STEPHEN F. AUSTIN STATE UNIVERSITY

2013 Field Report For: Bat Occurrence Relative to Silvicultural Treatments Intended to Yield Desired Forest Conditions for Priority Wildlife Species in Bottomland Hardwood Forests

Lorraine Ketzler

9/8/2013

Introduction

This survey was initiated by the growing concern for forest-dwelling bats that rely upon bottomland hardwood forests. Increasing interest in Desired Forest Conditions (DFC's), a set of guidelines proposed by the Lower Mississippi Valley Joint Venture (LMVJV) for managing forests using uneven-aged harvest systems, has led to increased concern about the impact of such logging practices on state-managed Wildlife Management Areas and federally-managed U.S. Fish and Wildlife Service National Wildlife Refuges (Allen et al. 2001). Previous research has indicated that DFC treatments are beneficial to songbirds, however no previous research has been conducted on forest-dwelling bats in DFC treatments (Twedt and Somershoe 2010).

The effects of DFCs on other species, including bats, are largely unknown. Possibly they benefit from increased prey availability due to increased vegetative structural complexity. Very likely, the impacts vary among the bat species that occur in the region. Species that specialize on large, hollow trees for roosting sites such as the Southeastern Myotis (*Myotis austroriparius*) and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), both listed as species of special concern by the U.S. Fish and Wildlife Service, may be negatively impacted by the removal of roosting trees or by the change in vegetative structure associated with more open canopy conditions.

In order to survey bats when they would be actively foraging, I began my field season in the spring and finished in the fall: April 15-August 9, 2013. I visited seven Wildlife Management Areas and seven National Wildlife Refuges (hereafter called "locations") and spent about a week at each location. Each visit included six acoustic survey nights with one travel day in between locations, with a few delays in the schedule due to weather and equipment failure. I conducted acoustic surveys at each location to record bat calls in the forest, deployed insect traps in order to assess prey availability, and conducted vegetation surveys to assess how vegetative structure and vegetative species diversity might influence bat species diversity. At each location, we surveyed stands that recieved DFC treatments (called "treatment units") as well as non-treated areas (called "control units").

Survey Area

I surveyed locations in the Lower Mississippi Alluvial River Valley from Red River Wildlife Management Area, Vidalia, Louisiana, to Cache River National Wildlife Refuge, Cotton Plant, Arkansas (Figure 1). I surveyed 14 locations with mature bottomland hardwood forest ecosystems (Table 1). Bottomland hardwood forests are diverse, dynamic forest communities and may include hardwood species that dominate most forested floodplains, as well as some softwood species that specialize in permanently flooded swamplands (Allen et al. 2001). Tree species diversity is driven by hydrology:

streambeds (black willow, *Salix nigra*), temporarily flooded soils (elms, *Ulmus* sp., ashes, *Fraxinus* sp., and sugarberry, *Celtis laevigata*), disturbed sites (sweetgum, *Liquidambar styracifua*), poorly drained sites (overcup oak, *Quercus lyrata* and water hickory, *Carya aquatica*), and nearly permanently flooded depressions (bald cypress, *Taxodium distichum*, and tupelos, *Nyssa* sp.) may be present in some systems (Bennett 2012).

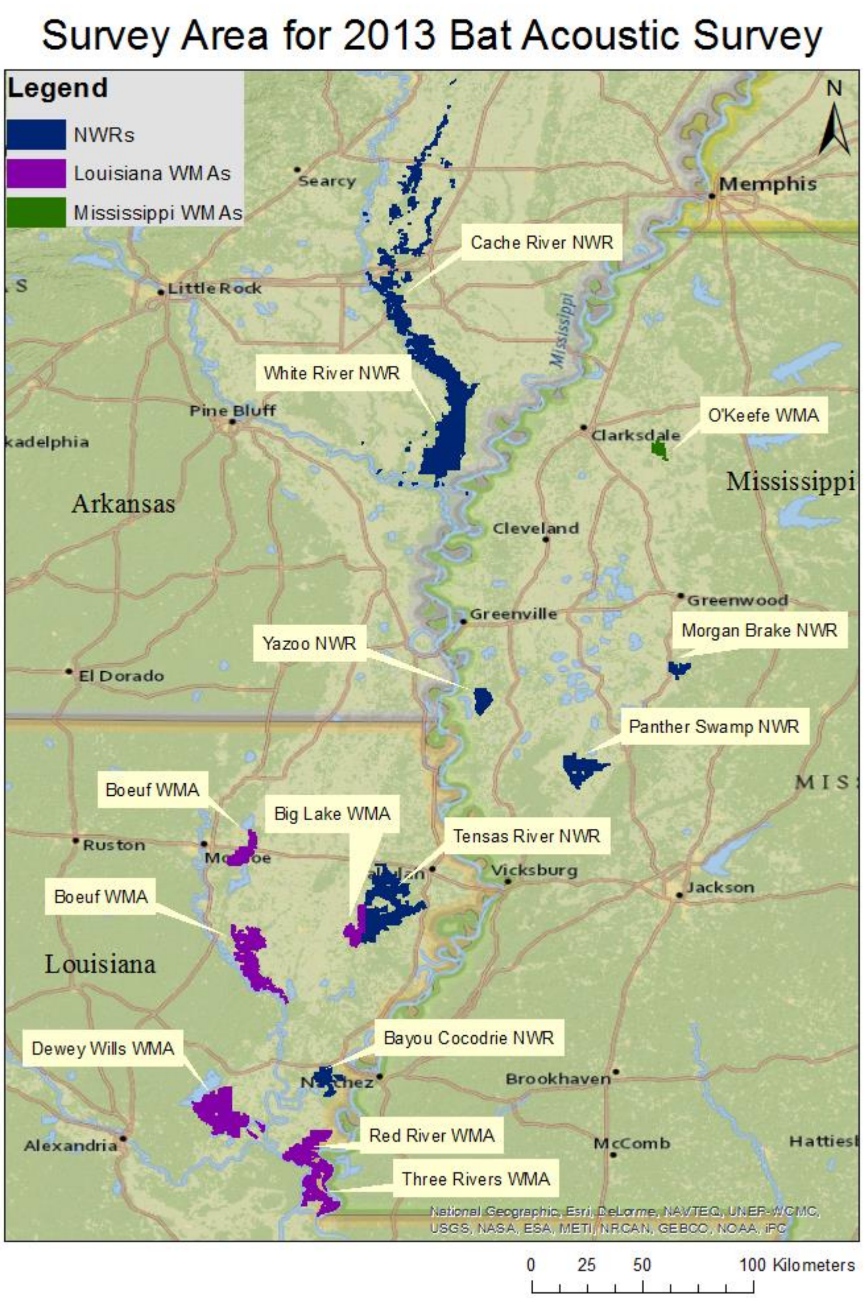


Figure 1. Survey area for 2013, including NWRs and WMAs in Louisiana, Mississippi and Arkansas.

Table 1. Locations and Dates for 2013 Ketzler Acoustic Bat Survey		
State	**Location**	**Date (2013)**
Louisiana	Three Rivers Wildlife Management Area	April 15-May 7
	Red River Wildlife Management Area	May 8-May 14
	Dewey Wills Wildlife Management Area	May 15-May 22
	Bayou Cocodrie National Wildlife Refuge	May 23-May 30
	Boeuf Wildlife Management Area	June 1-June 7
	Big Lake Wildlife Management Area	June 8-June 15
	Tensas River National Wildlife Refuge	June 16-June 24
	Russell Sage Wildlife Management Area	June 25-July 2
Mississippi	Yazoo National Wildlife Refuge	July 6-July 14
	Morgan Brake National Wildlife Refuge	July 6-July 14
	Panther Swamp National Wildlife Refuge	July 6-July 14
	O'Keefe Wildlife Management Area	July 15-July 22
Arkansas	White River National Wildlife Refuge	July 23-August 1
	Cache River National Wildlife Refuge	August 2-Agust 9

Locations were all state or federally managed lands that have had DFC treatments implemented within the past twelve years. Locations were chosen based on factors such as the number, size and quality of the DFC treatments available to be surveyed, and the presence of a bunkhouse or other lodgings for the survey crew.

