APPENDIX K: HYDROGEOMORPHIC APPROACH (HGM) REPORT FOR THE PROPOSED LOWER BOIS D'ARC CREEK RESERVOIR SITE

K-1: Modifying the East Texas HGM for the Lower Bois d'Arc Creek Reservoir Project

K-2: Functional Assessment of Forested Wetlands at Lower Bois d'Arc Creek Reservoir Site using the Modified East Texas HGM

Modifying the East Texas HGM for the Lower Bois D' Arc Creek Reservoir Project

Final Report

Prepared by:

Amy Camp, Hans Williams, Amy Urbanovsky, Jason Grogan

Waters of East Texas Center,

Arthur Temple College of Forestry and Agriculture

Stephen F. Austin State University

Nacogdoches, TX 75962-6109

and

Elizabeth Murray

Research Biologist

Wetlands and Coastal Ecology Branch

Environmental Laboratory (CEERD-EE-W)

U.S. Army Engineer Research and Development Center

At San Francisco District

1455 Market St., San Francisco, CA 94103

Presented to:

U. S. Army Corps of Engineers, Tulsa District

Regulatory Office (CESWT-RO)

1645 S 101 E Ave.

Tulsa, OK 74128-4609

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Contents

Introduction

In 2011, The Waters of East Texas Center, Stephen F. Austin State University, Arthur Temple College of Forestry and Agriculture (SFASU) was contracted by the Office of Wetlands, Oceans, and Watersheds, U. S. Environmental Protection Agency (EPA), Dallas, TX to conduct field testing in Fannin County, TX, of the methods outlined in the *Regional Guidebook for Applying the Hydrogeomorphic Approach to the Functional Assessment of Forested Wetlands in Alluvial Valleys of East Texas* (Williams *et al*. 2010). This guidebook was developed to support forested wetland functional assessment in the modern floodplains of the riverine systems in the East Texas Pineywoods ecoregion. The objective for the 2011 study was to test the potential efficacy of the methods and models in the guidebook for use in assessing forested wetland functions for the proposed Lower Bois d' Arc Creek Reservoir (LBCR) Project (Dans and Williams 2011). Forested wetlands with riverine geomorphic locations in Fannin County thought to approach the highest functional condition were sampled to measure the wetland variables identified in the guidebook. Specific sample locations were determined by the availability of property access. The variables are used in models to calculate functional capacity indices (FCI). An a priori decision was made to use the mid-gradient riverine models in the guidebook. It was assumed that no adjustments to variable metrics would be necessary if the FCI equaled 1.0 (0 to 1.0 scale) for all mid-gradient riverine wetland functions assessed by the guidebook. It was anticipated that adjustments would be required to appropriately apply the guidebook to Fannin County due to metric differences for variables such as tree species composition, tree size, and forest stand structure. Based on the results from the limited number of sites sampled, the recommendation was that six variables required metric adjustments before the FCI models in the guidebook were suitable for use. These variables were tree basal area, thickness of the A horizon, composition of tallest woody vegetation stratum, tree composition, log biomass, and woody debris biomass. Only the coarse woody debris variables were greatly different from what was observed in east Texas.

During the 2015 summer, SFASU was contacted by the U. S. Army Corps of Engineers, Tulsa District Regulatory Office (CESWT-RO) to discuss the additional work required to modify variable metrics and models in the East Texas HGM FCI spreadsheet calculator for use by the LBCR. The 2011 study was limited by the number of plots sampled. Although, the term “reference standard wetland” was used in the 2011 report, there was no planned intent to sample reference standard wetlands as defined by the HGM approach (Williams *et al.* 2010). Increased sampling of reference standard wetlands was required to improve necessary adjustments to variable metrics and increase user confidence for applying the East Texas HGM guidebook models outside of their intended geographic area. Also, after the SFASU team became more familiar with the geomorphic characteristics of the germane wetlands, it was determined that the low-gradient riverine models would be more appropriate for characterization of functional condition. CESWT-RO coordinated with SFASU to conduct additional field sampling during the fall 2015 and winter 2016 in reference standard low gradient riverine forested wetlands within a geographic area (HGM reference domain) representing conditions in Fannin County. The CESWT-RO coordinated with U. S. Army Corps of Engineers, Environmental Research and Development Center (ERDC) to use the field results to make variable metric and model modifications to the East Texas HGM low gradient riverine spreadsheet calculator for specific use by the LBCR.

Objectives

Developing a new, comprehensive HGM guidebook was not the intent of 2015-16 study. The overall goal of the 2015-16 study was to modify the existing East Texas HGM low-gradient riverine models and spreadsheet calculator as necessary for use by the LBCR. Since the planning and development of an HGM approach should be directed by a team familiar with the reference domain ecology, an assessment team was formed to identify and guide the completion of the study objectives. The assessment team consisted of personnel from the organizations listed below.

- U. S. Army Corps of Engineers, Tulsa District Regulatory Office (CESWT-RO)
- U. S. Army Corps of Engineers, Environmental Research and Development Center (ERDC)
- U. S. Environmental Protection Agency (EPA)
- U. S. Fish and Wildlife Service (FWS)
- U. S. Forest Service (USFS)

- Texas Commission on Environmental Quality (TCEQ)
- Texas Parks and Wildlife Department (TP&W)
- Waters of East Texas Center, Stephen F. Austin State University (SFASU)

- Freese and Nichols, Inc.
- North Texas Municipal Water District (NTMWD)
- Solv LLC

The assessment team met on October 6, 2015 at the John Bunker Sands Wetlands Center, Seagoville, TX to review general HGM principles. On November 15, 2015 the assessment team met at the Pat Mayse Wildlife Management Area, Paris, TX to review HGM field methods and determine the study objectives. The objectives were:

1. Establish the reference domain for the LBCR study.

2. Determine general sampling locations within the reference domain that contained forested low-gradient riverine reference standard wetlands.

3. Conduct field data collection in the reference standard wetlands within the reference domain using East Texas HGM guidebook methodology.

4. Use the field data to support modifications to the East Texas HGM low gradient riverine spreadsheet calculator based on the adjusted variable metrics and FCI models.

Methods

The Reference Domain

The CESWT-RO presented to the assessment team the reference domain on October 15, 2015. The geographic extent of the reference domain was based on the U. S. Geological Survey Hydrologic Unit Codes (HUC) in and around Fannin County, TX (Appendix Figure 1, p. 15). The main ecoregions represented in the reference domain are Blackland Prairie and Post Oak Savannah (Gould *et al.* 1960). Sampling within the reference domain was done primarily in the low-gradient riverine geomorphic settings of EPA Level IV Ecoregions 32c and 33f in and around Fannin County, TX.

General Sample Locations in Reference Domain

The general geomorphic and vegetational characteristics of a reference standard wetland were discussed and agreed upon by the assessment team at the November 15, 2015 meeting. In general, a reference standard wetland, a wetland thought to exhibit the best condition for all ecological functions, was characterized as forested, mature, exhibiting gap-phase dynamics, and receiving overbank, headwater flooding from a river or stream. For an example of the reference standard wetlands sampled in this study, refer to Appendix Figures 2A-2D, pp. 16-17. Based on this discussion, six sites were recommended to have locations with reference standard wetlands (Appendix Figure 3, p. 18). The sites sampled in chronological order were:

- U. S. Forest Service, Caddo National Grasslands-Bois-D' Arc Unit
- U. S. Forest Service, Caddo National Grasslands-Ladonia Unit
- White Oak Wildlife Management Area, Texas Parks and Wildlife Department
- Cooper Wildlife Management Area, Texas Parks and Wildlife Department
- Pat Mayse Wildlife Management Area, Texas Parks and Wildlife Department
- Lennox Woods, The Nature Conservancy of Texas

Appendix Table 1, p. 28, summarizes the sampling date and number of sampling points at each site.

Wetland Assessment Area and Plot Data Measurements

Field data collection was done by SFASU personnel. On occasion, other members of the assessment team accompanied the SFASU team as observers. Field data collection occurred during December 2015 through February 2016. Except as noted below, the wetlands assessment area (WAA) and plot based variables were measured using methods described in the East Texas HGM guidebook (Williams *et al.* 2010). WAA variables were assessed in the general area that represented reference standard characteristics and areas that were mature but not yet experiencing gap regeneration. The plots were randomly located in the WAA. Individual plots in the WAA were separated by at least 150 feet. The number of plots sampled in the WAA were based on WAA size, time on location, accessibility due to overbank flooding, and, based on best professional judgement, whether the WAA was adequately characterized. Coordinate locations of sampling points are included in the summary Appendix Table 2A-F, pp. 28-30)

Several modifications to the field data collection were agreed upon by the assessment team at the November 15, 2015 meeting. The 2011 SFASU field team found the A horizon depth to be difficult to measure in determining the metrics for V_{AHOR}. The hydric soil series typically found in the modern floodplains of Fannin County is the Tinn clay, 0 to 1 percent slopes, frequently flooded (fine, smectitic, thermic, Typic Hapluderts) (NRCS 2013). The Tinn soil is characterized by an A horizon to a depth of 17 inches. Since V_{AHOR} is used in only one function model (Cycle Nutrients), the assessment team agreed to delete this variable from that model in the spreadsheet calculator. As a result, this variable was not assessed in the field. In order to ensure consistency in field measurements between field teams for log biomass (V_{LOG}) and woody debris biomass (V_{WD}), the assessment team agreed to a standard protocol. Instead of the north and south orientation for the 50-foot transects recommended in the guidebook, the transects would be oriented north and east in an effort to capture woody debris that may be oriented parallel to the river/stream direction. Each 50-foot transect started at plot center. Small diameter woody debris (0.25 to 1-inch diameter) was counted at the 40-foot to 46-foot segment. Medium diameter woody debris (1 to 3-inches diameter) was counted on the 24-foot to 36-foot segment.

