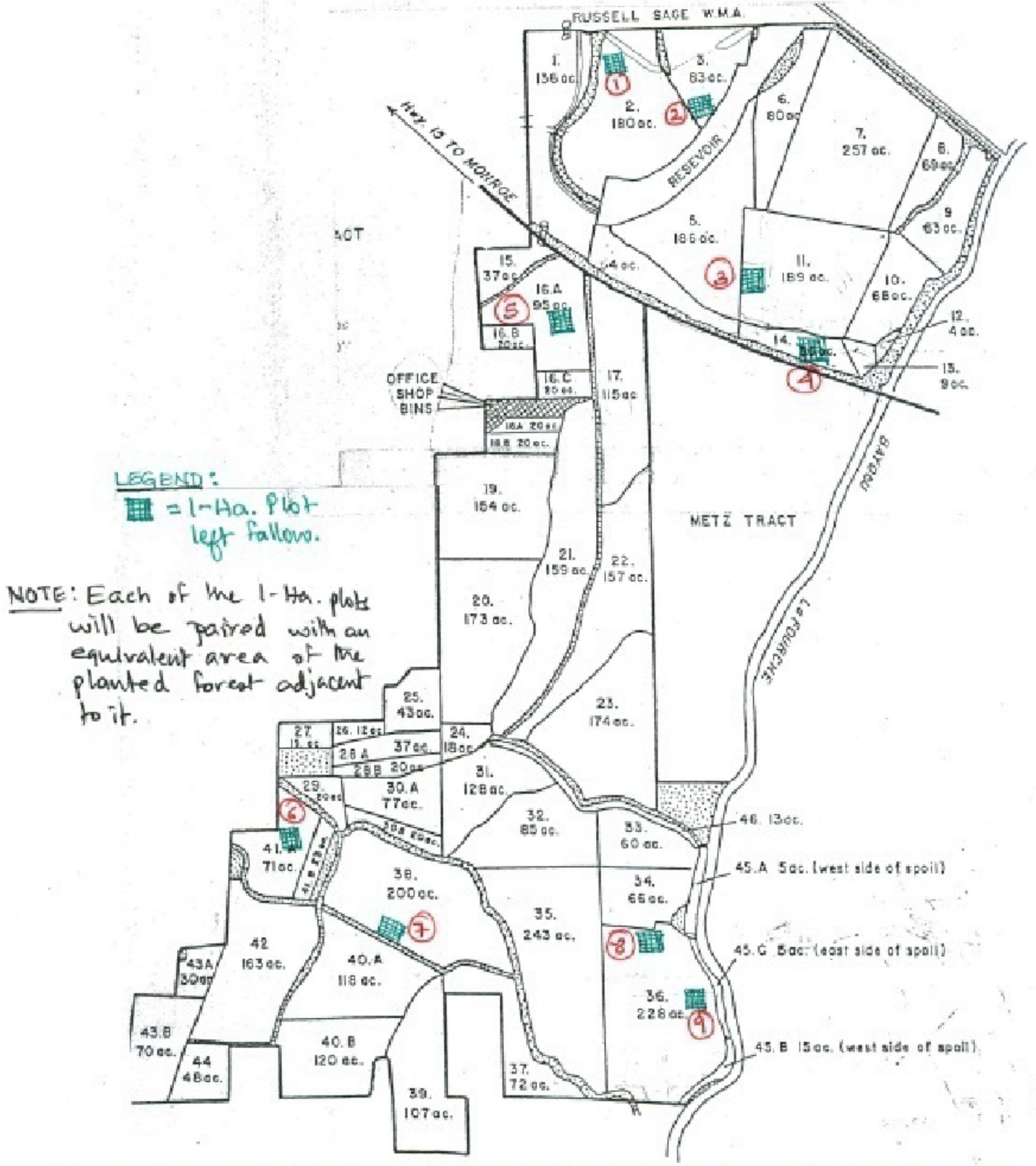
Travel

Travel has been estimated at $2,00 per year, based on approximately 16 trips a month during Mid-May, June, July and Mid-August, and 2 trips per month thereafter, to all 10 sites in the Ouachita WMA. This will primarily be for mileage reimbursement (Current rate for personal vehicle use is $0.48/mi) The total amount also will include expenses for gasoline and oil for the ATV and one trip to a scientific meeting to present research findings.