I surveyed three treatment units and three control units at each location, except for the locations in Mississippi (Yazoo NWR, Morgan Brake NWR, Panther Swamp NWR, and O'Keefe WMA) had only one treatment unit and one control unit each. DFC treatments in Mississippi are fairly new and these Refuges were the only locations with available units that matched my requirements. I surveyed Yazoo NWR, Morgan Brake NWR, and Panther Swamp NWR during the same week, as I was able to split the survey crew into two independently functioning teams and lodge both teams separately.

I selected treatment and control units based on information provided by management agencies and foresters or biologists from each location, as well as personal experience of the research team. Treatment units were selected based on ranking. First, treatment units were ranked by the type of treatment. Group selection treatment was preferred, although individual selection treatments were considered if three group-selected treatment units were not available. Secondly, they were ranked by age, and only treatment units newer than 12 years old were considered. Newer treatment units were preferred and ranked higher. Size was also a factor in choosing units, as only units over 50 acres were considered. The only exception is the treatment unit at Yazoo NWR, at 23 acres, because that was the only treatment unit available at that location. Access to the treatment unit was also considered; ATV trails or gravel roads in "good condition" were preferred.

I chose control units based on age and species composition. Most of the original bottomland hardwood forests in the LMAV have been logged at some point, resulting in a loss of about 88% of the original forested area after 1978 (Allen et al. 2001). Therefore, it seemed unlikely that the locations available for my study could be considered "virgin" or "primary forest." In fact, of my study locations, only one, Bayou Cocodrie NWR, had what is considered "old growth" forest. With that in mind, although older units were preferred, and many units were at least 30 years old, units were considered "untreated" if they had not been treated within the past 12 years, which would allow canopy closure to occur over previously treated areas.

I tried to match control units to treatment units with similar species composition in order to minimize other factors that might influence bat response. That is, we attempted to ensure that the primary variable influencing bat species diversity between units at each location should be that the forest was treated according to the DFC guidelines. As well, I selected control units based on proximity to the treatment units. This aided in choosing units that should have more similar species composition, as the hydrology and soils should be more similar in areas that are geographically close. This also reduced the distance required to travel when we were surveying locations with non-contiguous management units. Finally, similar to the selection for treatment units, I considered access to the units and chose units that were accessible by ATV trails or gravel roads in "good condition".

I contacted managers, biologists and foresters from each location to request assistance with choosing treatment and control units. Whenever recommendations were given, I selected units that were recommended. Whenever recommendations were not made, I chose units without advice using the criteria previously mentioned. Occasionally, recommended sites were not appropriate for this survey. For example, one of the recommended treatment units was a younger replanted site with even-aged regrowth except for what had been thinned the previous year. Trees on this unit were estimated to be about 10 years old or younger. I chose an alternative treatment unit to survey which had more mature trees with a higher canopy, although that unit had not been treated as recently.

Materials and Methods

I deployed two Petterson D500x, Petterson Elektronic AB, acoustic monitoring devices per treatment and control unit for a total of 12 devices deployed per location. For the MS Refuges, 4 devices were deployed per location, for a total of 12 among the three Refuges. Each device was set to passively monitor and record calls for 6 continuous nights from 20:00 to 06:45. I also deployed each device with specific settings tailored to the conditions encountered in the field (Table 2) (Petterson Elektronik AB 2012). For example, some settings are higher or lower than what would be used in an area with less extraneous noise. In bottomland hardwood forests, insect noise is typically high because of high humidity, standing water, and woody debris, so I set my devices to record bat calls with minimum bug noise interference.

Table 2. Settings for Petterson D500x Acoustic Monitoring Device, 2013 Ketzler Acoustic Bat Survey

Type of Setting	Set to:	Reasoning
Profile	User 2	User 2 is less likely to be accidentally changed when turning the device on.
Time	20:00-6:45	This time covers most of the night, from sunset to sunrise from April – August.
Sample Frequency	500	This is the most data intense option for the device.
Pre-Trigger	Off	Each recording begins when a call is first detected, rather than postponing the recording to wait for a stronger call, this increases the likelihood of recording calls, even weak ones.
Recording Length	3 seconds	Weak calls will still be recorded, and good quality calls will be recorded with sufficient time to capture characteristics for identification.
HP Filter	Yes	Reduces bug noise.
Auto	Yes	The device automatically turns on and off to save battery power when no calls are being detected.
Trigger Sensitivity	Very Low	Set low to reduce bug noise.
Gain	20	Set low to reduce bug noise.
Trigger Level	200	Set high to reduce bug noise.
Interval	0	Records calls back-to-back without any time in between calls.

Acoustic deployment points were located within units at least 50m from the edge of the unit. Occasionally, gaining access into the units was problematic, such as when flooding after high rainfall events prevented us from crossing especially low depressions. When this was the case, points were sometimes positioned closer than 50m to the edge of the unit. I deployed devices in “grab and go” kits provided by Bat Conservation Management, which included the Petterson D500x acoustic recording device, a 25-foot cable that connected the Petterson D500x to an external microphone, and an external 6V battery with a connecting cable to power the acoustic device. I originally used one 32GB CF card and one 16GB CF card to store files on each device. In May, I noticed that the number of files recorded was increasing to reach the maximum capacity of those two cards, and began using two 32GB CF cards and one 16GB CF card. Even with 80GB, I occasionally had to switch out cards mid-week to create room for files for the rest of the survey week. I was unable to use AA- or C-cell batteries as recommended by the manufacturer because the power required by the device was insufficient for the number of files recorded during my survey week (Petterson Elektronik AB 2012). I found that four C-cell batteries could power a device for two nights maximum before the device warned that the power level was too low to continue recording files. External 6V batteries proved sufficient to last the full 6 nights.

Grab and go kits were secured to 23-foot extendable fiberglass and aluminum painter poles so that the kits were off the ground (Figure 3). This reduced the possibility of flooding the devices. Poles were stabilized by metal T-posts that were pounded into the ground about 6 inches deep. Poles were zip-tied to the T-posts to secure them. The external mic was positioned at a 45 degree angle using pvc pipe and joints which were strapped to the top of the painter pole with zip-ties. This allowed us to record calls from bats that were flying in the midstory and accessing gaps.

Figure 3. Grab and go kit with painter pole and cables showing, deployed in a control unit at Tensas River NWR.

Figure 4. Painter pole with pvc pipe and mic pointing into a treated gap at Red River WMA.

For treatment units, I chose acoustic device deployment points within the forest where DFC treatments had created gaps in the canopy (Figure 4). Occasionally, especially with individual selection treatment units, although the unit had been treated more recently than 12 years ago canopy closure had occurred and no treatment-caused gaps were discernible. In that case, I selected natural tree-fall gaps.

For control units, I selected natural tree-fall gaps for acoustic device deployment points. All acoustic devices, in treatment units and in control units, were situated at the edge of the gap in an attempt to reduce the likelihood that the pole would be observed by human recreationists.

In addition to acoustic devices, I deployed insect traps in order to assess prey availability. Traps were purchased through BioQuip and were constructed using 5 gallon plastic buckets with metal funnels, plastic baffles, circular blacklight fluorescent bulbs, a ballast, and lids attached by bungee cord (Figure 5). A nylon net bag was tied to the funnel to collect nocturnal flying insects that were attracted to the light, hit the baffles, and fell down the funnel into the bag. VapoStrips were placed inside the buckets to kill captured insects. Traps were hung from tree branches using rope tied to the lid, and were lifted 1.5-2m above the ground. The bulbs were powered by 6V batteries that were housed in plastic boxes, and the short connecting cable was the limiting factor for placement of the buckets, as both the bucket and battery had to be hung from the same tree or very close trees. Batteries had to be replaced every day, and recharged overnight. Timers ordered through BioQuip to turn on and off devices for specific sampling periods failed, and I was unable to replace them during the field season.

Figure 5. Insect trap that has been deployed and turned on.