Use of 2011 Study Data

The 2011 study included field sampling in mature forest stands that may or may not have met the reference standard definition, as well as, younger forest stands (Dans and Williams 2011). Since all sampling in 2011 was done within the appropriate geographic and hydrogeomorphic setting, the decision was made between CESWT-RO, ERDC and SFASU to utilize the 2011 data to supplement the 2015-16 data in order to facilitate calibration of the variable metrics used in the models. Specifically, calibration requires a range of conditions by which a curve may be derived, and these younger stands provided midrange conditions on which to ground the curves.

Field Data Summary and Recalibration of Spreadsheet Calculator

For each site and each plot sampled at a site, the WAA and plot-based field data were entered in to the East Texas HGM low gradient riverine spreadsheet calculator for computation of the variable averages and the conversion of the results from English to metric units. These results are summarized in Appendix Tables 3A-3L, pp. 32-41. To facilitate recalibration of the East Texas HGM variable metrics, the SFASU field team characterized each plot using two criteria: maturity and climax stage. The maturity and climax categories are:

Maturity Ranking:
1. Over-mature
2. Mature
3. Younger

Climax Stage Ranking:
1. Mature climax structure. Single tree die-off and gap regeneration started.
2. Closed canopy of mature trees, no gap regeneration started, but anticipated based on tree maturity and density.
3. Closed canopy of young trees. Canopy thin enough that shrubs and ground cover plentiful.

The SFASU field team used forest stand structure characteristics and best professional judgement to assign each plot a maturity and climax stage ranking. The summary spreadsheets were sent to ERDC personnel for adjustment of the variable metrics and modification of the low-gradient riverine spreadsheet calculator.

To formulate the changes needed to accurately assess the LBCR data, the field data were organized by maturity, disturbance, and climax ranking. The reference standard was determined by grouping the data from the most mature sites. As reference standard data, most variables should be at or near 1.00. If the existing East Texas HGM variable subindex (VSI) curve for an individual variable captured the variability of the new data set, the original curve was kept. If the existing East Texas HGM VSI curve did not capture the variability of the reference standard LBCR data, the range for a 1.00 was expanded until it captured as many of those most mature sites as possible without also capturing a majority of less-mature sites. The steepness of the curves was then determined by looking at the other age classes, and trying to ensure stands of different maturities received different VSIs for the newly calibrated variables.

Results

<u>Field Data and Variable Subindex Curves</u>

Compilation of field data into the East Texas HGM calculator revealed that many variables already scored near a 1.00, implying that many variables required no change to the East Texas HGM VSI curves to make them applicable for the LBCR. A summary of the values found for each plot by site is included in the Appendix Tables 3-7, pp. 32-41. For those variables that were not consistently separating reference standard sites from the younger sites, new VSI curves were generated based on the field data. The original East Texas HGM VSI curves are included in Appendix Figures 4A-4R, pp. 19-23, and the revised LBCR HGM VSI curves are included in Appendix Figures 5A-5P, pp. 24-27.

The field dataset sent to ERDC (Appendix Tables 3-7, pp. 32-41) was the basis for any modifications of the East Texas HGM VSI curves. After calibration of the field data, it was determined that the following curves exhibited no change from the original East Texas HGM VSI curves:

- V_{PATCH}
- V_{FREQ}
- V_{DUR}
- V_{POND}
- V_{STRATA}
- V_{SOIL}
- V_{TBA}
- V_{TDEN}
- V_{SNAG}
- V_{OHOR}
- V_{GVC}
- V_{LITTER}

The East Texas HGM VSI curves that required modification are:

- V_{COMP}
- V_{SSD}
- V_{LOG}
- V_{WD}

All modifications to the East Texas curves were data-driven. If the field data variability was not adequately captured by the current East Texas VSI curve, it was adjusted to represent the values exhibited by the sampling sites ranked highest for both maturity and climax. The data from sites that ranked second and third for maturity and climax were used to adjust the steepness of the VSI curve on each side of the 1.00 range.

Changes to Curves

The metric range for a VSI score of 1.0 for V_{SSD}, V_{LOG}, and V_{WD} was larger for the LBCR data when compared with the East Texas VSI curves. This is supported by the data collected from the highest ranking sites. The East Texas HGM VSI curve for sapling-shrub density has a range from 1250 stems/ha to 2500 stems/ha. The LBCR sapling-shrub density VSI curve has a range from 1000 stems/ha to 4000 stems/ha. For log volume, the original East Texas range was from 8 m^3/ha to 30 m^3/ha, and the modified LBCR range is from 2.5 m^3/ha to 60 m^3/ha.

The range for woody debris originally was from 5 m^3/ha to 35 m^3/ha, and the modified range is from 20 m^3/ha to 90 m^3/ha.

The V_{TCOMP} species grouping and calculation was modified as well, based on field observations and regional literature. For each sampling plot, tree count was done by species to help support the development of the new species groupings. For example, the White Oak WMA site is situated between the Post Oak Savannah and Pineywoods ecoregions, and exhibits typical Pineywoods forest tree species composition. In addition to adjusting the species groupings, an adjusted quality index calculation was added to give value to diversity and better evaluate the variable. The modifications to the tree species grouping are listed in Appendix Table 8, p. 42, the tree count by species at each site is in Appendix Table 9A-F, pp. 43-53, and the calculation for the adjusted quality index is listed in the Appendix under Calculations, p. 57.

The East Texas HGM low-gradient riverine FCI equations were unchanged, with the exception of the removal of V_{AHOR} from the cycle nutrients function (Appendix pp. 51 and 52).

Introduction of Flats Models

At the May 4th, 2016, assessment team meeting, it was determined that a portion of the proposed Riverby Ranch mitigation site, Fannin County, TX, is functioning as a wetland in a flat geomorphic setting. This is due to an upstream dam (Denison Dam impounding Lake Texoma) on the Red River that flows adjacent to the mitigation site. In order for the LBCR HGM VSI curves to be used in the flat wetlands, adjustments were made to the low-gradient riverine models to indicate that these areas are functioning as flats (wetlands that are supported primarily by precipitation rather than riverine flooding). The models were altered by removing V_{FREQ} and V_{DUR}, in keeping with flats models in other HGM guidebooks. As with other HGM guidebooks, flat wetlands are not assessed for “Detain Floodwater” or “Export Organic Carbon,” as those functions require a closer tie to the river itself. The formulas for “Maintain Plant Communities” and “Provide Habitat for Fish and Wildlife” were revised to remove V_{FREQ} and

V_{DUR}. The remaining two FCI models ("Cycle Nutrients" and "Detain Precipitation") are unchanged from the riverine form to flats form (See Appendix p. 53).

Discussion

It is important to note that the reference domain endured severe drought in 2011, as well as, an ice storm in December 2013. In the winter of 2015 and spring of 2016, the region experienced excessive rainfall leading to abnormal amounts of overbank flooding. The drought most likely killed many trees, potentially affecting the forest stand structure and many HGM variables, such as tree density, snag density, log volume, and/or woody debris variables. In addition, the increase in the size and number of canopy gaps may have contributed to increased sapling-shrub densities in the understory. The recent, high-energy flooding also had a large effect on the depth of the O horizon, litter cover, log volume, and woody debris. The O horizon was scoured on most sampling sites. At many sites the woody debris was concentrated in large drift piles due to the excessive flooding.

The majority of sampling was performed in the winter, not the growing season. This made tree species identification and variables such as ground vegetation cover potentially more difficult to determine. The climatic events mentioned above do occur on a regular basis in the reference domain, however, the assessment team is experienced in HGM field data collection and is confident the variables have been adequately assessed for this study.

Literature Cited

Dans, D. and Williams H. 2011. Field Testing East Texas HGM Riverine Wetland Functional Assessment Guidebook: Proposed Lower Bois d' Arc Creek Impoundment Project. Report Prepared by Waters of East Texas Center, Stephen F. Austin State University, Nacogdoches, TX. Report Submitted to Wetlands Division, Office of Wetlands, Oceans, and Watersheds, Environmental Protection Agency, Region 6, Dallas, TX in May 2011. 63 pp.

Gould, F. W., Hoffman, G. O. and Rechenthin, C. A. 1960. Vegetational areas of Texas. Texas A and M University, Texas Agricultural Experiment Station, Leaflet No. 492.

NRCS. 2013. Natural Resources Conservation Service, Web Soil Survery. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Accessed June 10, 2016.

Williams, H. M., Miller, A. J., McNamee, R.S., and Klimas, C.V. (2010). "A Regional Guidebook for Applying the Hydrogeomorphic Approach to the Functional Assessment of Forested Wetlands in Alluvial Valleys of East Texas," ERDC/EL TR-10-17, U. S. Army Engineer Research and Development Center, Vicksburg, MS.