Indirect Costs

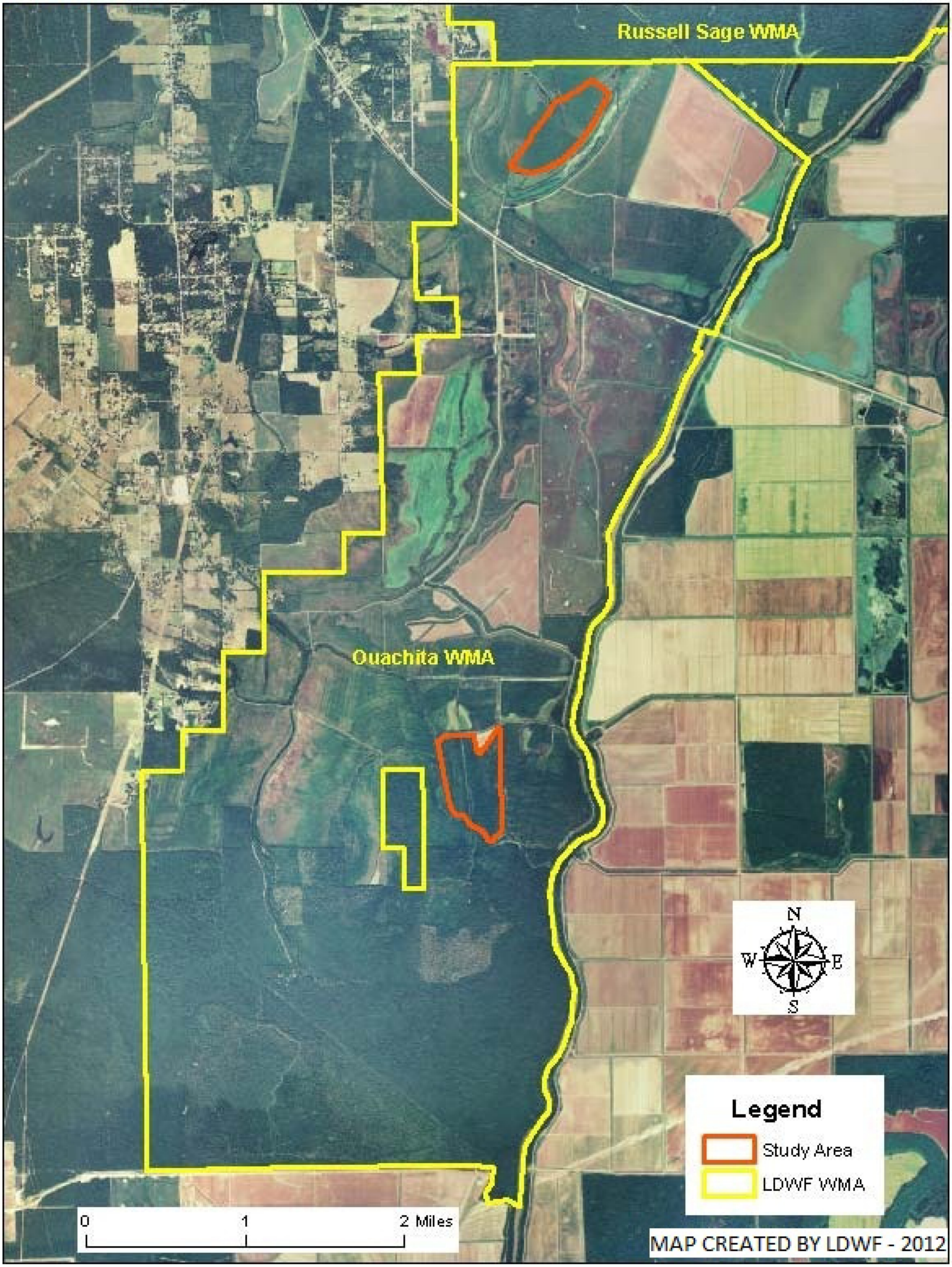
Indirect costs were calculated at a rate of 42% of modified total direct costs.

7. APPENDIX 1



Map of the Ouachita Wildlife Management Area showing the location of the 9, 1-ha. plots that have been left fallow (Source: LDWF).

APPENDIX 2



Russell Sage WMA
Ouachita WMA
N
W
E
S
Legend
Study Area
LDWF WMA
0
1
2 Miles
MAP CREATED BY LDWF - 2012