I deployed six insect traps for four nights during the survey week. Each treatment and each control unit had one trap each. Traps were situated near acoustic device deployment points, but no closer than 50m to reduce the bias associated with attracting insects to the trap. Each trap was manually turned on at dusk and allowed to run overnight. Each trap was checked the next day to retrieve the sample. Insects were removed from the net bag and placed in jars that were labeled by point and date, and then were frozen; no chemical preservative was added. After traps ran for two nights at the first deployment point, they were moved to be near the second acoustic deployment point in that unit, again no closer than 50m to the acoustic device.

Samples will be processed at Stephen F. Austin State University. Insects will be identified to order, family, and, whenever possible, to genus and species. For each sample jar, insects will be separated into subsamples based on size and weighed for biomass as Dodd et al. (2008) recommended. This will allow me to analyze insects captured per trap night, per treatment or control unit, per location, etc.

I surveyed vegetation based on the recommendations from Wilson et al. (2007) *in* Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat (2007). I surveyed at 10 points along two transects in each treatment and each control unit. Vegetation surveys were also conducted at acoustic deployment points, for a total of 12 vegetation points per unit. With three treatment units, three control units, two transects per unit plus two additional points per unit, 72 total vegetation points were surveyed at each location. Points were located at least 100m from each other along each transect, measuring 400m per transect. Circular vegetation plots of 1/100th hectare were surveyed at each point.

Within each plot, trees greater than 20cm Diameter at Breast Height (DBH) were measured using a metric DBH tape (Figure 6). Each tree measured was identified to species. Trees less than 20cm DBH were not measured or identified. Each tree over 20cm DBH was classified by crown class: emergent, dominant, co-dominant, intermediate, suppressed, residual, or dead. Tree condition was noted using a number code from 1 to 8, where 1= no die-off of the crown and 8= dead, downed wood. If trees were dead and down, they were measured for length. When cavities were noticed, they were recorded as large or small; large cavities were estimated as greater than 25cm diameter. Two to three of the tallest trees in the plot were measured for height using a clinometer (metric) to calculate average canopy height.

Figure 6. Measuring DBH on a bald cypress.

In addition to tree characteristics, plot-level characteristics such as canopy closure were measured. Canopy closure was measured using a densiometer; four points along the edge of the circular plot were surveyed in the 4 cardinal directions to provide an average % canopy closure per plot. Stem density for trees less than 20cm DBH was calculated using a 4m radius circular nested sub-plot measured from the center point of the greater plot as described by Martin et al. (1997). Vertical stems less than 20cm DBH were counted at chest height. Only the total number of stems was recorded. If plots were located where the stem count would be higher than 200, the plot was shortened to 1m radius and percent coverage was recorded instead.

I attempted to capture midstory clutter as well based on the method used by Loeb and O'Keefe (2006). I designated the "midstory" as the area above 9m from the ground which remained below the overstory canopy. I ocularly assessed the midstory of each plot from the center point and assigned clutter into three classes: Low, Medium, and High.

A model of units and deployment points may be observed in Figure 6. Maps for each Refuge can be found in the Appendix.

Figure 6. Model of treatment and control units with deployment points and vegetation transects.

I used SonoBat™ software programs to analyze acoustic data as recommended by J.M. Szewczak (SonoBat™ Utilities 2012). The SonoBat™ D500x file attributer 2.2 named each recorded acoustic file according to a naming convention I designated. After files were attributed, I used SonoBat™ Batch Scrubber 5.1 to remove insect noise that was recorded even with the device settings that were used to reduce insect noise and other non-bat calls. I used the medium setting, which accepts all but poor quality calls, and accepts some noise with tonal content. I also set the scrubber to accept files in the 5-20kHz spectrum in order to keep any files that might be Rafinesque's big-eared bat, which typically have low frequency calls.

I used SonoBat™ 3.1 NE to SonoBatch all remaining files. In batch processing, the software program compares call sequences to a known species call library using maximum likelihood algorithms to arrive at a consensus ID.

In order to verify calls, each call must be viewed in SonoBat™ 3.1 NE. The program converts acoustic data into the visual spectrum (Figure 7) and experienced call verifiers are able to classify calls that would otherwise be too noisy, faint, or distorted for the software to identify.

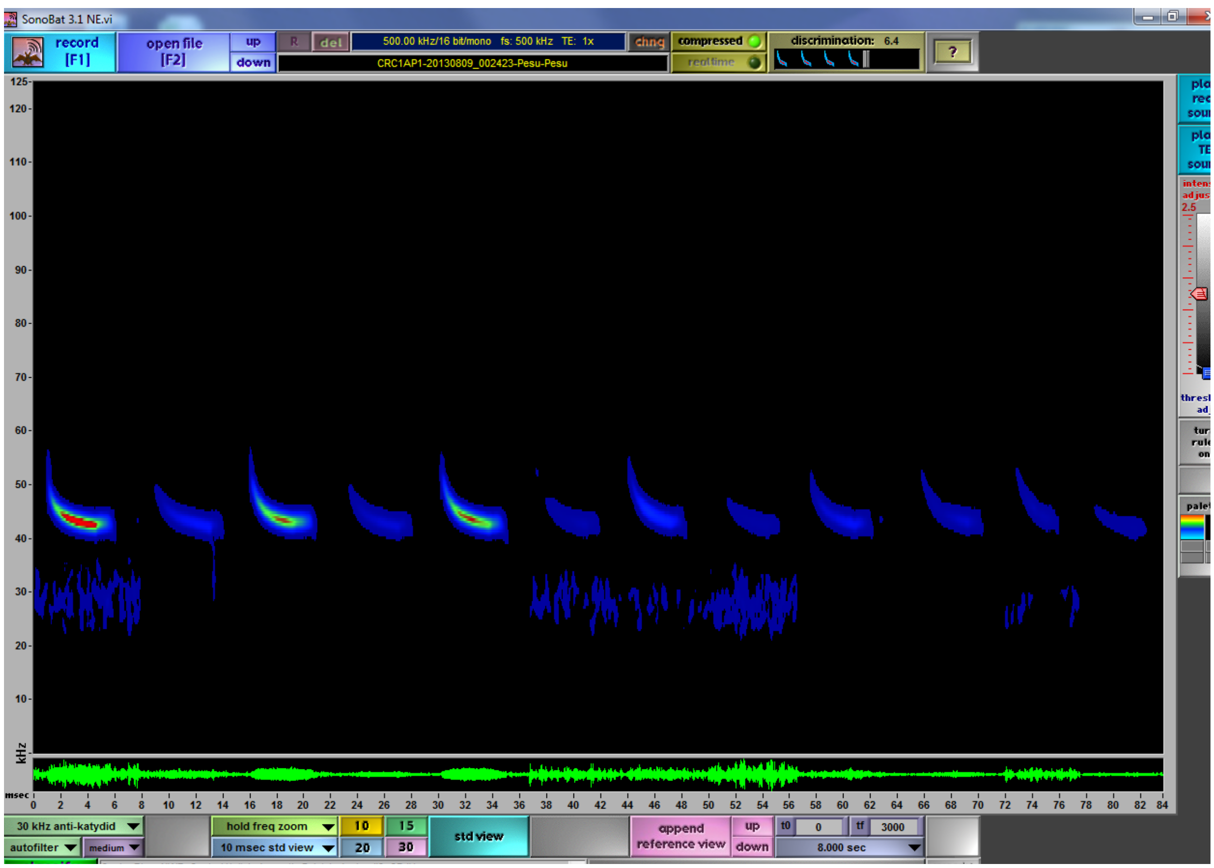


Figure 7. Sonobat 3.1 NE with a Tri-colored Bat (*Perimyotis subflavus*) call from Cache River NWR, Control Unit 1, Acoustic Point 1. The call frequency and amplitude are indicated by the scale bar and coloration. Many calls are not as clear as this one and the program may not be able to automatically identify them, which is why verification is important.