Appendix

Figures

Sampling Locations

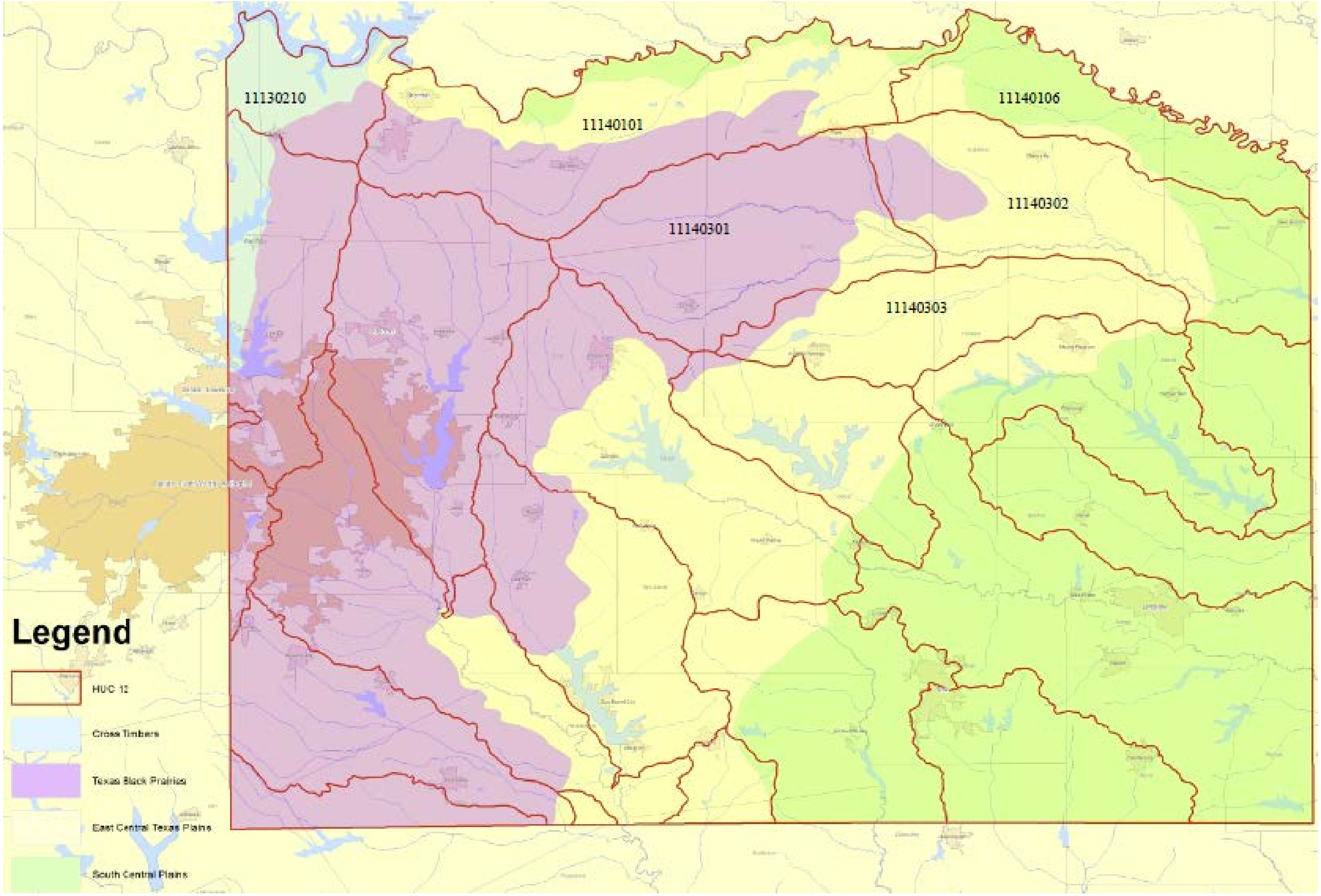


Figure 1. Reference domain in Northeast Texas chosen for the LBCR study including hydrologic unit codes (HUC).

Figure 2A. Example of a reference standard wetland site for Fannin County. Photo was taken at Plot 9 on Pat Mayse WMA.

Figure 2B. Example of a reference standard wetland site for Fannin County. Photo was taken at Plot 10 on Pat Mayse WMA.

Figure 2C. Example of a reference standard wetland site for Fannin County. Photo was taken at Plot 16 on Pat Mayse WMA.

Figure 2D. Example of a reference standard wetland site for Fannin County. Photo was taken at Plot 2 on Pat Mayse WMA.

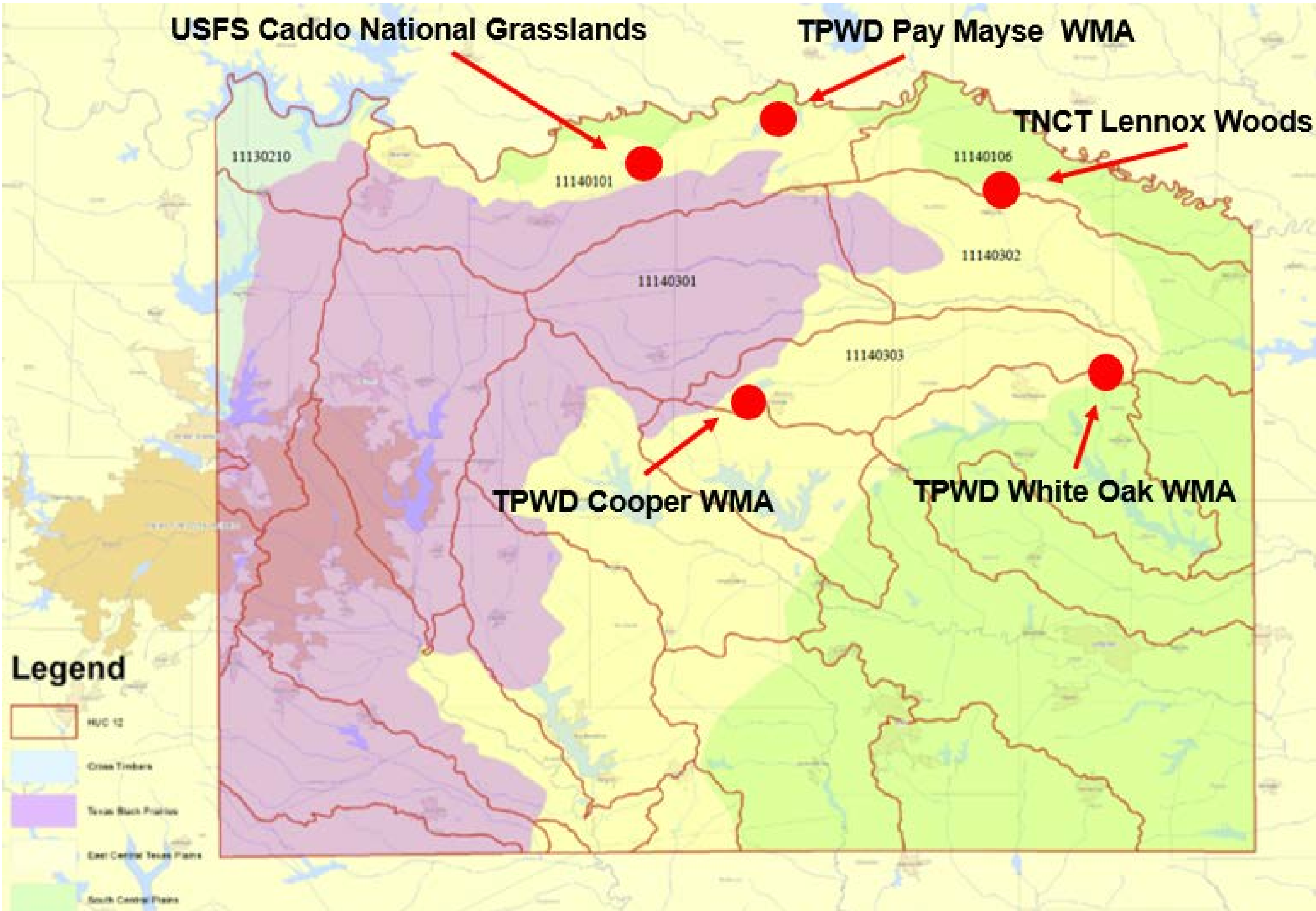


Figure 3. Locations of the six LBCR sampling sites within the reference domain in Fannin County, TX.

Original East Texas HGM Variable Curves

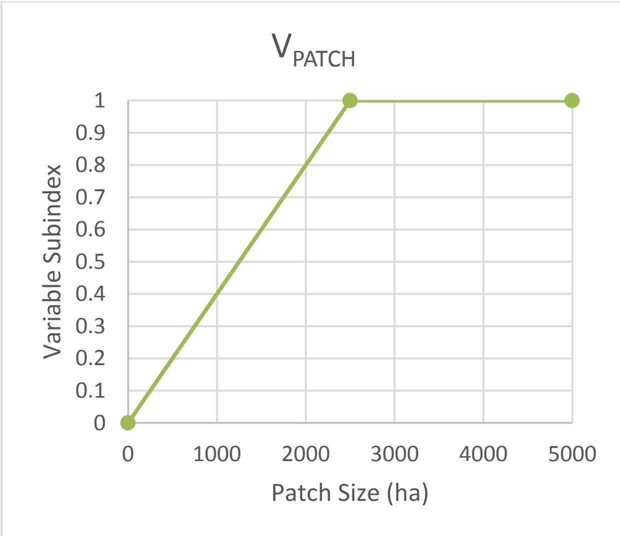


Figure 4A. Original East Texas VSI curve for patch size.

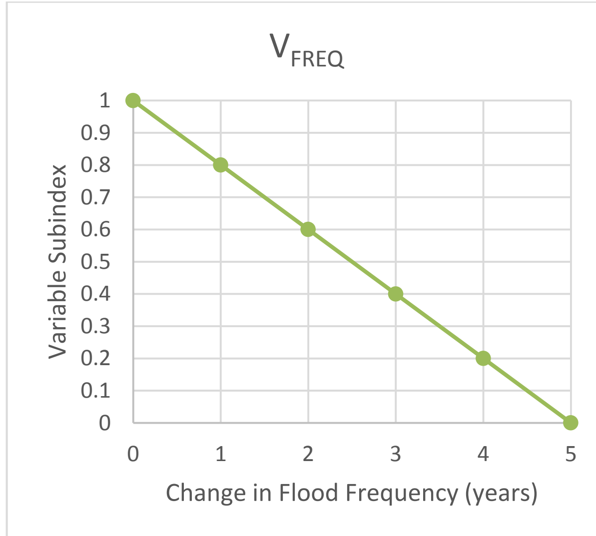


Figure 4B. Original East Texas VSI curve for flood frequency interval.

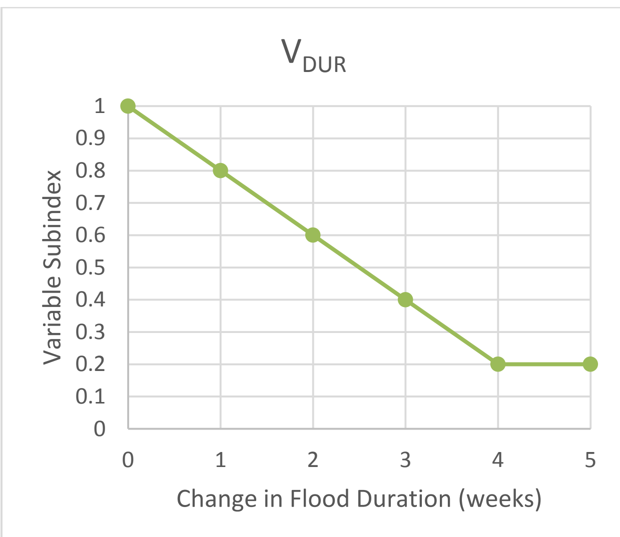


Figure 4C. Original East Texas VSI curve for flood duration.

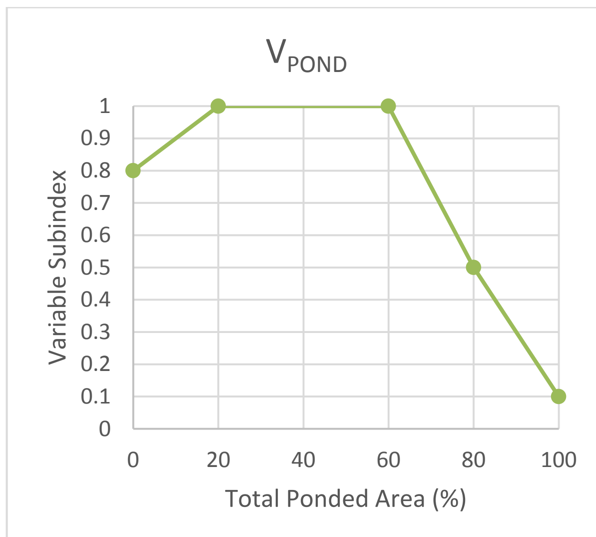
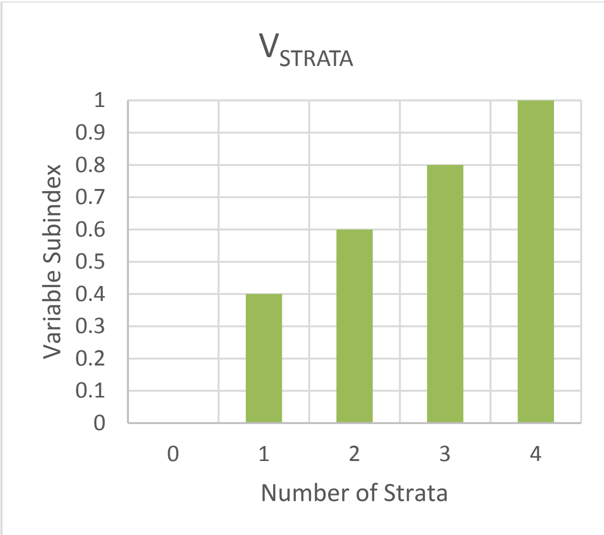


Figure 4D. Original East Texas VSI curve for percent ponding.



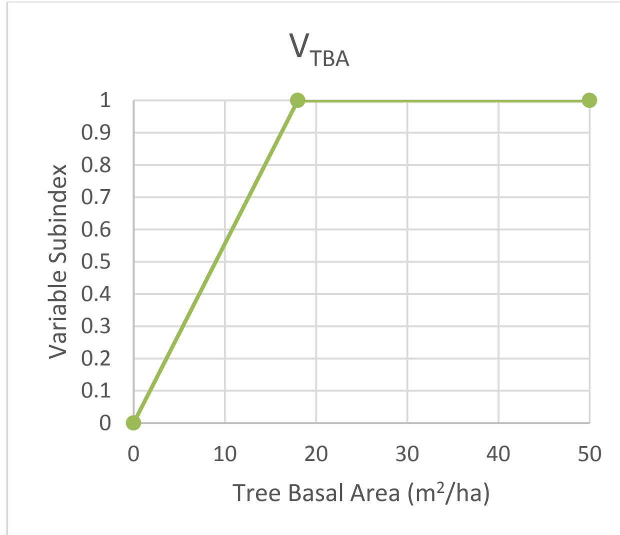
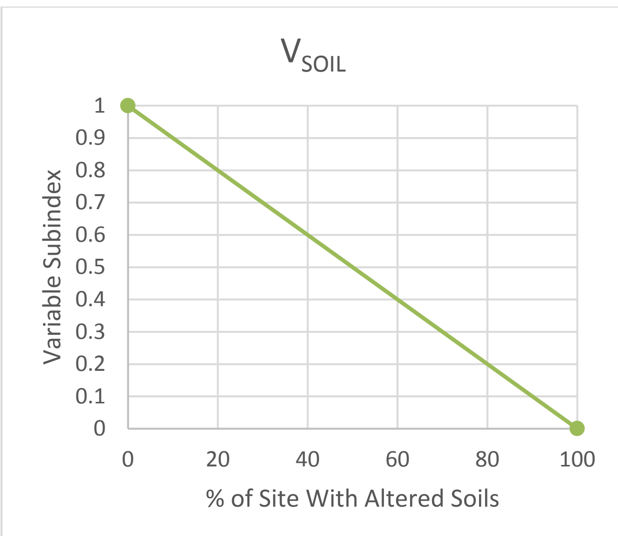


Figure 4E. Original East Texas VSI curve for number of vegetative strata present.

Figure 4F. Original East Texas VSI curve for basal area.



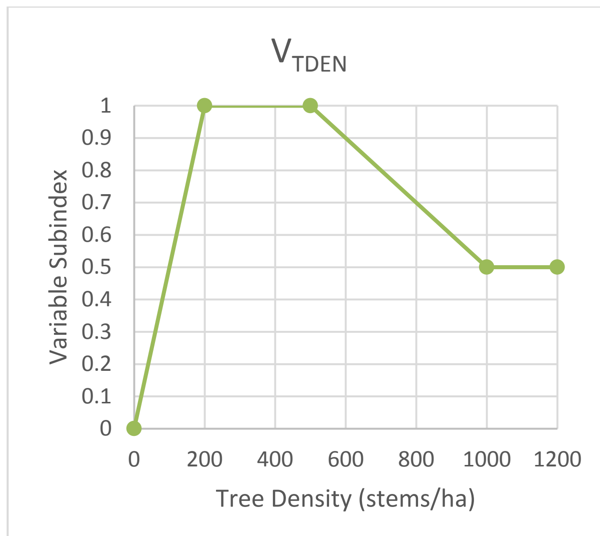


Figure 4G. Original East Texas VSI curve for percent altered soils.

Figure 4H. Original East Texas VSI curve for tree density.

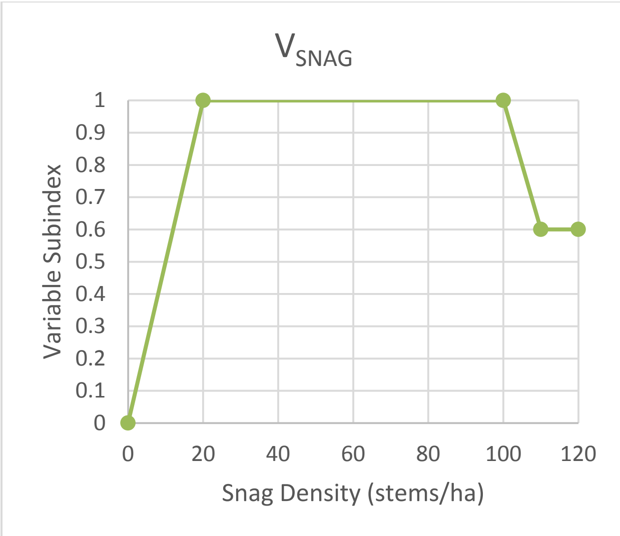


Figure 4I. Original East Texas VSI curve for snag density.