Results

I used the consensus data from SonoBat™ 3.1 NE to compile species lists for each location, because I have not finished verifying each call file. SonoBat 3.1 is not able to distinguish the differences between eastern red bats and Seminole bats (*Lasiurus borealis,* LABO, and *Lasiurus seminolus,* LASE), so I have grouped them together in my results (Szewczak 2011). I have also grouped Myotis species together, primarily because Southeastern Myotis (*Myotis austroriparius*) does not occur in the decision tree for SonoBat 3.1 NE, but also because of the difficulty in distinguishing between Myotis species (J.M. Szewczak, Humboldt State University Bat Lab, personal communication; Szewczak, classification notes). In addition to the previously mentioned *Lasiurus spp.* and *Myotis spp.*, I found the following species at each National Wildlife Refuge I surveyed: evening bat (*Nycticeius humeralis*, NYHU), hoary bat (*Lasiurus cinereus*, LACI), silver-haired bat (*Lasionycteris noctivagans*, LANO), tri-colored bat (*Perimyotis subflavus*, PESU), big brown bat (*Eptesicus fuscus*, EPFU), and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*, CORA).

Verification of calls may reduce the number of hoary bat and silver-haired bat calls, which may remove them in the presence/absence tables from specific acoustic deployment points, from specific management units, and possibly from an entire location. Insect noise often resembles the long, low calls that are observed from these two species, and may have been incorrectly identified as bat calls (J.M. Szewczak, Humboldt State University Bat Lab, personal communication). Silver-haired bats and hoary bats are uncommon in the southeast during the summer (Harvey et al. 2011).

The following Tables 3-9 present bat species detections per acoustic deployment point at each location.

At Bayou Cocodrie NWR, NYHU and *Myotis spp.* were present at nearly all acoustic points while CORA and LANO were detected at fewer points (Table 3). At Tensas River NWR, NYHU, LABO/LASE, and *Myotis spp.* were detected at nearly all acoustic points while CORA were detected at fewer points (Table 4). At Morgan Brake NWR, NYHU, LABO/LASE, CORA and *Myotis spp.* were detected at all acoustic points while EPFU were not (Table 5). At Panther Swamp NWR, NYHU, LABO/LASE, LACI, PESU, LANO and *Myotis spp.* were detected at all acoustic points while EPFU and CORA were not (Table 6). At Yazoo NWR, NYHU, LABO/LASE, LACI, PESU, LANO, CORA and *Myotis spp.* were detected at all acoustic points while EPFU were not (Table 7). At White River NWR, NYHU, LABO/LASE, LACI, PESU and *Myotis spp.* were detected at nearly all acoustic points while CORA and EPFU were detected at fewer points (Table 8). At Cache River, NYHU, LABO/LASE, PESU, and *Myotis spp.* were detected at nearly all acoustic points while CORA and EPFU were detected at fewer points (Table 9).

Table 3. Species Identified per Treatment and Control Unit at Bayou Cocodrie NWR (unverified, by consensus).

	NYHU	LABO/LASE	LACI	PESU	EPFU	LANO	CORA	*Myotis spp.*
T1AP1	🦇	🦇	🦇	🦇	🦇			🦇
T1AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP1	🦇	🦇	🦇	🦇	🦇			🦇
C1AP2	🦇		🦇	🦇		🦇	🦇	🦇
T2AP1	🦇	🦇		🦇	🦇	🦇		🦇
T2AP2	🦇				🦇			🦇
C2AP1	🦇	🦇	🦇	🦇	🦇			🦇
C2AP2	🦇	🦇	🦇	🦇	🦇		🦇	🦇
T3AP1	🦇	🦇		🦇				
T3AP2	🦇	🦇	🦇	🦇	🦇	🦇		🦇
C3AP1	🦇	🦇	🦇	🦇	🦇	🦇		🦇
C3AP2	🦇	🦇	🦇		🦇	🦇	🦇	🦇

Table 4. Species Identified per Treatment and Control Unit at Tensas River NWR (unverified, by consensus).

	NYHU	LABO/LASE	LACI	PESU	EPFU	LANO	CORA	*Myotis spp.*
T1AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T1AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP2	🦇	🦇	🦇	🦇	🦇	🦇		🦇
T2AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T2AP2	🦇	🦇	🦇		🦇		🦇	🦇
C2AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C2AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T3AP1	🦇	🦇		🦇	🦇			
T3AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C3AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C3AP2	🦇	🦇	🦇	🦇	🦇	🦇		🦇

Table 5. Species Identified per Treatment and Control Unit at Morgan Brake NWR (unverified, by consensus).

	NYHU	**LABO/LASE**	**LACI**	**PESU**	**EPFU**	**LANO**	**CORA**	***Myotis spp.***
T1AP1	🦇	🦇		🦇		🦇	🦇	🦇
T1AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP1	🦇	🦇	🦇	🦇	🦇		🦇	🦇
C1AP2	🦇	🦇	🦇	🦇		🦇	🦇	🦇

Table 6. Species Identified per Treatment and Control Unit at Panther Swamp NWR (unverified, by consensus).

	NYHU	**LABO/LASE**	**LACI**	**PESU**	**EPFU**	**LANO**	**CORA**	***Myotis spp.***
T1AP1	🦇	🦇	🦇	🦇		🦇	🦇	🦇
T1AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP2	🦇	🦇	🦇	🦇		🦇		🦇

Table 7. Species Identified per Treatment and Control Unit at Yazoo NWR (unverified, by consensus).

	NYHU	**LABO/LASE**	**LACI**	**PESU**	**EPFU**	**LANO**	**CORA**	***Myotis spp.***
T1AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T1AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP2	🦇	🦇	🦇	🦇		🦇	🦇	🦇

Table 8. Species Identified per Treatment and Control Unit at White River NWR (unverified, by consensus).

	NYHU	LABO/LASE	LACI	PESU	EPFU	LANO	CORA	*Myotis spp.*
T1AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T1AP2	🦇	🦇	🦇	🦇	🦇		🦇	🦇
C1AP1	🦇	🦇	🦇	🦇	🦇		🦇	🦇
C1AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T2AP1	🦇	🦇	🦇	🦇	🦇	🦇		🦇
T2AP2	🦇	🦇	🦇	🦇		🦇	🦇	🦇
C2AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C2AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T3AP1	🦇		🦇					
T3AP2	🦇	🦇	🦇	🦇	🦇	🦇		🦇
C3AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C3AP2	🦇	🦇		🦇		🦇		🦇

Table 9. Species Identified per Treatment and Control Unit at Cache River NWR (unverified, by consensus).

	NYHU	LABO/LASE	LACI	PESU	EPFU	LANO	CORA	*Myotis spp.*
T1AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T1AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C1AP2	🦇	🦇	🦇	🦇		🦇		🦇
T2AP1				🦇				🦇
T2AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C2AP1	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C2AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
T3AP1	🦇	🦇		🦇	🦇	🦇		🦇
T3AP2	🦇	🦇	🦇	🦇	🦇	🦇	🦇	🦇
C3AP1	🦇	🦇	🦇	🦇		🦇	🦇	🦇
C3AP2	🦇	🦇	🦇	🦇				🦇

As previously mentioned, verification may reduce the number of call files identified as LACI and LANO calls. Initial assessment indicates that species richness may occur evenly across the surveyed Refuges.

The SonoBat™ Ozarks software package is proposed for release soon and may affect this initial data analysis as well. The program may be better able to separate and identify Myotis species, especially *Myotis austroriparious*, as it is proposed to appear in the decision tree for the new program.

Discussion

I hope to finish processing insect samples and transcribing vegetation data this school year with the assistance of 5 student employees, 4 for insect identification and biomass data collection and 1 for vegetation data transcription. I will continue to verify calls and I hope to begin analyzing acoustic data in early 2014. Once verified calls can be used for analyses, I can test for any true and significant differences between treatment units and control units.

The Southeastern Bat Diversity Network Conference is scheduled for February, 2014, and will be hosted in Nacogdoches at Stephen F. Austin State University. I hope to have more data to present at the Conference. As well, I will be attending and presenting at the Texas Chapter of The Wildlife Society annual meeting in Austin this spring.

My second field season will begin in April/May 2014. Dr. Comer, Dan Twedt, Gypsy Hanks and interested Refuges will be consulted for advice about the season's locations, schedule, and for any revisions to the methodology.