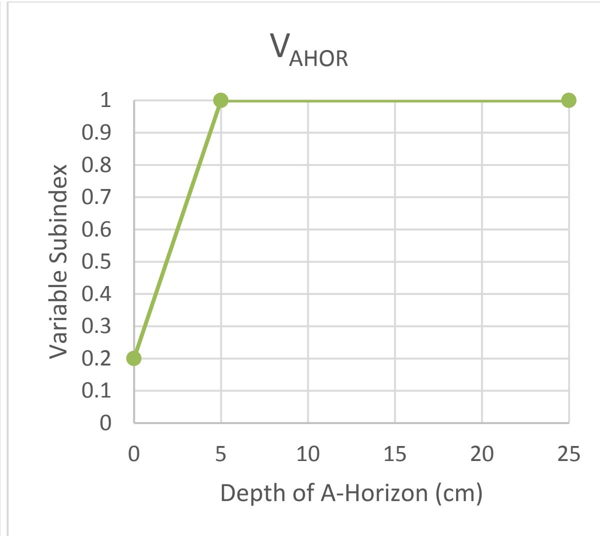


Figure 4J. Original East Texas VSI curve for A horizon depth.

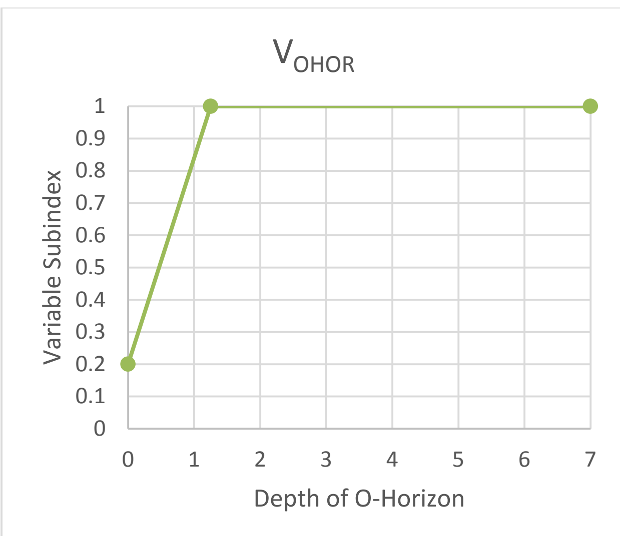


Figure 4K. Original East Texas VSI curve for O horizon depth.

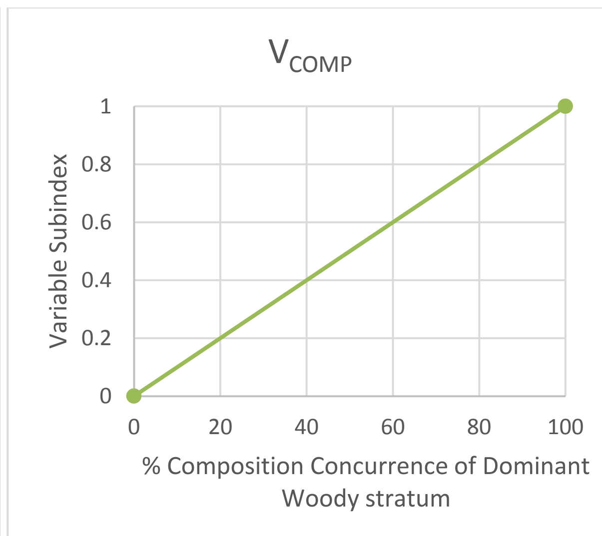


Figure 4L. Original East Texas VSI curve for percent composition of dominant woody stratum.

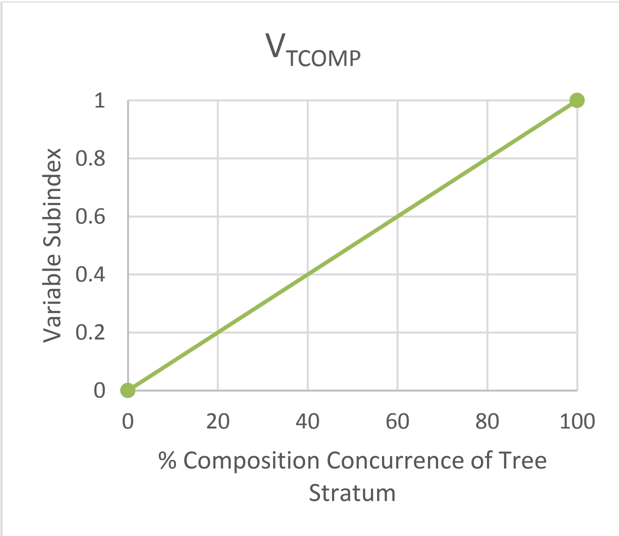


Figure 4M. Original East Texas VSI curve for percent composition of tree stratum.

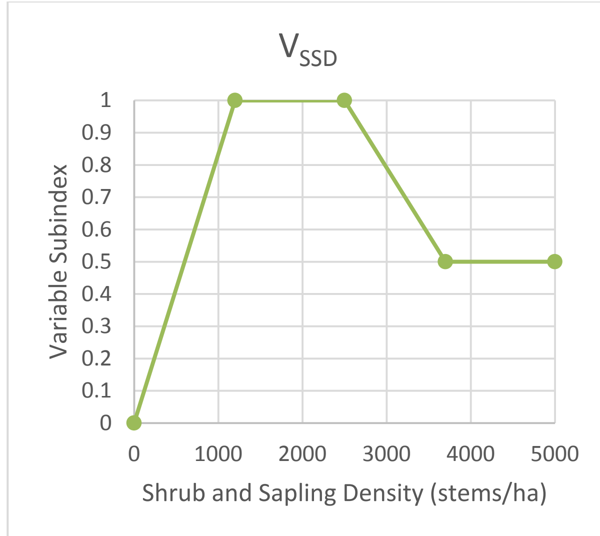


Figure 4N. Original East Texas VSI curve for shrub and sapling density.

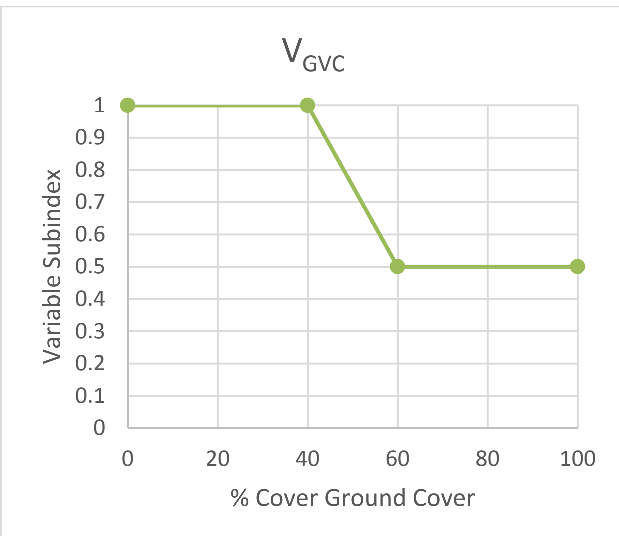


Figure 4O. Original East Texas VSI curve for percent ground cover.

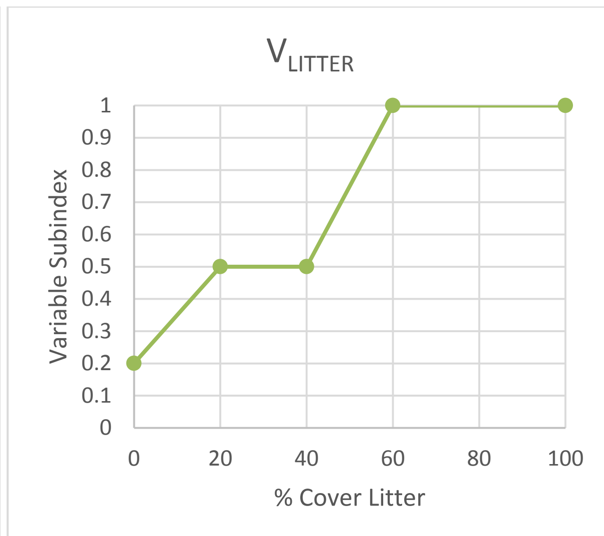


Figure 4P. Original East Texas VSI curve for percent litter cover.

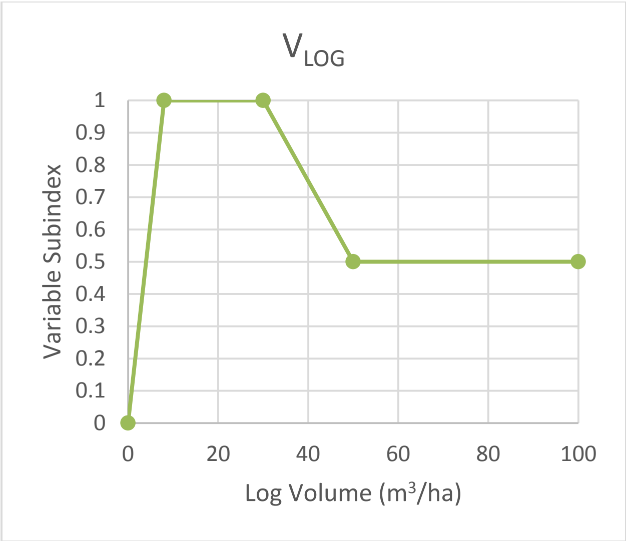


Figure 4Q. Original East Texas VSI curve for log volume.

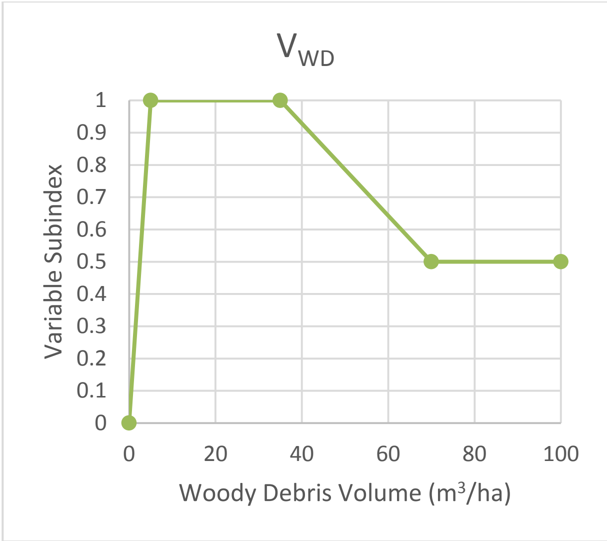


Figure 4R. Original East Texas VSI curve for woody debris volume.

Modified Fannin County HGM Variable Curves

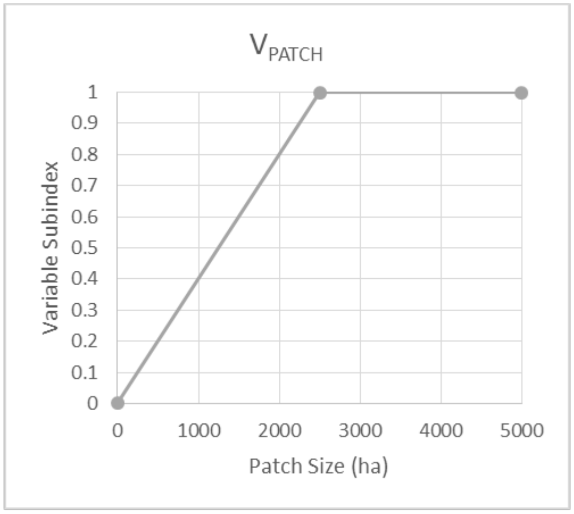


Figure 5A. Modified Fannin County VSI curve for patch size.

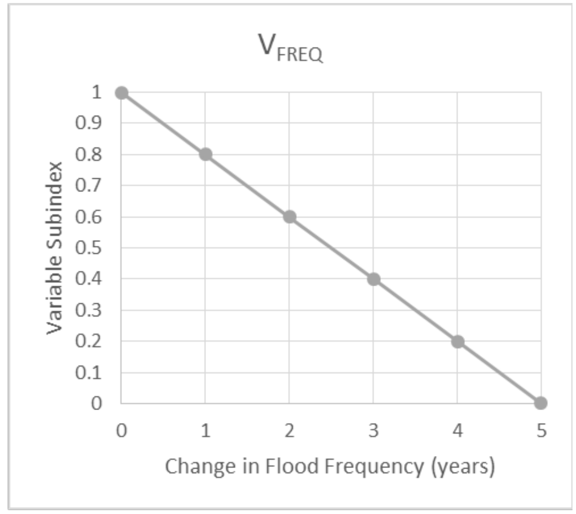


Figure 5B. Modified Fannin County VSI curve for flood frequency.

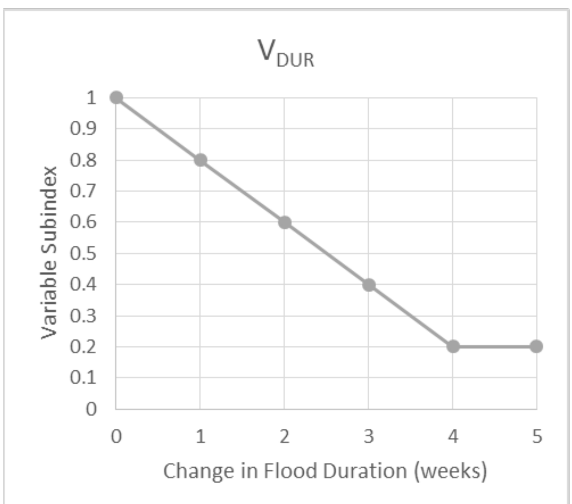


Figure 5C. Modified Fannin County VSI curve for flood duration.

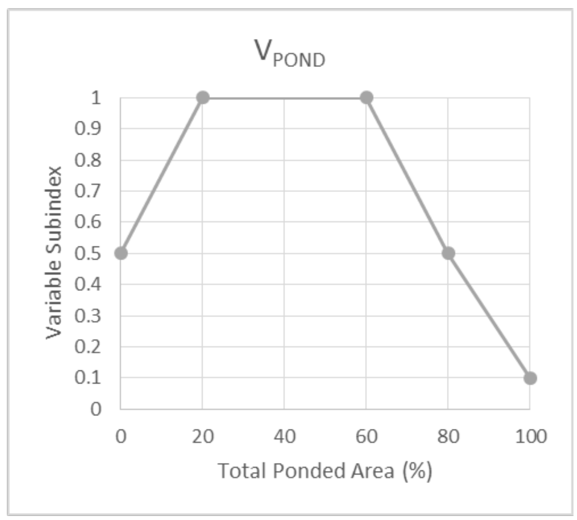


Figure 5D. Modified Fannin County VSI curve for percent ponded area.

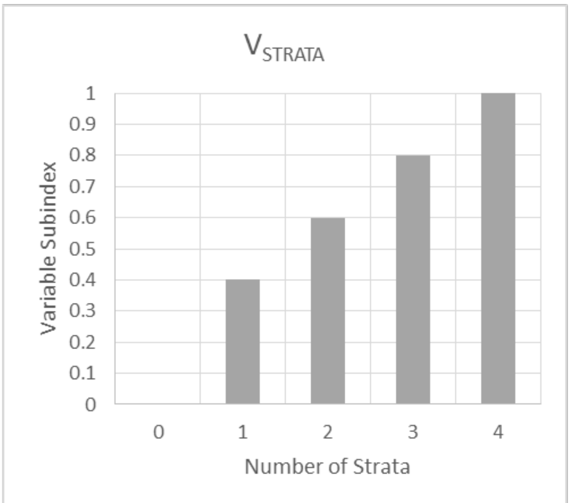


Figure 5E. Modified Fannin County VSI curve for number of strata present.

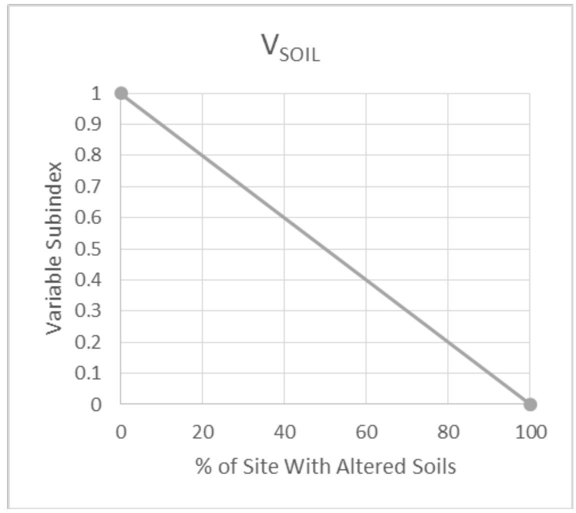


Figure 5F. Modified Fannin County VSI curve for percent altered soils.

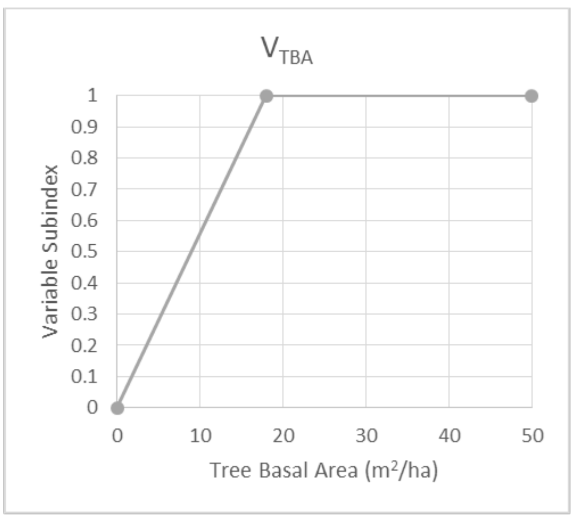


Figure 5G. Modified Fannin County VSI curve for basal area.

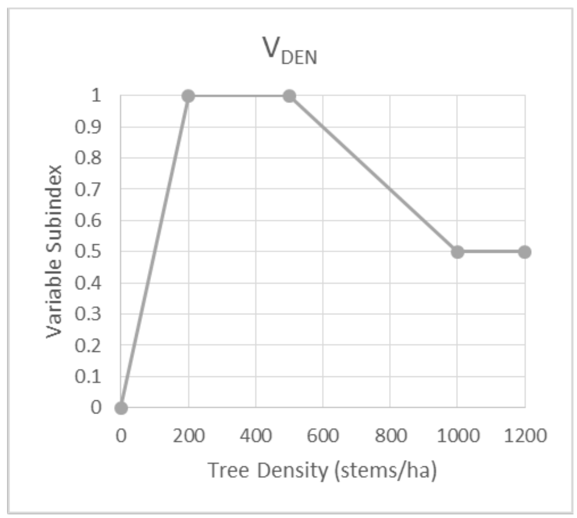


Figure 5H. Modified Fannin County VSI curve for tree density.