Acknowledgements

I appreciate all of the help that I was given throughout the season. My crew and I felt welcome at each location and especially feel grateful to the maintenance staff that assisted us with vehicle issues and broken equipment. I am thankful to Janet Ertel from the Region 4 I&M office for funding the field season and purchasing equipment. Gypsy Hanks and Dan Twedt were essential for putting the grant proposal together and initiating the project, as well as for guiding me throughout the 2013 season. I would like to thank Dr. Comer for giving me the opportunity to work on this project. My field crew was excellent: Kevin Narum, Tim Gibble, Hunter Handley, Courtney Threadgill.

Literature Cited

Allen, J. A. and B. D. Keeland, J. A. Stanturf, A. F. Clewell, H. E. Kennedy, Jr. 2001 (revised 2004). A guide to bottomland hardwood restoration. U.S. Geological Survey, Biological Resources Division Information and Technology Report USGS/BRD/ITR-2000-0011, U.S. Department of Agriculture, Forest Service, Southern Research Station, General Technical Report SRS-40, 132 p.

Bennett, A. J. 2012. Vegetative characteristics of adjacent old-growth and mature secondary bottomland hardwood forests in East Texas. Project proposal, Stephen F. Austin State University, Nacogdoches, Texas, USA.

Dodd, L. E., and M. J. Lacki, L. K. Rieske. 2008. Variation in moth occurrence and implications for foraging habitat of Ozark big-eared bats. Forest Ecology and Management 255:3866-3872.

Harvey, M. J., and J. S. Altenbach, T. L. Best. 2011. Bats of the United States and Canada. Johns Hopkins University Press, Maryland, USA.

Loeb, S. C. and J. M. O'Keefe. 2006. Habitat use by forest bats in South Carolina in relation to local, stand, and landscape characteristics. Journal of Wildlife Management, 70(5):1210-1218.

Martin, T. E., and C. Paine, C. J. Conway, W. M. Hochachka, P. Allen, W. Jenkins. 1997. BBird field protocol. Breeding Biology Research & Monitoring Database, Montana Coop. Wildlife Research Unit, Biological Resources Division, University of Montana, Missoula, Montana, USA.

Petterson Elektronik AB. 2013. Version 2.1.3 D500x user's manual. Petterson Elektronic AB, Uppsala Science Park, Uppsala, Sweden.

Smith, D. A., and S. D. Gehrt. 2010. Bat response to woodland restoration within urban forest fragments. Restoration Ecology, 18(6):914-923.

Szewczak, J. M. 2012. SonoBat Utilities. SonoBat software for bat call analysis. <http://www.sonobat.com/download/SonoBatUtilities.pdf> Accessed May 2013.

Szewczak, J. M. 2011. Echolocation call characteristics of eastern US bats. Humboldt State University Bat Lab.

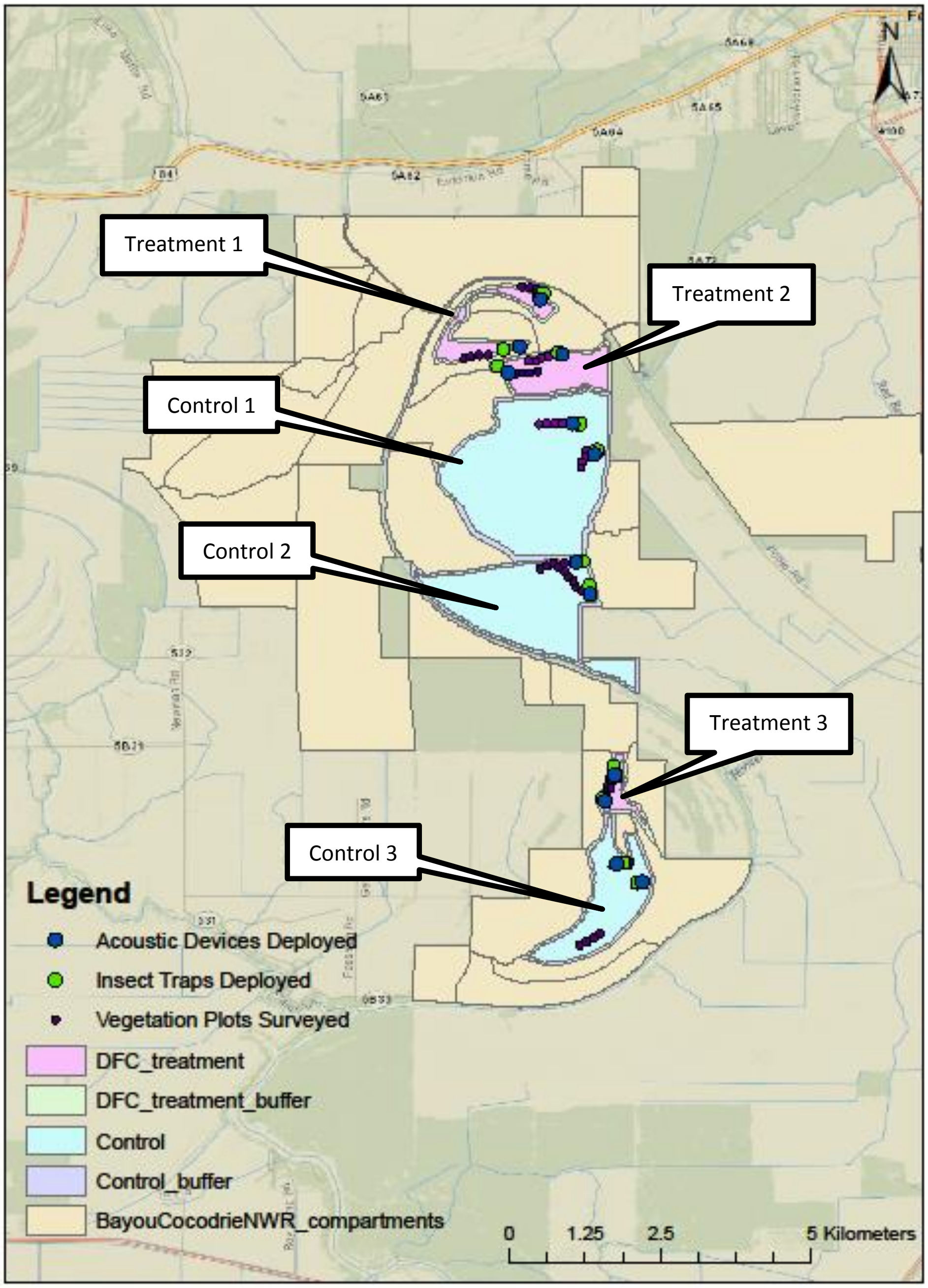
Szewczak, J. M. SonoBat 3.1 NE classification notes. SonoBat software for bat call analysis. <http://www.sonobat.com/download/SonoBatClassificationNote-NE-v3.1.pdf> Accessed May 2013.

Twedt, D. J., and S. G. Somershoe. 2010. Bird response to prescribed silvicultural treatments in bottomland hardwood forests. The Journal of Wildlife Management. 73(7): 1140-1150.