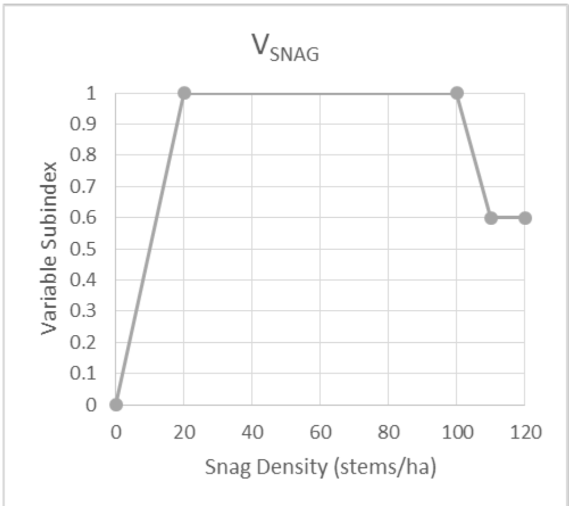


Figure 5I. Modified Fannin County VSI curve for snag density.

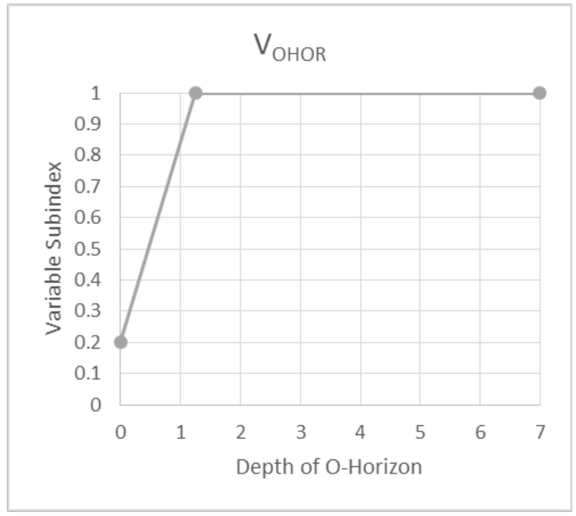


Figure 5J. Modified Fannin County VSI curve for O horizon depth.

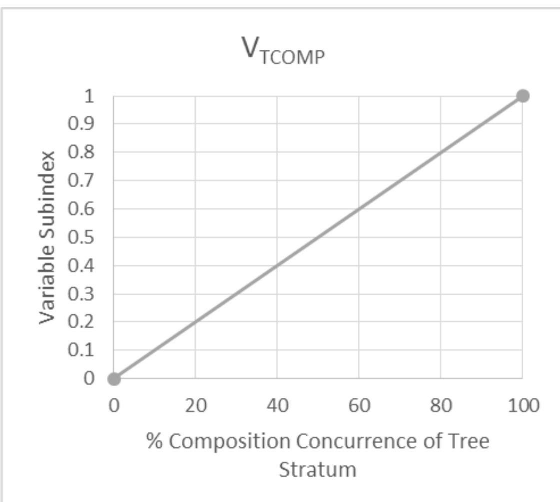


Figure 5K. Modified Fannin County VSI curve for tree composition.

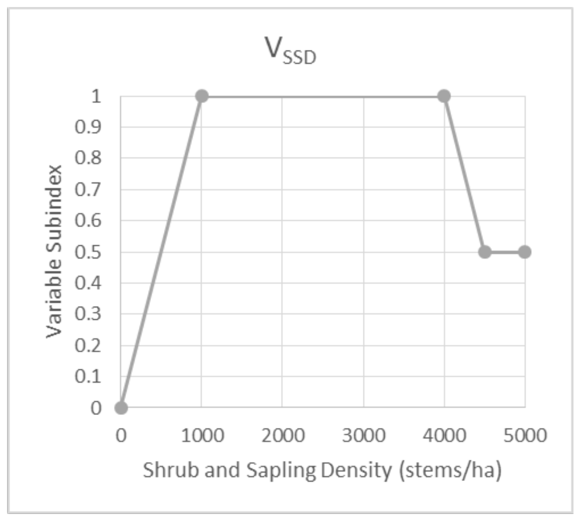


Figure 5L. Modified Fannin County VSI curve for shrub and sapling density.

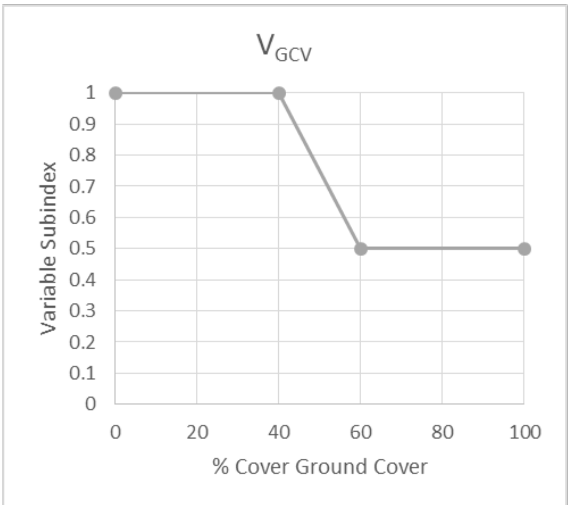


Figure 5M. Modified Fannin County VSI curve for percent ground cover.

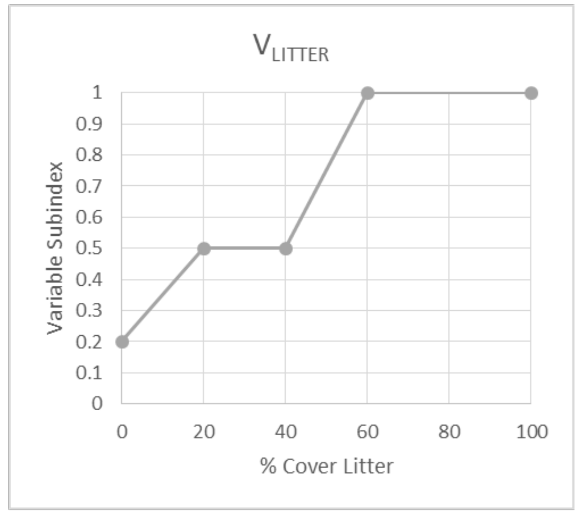


Figure 5N. Modified Fannin County VSI curve for percent litter cover.

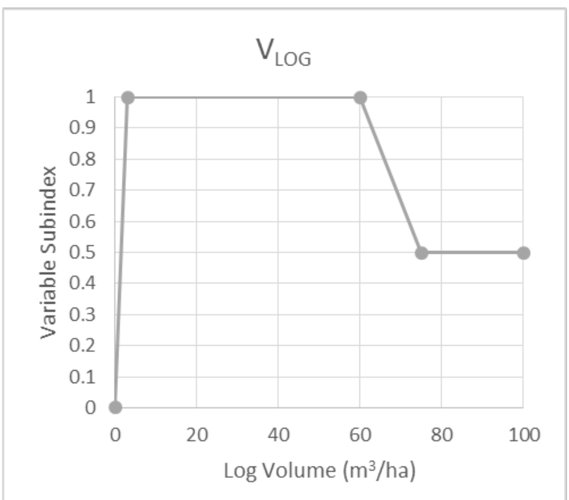


Figure 5O. Modified Fannin County VSI curve for log volume.

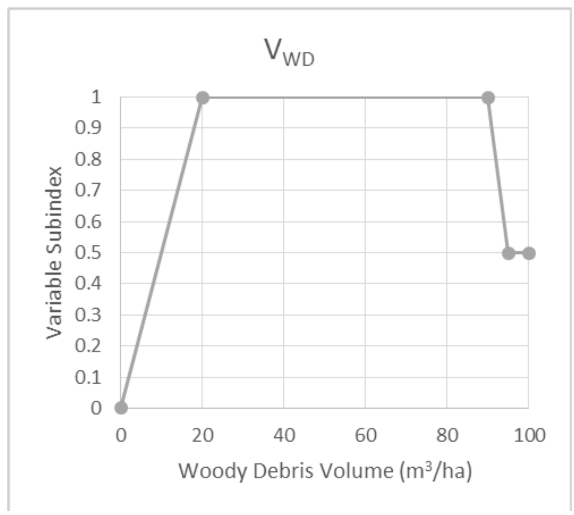


Figure 5P. Modified Fannin County VSI curve for woody debris volume.

Tables

Site and Plot Information

Table 1. Summary of sampling dates and number of sampling points at each sampling location for the LBCR study.

Sampling Location	Date Sampled	Number of Sampling Points
Caddo National Grasslands – Bois D'Arc Unit	12/09/15 – 12/10/15	14
Caddo National Grasslands – Ladonia Unit	12/16/15	4
Pat Mayse WMA	02/04/16 – 02/05/16	17
White Oak WMA	01/28/16 & 02/19/16	15
Cooper WMA	01/29/16	6
TNC Lennox Woods	02/18/16	8

Table 2A. Coordinate locations of all LBCR sampling points for the Caddo National Grasslands Bois D'Arc Unit.