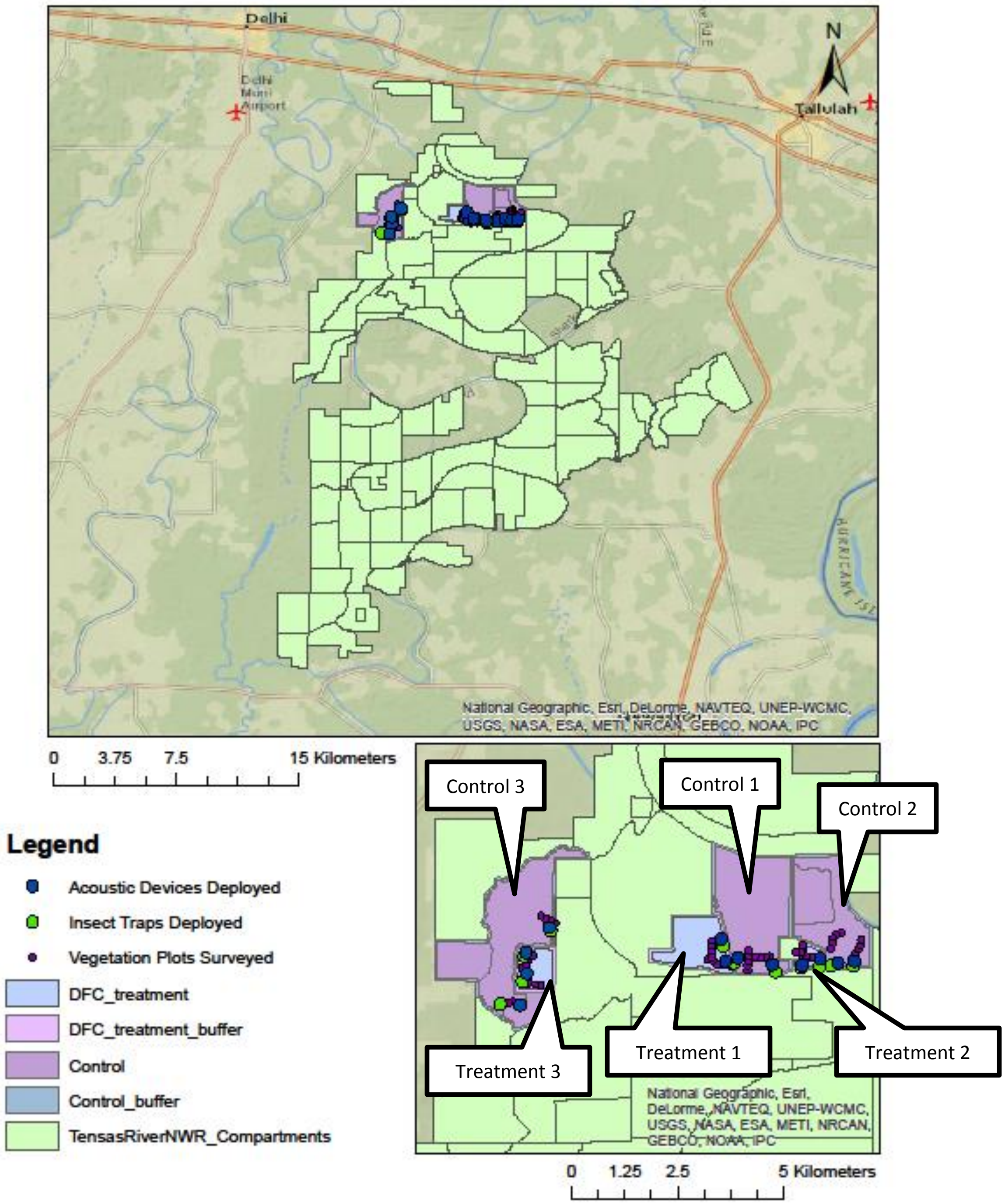
Wilson, R., and K. Ribbeck, J. Denman, E. Johnson, M. Blaney, C. Hunter. 2007. Prospectus for ivory-billed woodpecker habitat assessment, appendix 4 *in* R. Wilson, K. Ribbeck, S. King, and D. Twedt, editors. Restoration, management, and monitoring of forest resources in the Mississippi alluvial valley: recommendations for enhancing wildlife habitat. Lower Mississippi Valley Joint Venture, Forest Resource Conservation Working Group, Vicksburg, Mississippi, USA.

Appendix

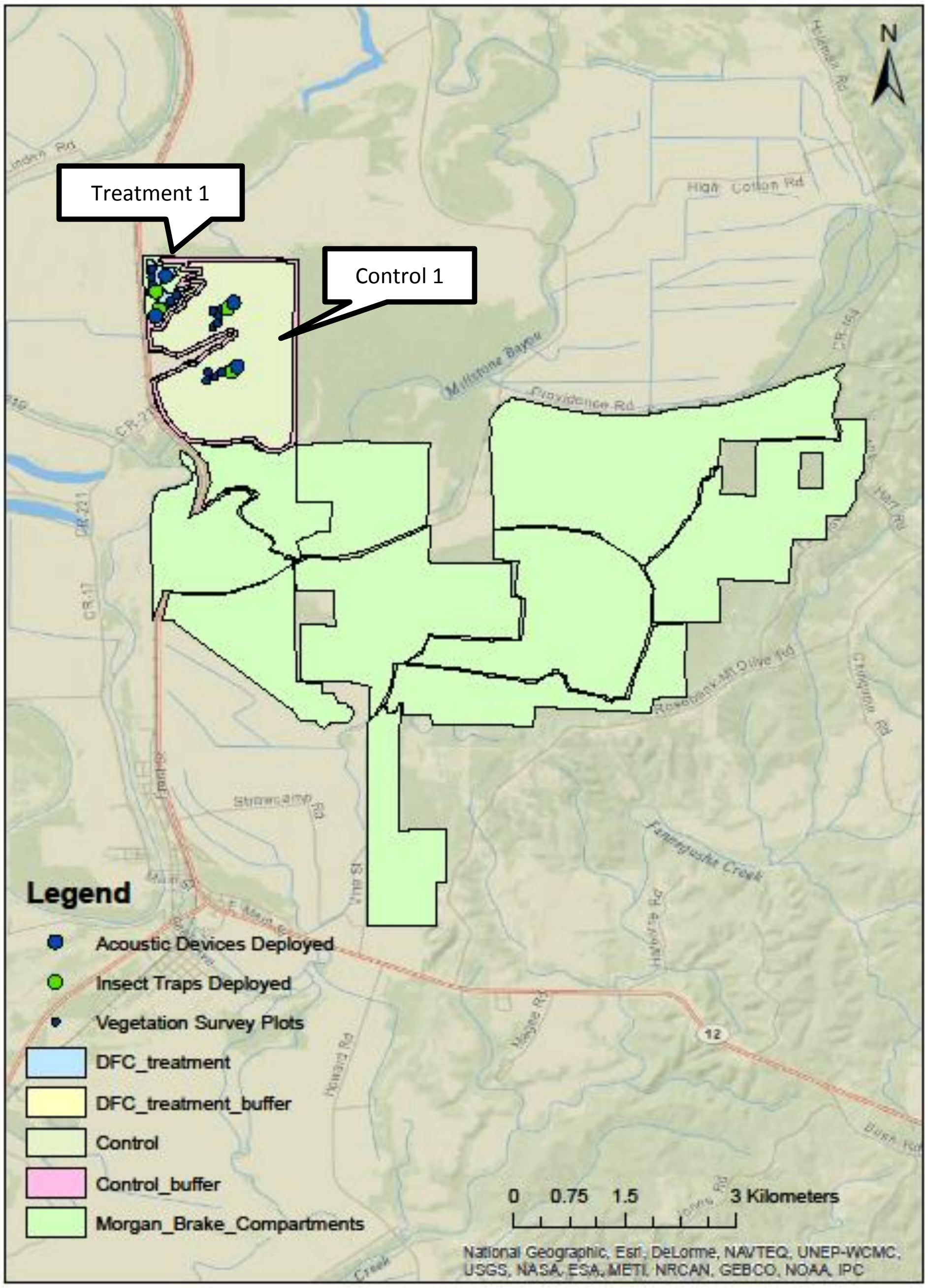
Bayou Cocodrie NWR, 2013 Ketzler Acoustic Bat Survey



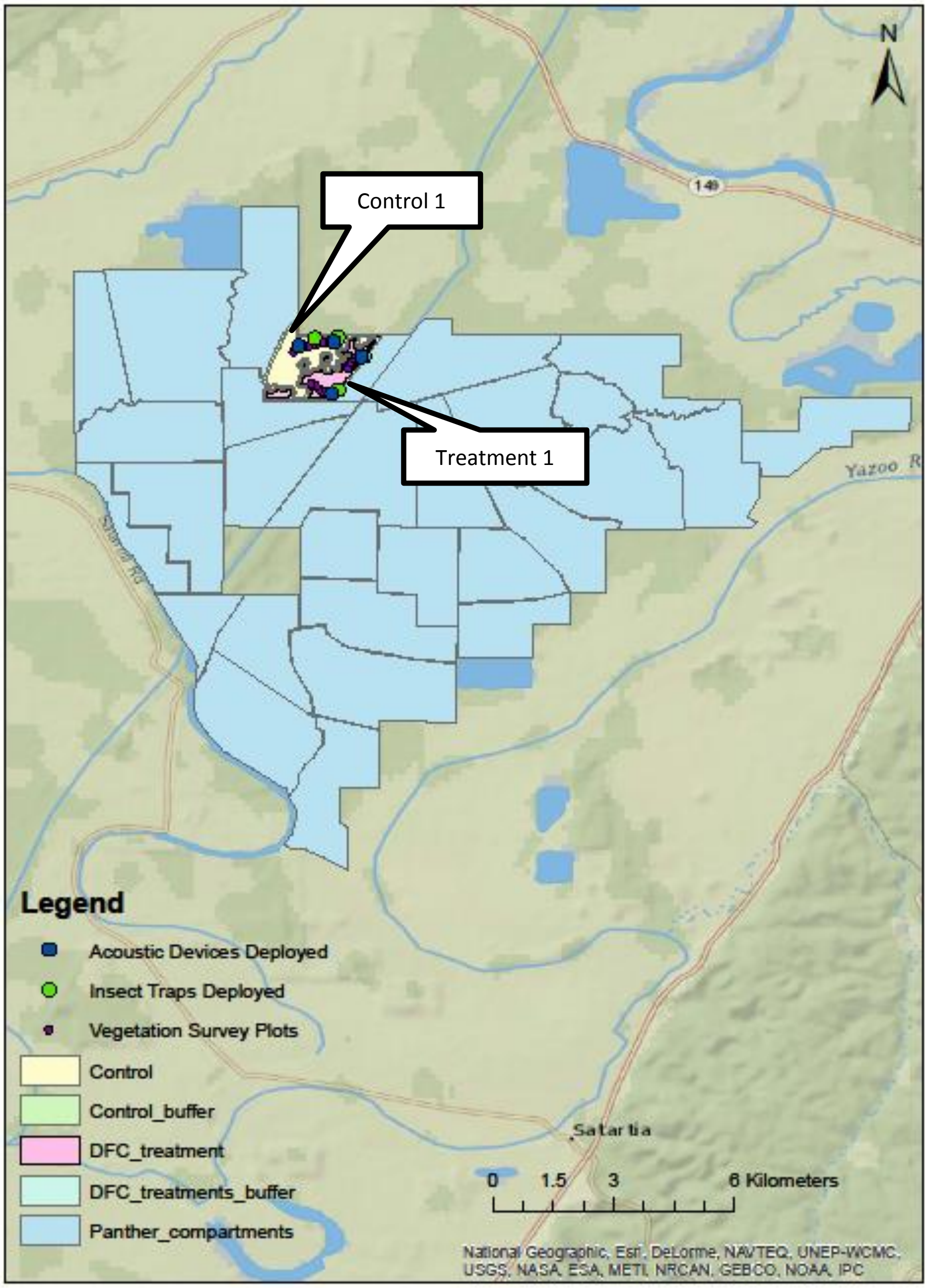
Tensas River NWR, 2013 Ketzler Acoustic Bat Survey

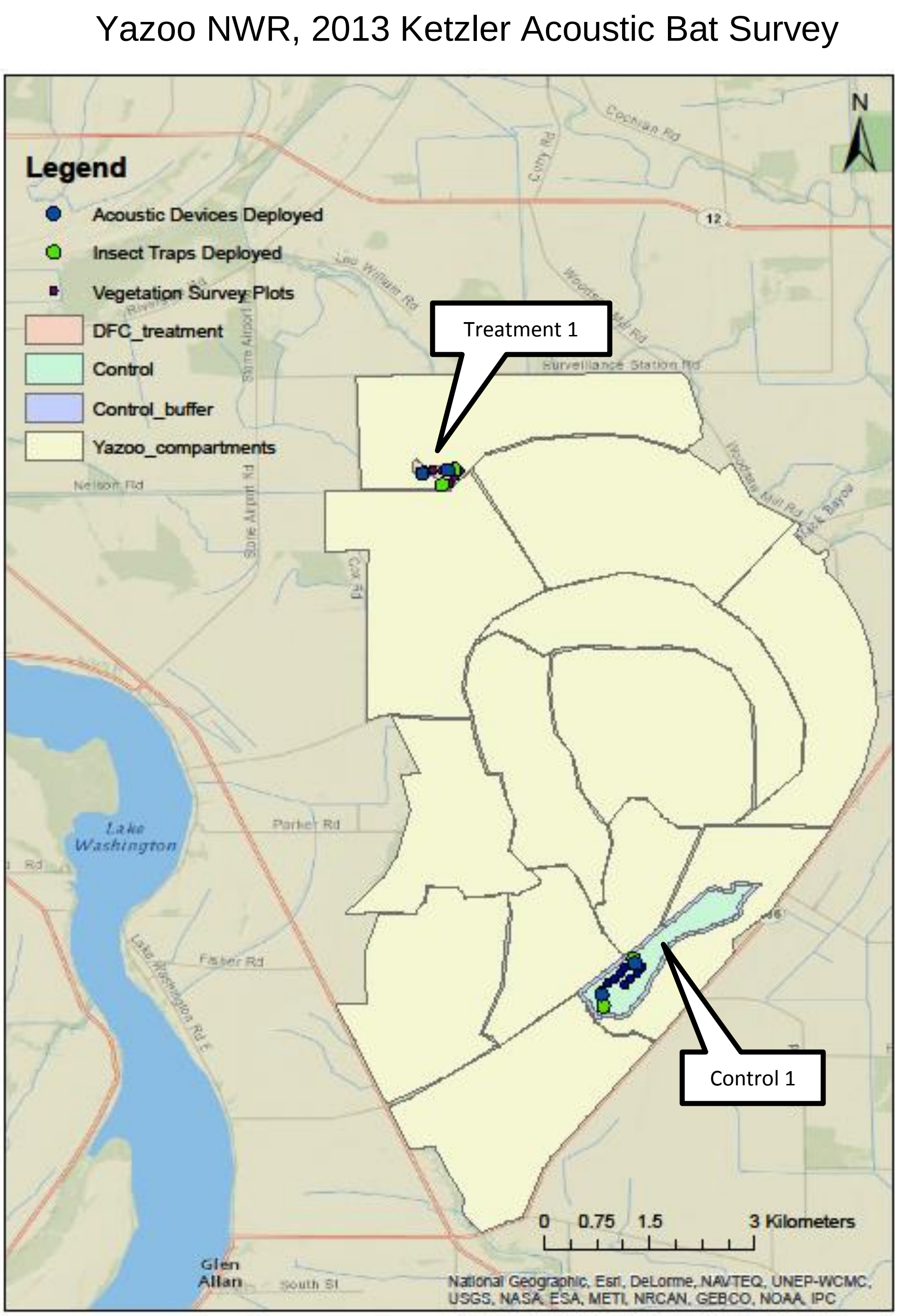


Morgan Brake NWR, 2013 Ketzler Acoustic Bat Survey

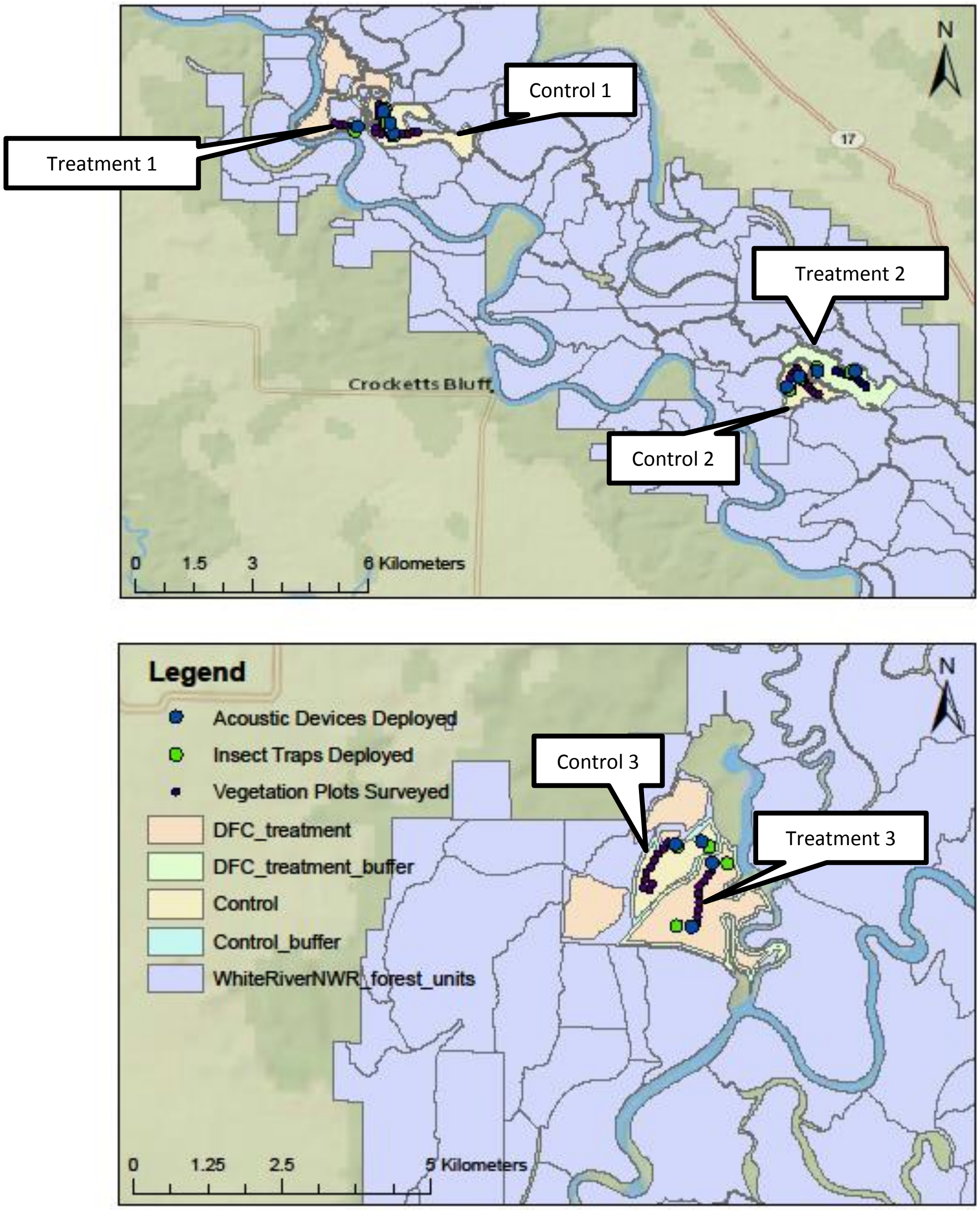


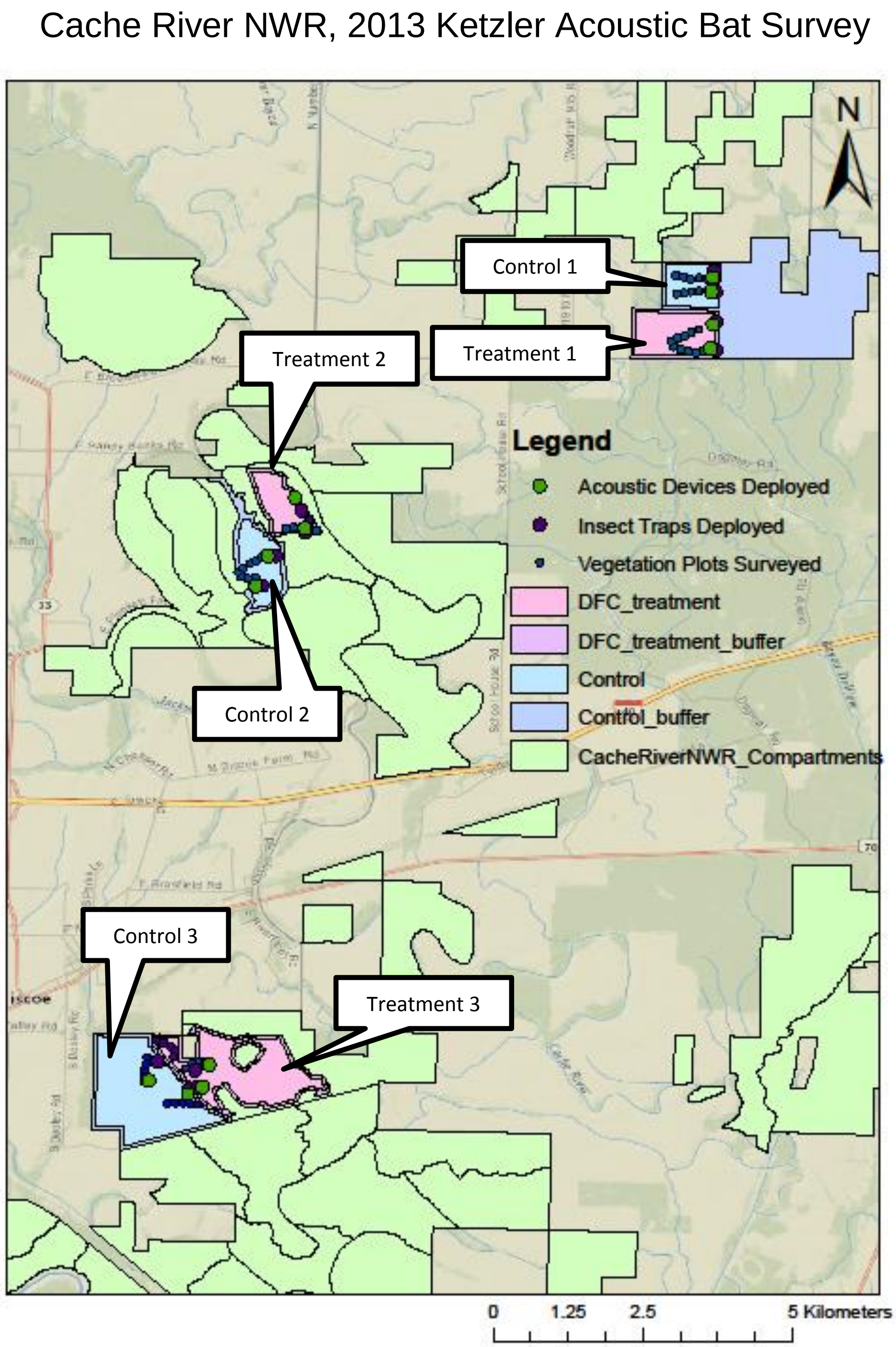
Panther Swamp NWR, 2013 Ketzler Acoustic Bat Survey




Yazoo NWR, 2013 Ketzler Acoustic Bat Survey
Legend
Acoustic Devices Deployed
Insect Traps Deployed
Vegetation Survey Plots
DFC_treatment
Control
Control_buffer
Yazoo_compartments
Treatment 1
Control 1
N
Cochran Rd
Surveillance Station Rd
Nelson Rd
Parker Rd
Fisher Rd
Lake Washington
Lake Washington Rd E
Glen Allan
South St
0 0.75 1.5 3 Kilometers
National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, IPC

White River NWR, 2013 Ketzler Acoustic Bat Survey




Cache River NWR, 2013 Ketzler Acoustic Bat Survey
N
Control 1
Treatment 1
Treatment 2
Control 2
Control 3
Treatment 3
Legend
Acoustic Devices Deployed
Insect Traps Deployed
Vegetation Plots Surveyed
DFC_treatment
DFC_treatment_buffer
Control
Control_buffer
CacheRiverNWR_Compartments
0
1.25
2.5
5 Kilometers