Study Site	Latitude	Longitude
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 1	33.7433453	-95.95981038
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 2	33.74268982	-95.95942287
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 3	33.74166458	-95.95996705
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 4	33.74089807	-95.96033462
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 5	33.7407826	-95.95970883
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 6	33.7453938	-95.96204465
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 7	33.7449488	-95.96302773
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 8	33.74654137	-95.96114155
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 9	33.74338332	-95.96279998
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 10	33.74255005	-95.96283647
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 11	33.74187108	-95.96351153
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 12	33.741823	-95.96410965
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 13	33.74057737	-95.9626368
USFS Caddo National Grass Lands Bois D'Arc Unit Plot 14	33.74103135	-95.9636242

Table 2B. Coordinate locations of all LBCR sampling points for the Caddo National Grasslands Ladonia Unit.

Study Site	Latitude	Longitude
USFS Caddo National Grass Lands Ladonia Unit Plot 1	33.79768538	-95.8816987
USFS Caddo National Grass Lands Ladonia Unit Plot 2	33.79471243	-95.8834426
USFS Caddo National Grass Lands Ladonia Unit Plot 3	33.79434773	-95.88237828
USFS Caddo National Grass Lands Ladonia Unit Plot 4	33.79248402	-95.88337712

Table 2C. Coordinate locations of all LBCR sampling points for White Oak WMA.

Study Site	Latitude	Longitude
TPWD White Oak WMA Plot 1	33.30036275	-94.8232002
TPWD White Oak WMA Plot 2	33.30063995	-94.82366545
TPWD White Oak WMA Plot 3	33.3009408	-94.82429165
TPWD White Oak WMA Plot 4	33.30084133	-94.82494255
TPWD White Oak WMA Plot 5	33.30056635	-94.82555382
TPWD White Oak WMA Plot 6	33.30031772	-94.82603038
TPWD White Oak WMA Plot 7	33.30161257	-94.8252346
TPWD White Oak WMA Plot 8	33.302209	-94.82547813
TPWD White Oak WMA Plot 9	33.30276123	-94.82571237
TPWD White Oak WMA Plot 10	33.303353	-94.82596847
TPWD White Oak WMA Plot 11	33.30433932	-94.82630405
TPWD White Oak WMA Plot 12	33.27584697	-94.74037952
TPWD White Oak WMA Plot 13	33.27623525	-94.73964307
TPWD White Oak WMA Plot 14	33.27585712	-94.73933983
TPWD White Oak WMA Plot 15	33.27585958	-94.7387917

Table 2D. Coordinate locations of all LBCR sampling points for Cooper WMA.

Study Site	Latitude	Longitude
TPWD Cooper WMA Plot 1	33.25280033	-95.79501742
TPWD Cooper WMA Plot 2	33.25309992	-95.79486032
TPWD Cooper WMA Plot 3	33.25360307	-95.79484568
TPWD Cooper WMA Plot 4	33.25386913	-95.79430807
TPWD Cooper WMA Plot 5	33.25418463	-95.79448687
TPWD Cooper WMA Plot 6	33.25410905	-95.79510808

Table 2E. Coordinate locations of all LBCR sampling points for Pat Mayse WMA.

Study Site	Latitude	Longitude
TPWD Pat Mayse WMA Plot 1	33.7944777	-95.67430932
TPWD Pat Mayse WMA Plot 2	33.79464307	-95.67362865
TPWD Pat Mayse WMA Plot 3	33.79462212	-95.67297182
TPWD Pat Mayse WMA Plot 4	33.79521733	-95.67297582
TPWD Pat Mayse WMA Plot 5	33.79497623	-95.67419137
TPWD Pat Mayse WMA Plot 6	33.79554135	-95.67652143
TPWD Pat Mayse WMA Plot 7	33.79592177	-95.6770445
TPWD Pat Mayse WMA Plot 8	33.79645008	-95.67747633
TPWD Pat Mayse WMA Plot 9	33.79658295	-95.67828087
TPWD Pat Mayse WMA Plot 10	33.7932427	-95.67358313
TPWD Pat Mayse WMA Plot 11	33.7927972	-95.67292987
TPWD Pat Mayse WMA Plot 12	33.7932318	-95.67271698
TPWD Pat Mayse WMA Plot 13	33.79321555	-95.67177645
TPWD Pat Mayse WMA Plot 14	33.78944873	-95.67233893
TPWD Pat Mayse WMA Plot 15	33.7890028	-95.67289952
TPWD Pat Mayse WMA Plot 16	33.78876557	-95.67407875
TPWD Pat Mayse WMA Plot 17	33.78765152	-95.67432448

Table 2F. Coordinate locations of all LBCR sampling points for Lennox Woods.

Study Site	Latitude	Longitude
TNCT Lennox Woods Plot 1	33.73554007	-95.08355218
TNCT Lennox Woods Plot 2	33.7358862	-95.0846221
TNCT Lennox Woods Plot 3	33.73578458	-95.08567867
TNCT Lennox Woods Plot 4	33.73525033	-95.08514368
TNCT Lennox Woods Plot 5	33.73472332	-95.08529805
TNCT Lennox Woods Plot 6	33.73440662	-95.0849352
TNCT Lennox Woods Plot 7	33.73427472	-95.0840929
TNCT Lennox Woods Plot 8	33.73518888	-95.08379133

Field Data

Table 3A. Field data collected for the LBCR study at the Caddo National Grasslands Bois D'Arc Unit.

	Variable	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14
A	Maturity (1-3)	2	2	2	3	2	2	2	2	2	2	2	2	2	2
B	Climax (1-3)	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C	Disturbance (1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	Notes														
1	V_{PATCH}	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	V_{DUR}	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	V_{POND}	50	50	50	50	50	50	50	50	50	50	50	50	50	50
7	V_{STRATA}	3	3	3	3	3	3	3	3	3	3	3	3	3	3
8	V_{SOIL}	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	V_{TBA}	30	28	41	35	39	28	*	23	35	23	23	39	32	21
10	V_{TDEN}	600	650	825	550	775	500	750	325	450	625	425	750	400	325
11	V_{SNAG}	50	100	100	75	75	25	50	75	225	175	125	0	150	175
12	V_{OHOR}	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	66	66	66	75	66	66	66	66	66	66	66	66	66	66
16	V_{SSD}	0	250	250	3000	1000	125	250	125	125	125	375	250	125	1000
17	V_{GVC}	21	29	11	11	9	39	8	49	15	23	21	15	8	26
18	V_{LITTER}	20	51	19	89	69	45	18	15	18	36	50	23	20	89
19	V_{LOG}	3	9	17	22	5	0	10	31	17	6	2	0	3	11
20	V_{WD}	23	35	39	22	35	21	10	49	45	15	7	13	10	37

Table 3B. Variable subindex scores for field data collected for the LBCR study at the Caddo National Grasslands Bois D'Arc Unit.

Variable		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14
1	V_{PATCH}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	V_{DUR}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	V_{POND}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	V_{STRATA}	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
8	V_{SOIL}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	V_{TBA}	1.00	1.00	1.00	1.00	1.00	1.00	N/A	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	V_{TDEN}	0.90	0.85	0.68	0.95	0.73	1.00	0.75	1.00	1.00	0.88	1.00	0.75	1.00	1.00
11	V_{SNAG}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.60	0.60	0.60	0.00	0.60	0.60
12	V_{OHOR}	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	0.66	0.66	0.66	0.75	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
16	V_{SSD}	0.00	0.21	0.21	0.79	0.83	0.10	0.21	0.10	0.10	0.10	0.31	0.21	0.10	0.83
17	V_{GVC}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	1.00	1.00	1.00	1.00	1.00	1.00
18	V_{LITTER}	0.50	0.78	0.48	1.00	1.00	0.63	0.46	0.43	0.46	0.50	0.75	0.50	0.50	1.00
19	V_{LOG}	0.41	1.00	1.00	1.00	0.67	0.00	1.00	0.98	1.00	0.71	0.30	0.00	0.41	1.00
20	V_{WD}	1.00	1.00	0.94	1.00	1.00	1.00	1.00	0.80	0.86	1.00	1.00	1.00	1.00	0.97

Table 4A. Field data collected for the LBCR study at the Caddo National Grasslands Ladonia Unit.

	Variable	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15
A	Maturity (1-3)	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
B	Climax (1-3)	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
C	Disturbance (1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	Notes															
1	V_{PATCH}	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	V_{DUR}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	V_{POND}	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
7	V_{STRATA}	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
8	V_{SOIL}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	V_{TBA}	35	32	30	35	23	23	18	23	18	21	23	25	21	14	14
10	V_{TDEN}	400	325	175	300	200	225	200	325	300	275	300	475	250	375	175
11	V_{SNAG}	0	25	50	0	25	0	25	0	25	0	0	50	50	75	100
12	V_{OHOR}	0	0	0	0	0.5	0.3	0	1.6	0.3	0.5	0.2	0.4	0.5	0.4	0.3
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	83	66	66	83	66	83	80	73	86	77	66	75	80	83	92
16	V_{SSD}	750	0	0	0	125	3375	1000	1625	375	5625	250	875	1125	625	1500
17	V_{GVC}	0	0	1	0	0	0	0	0	0	0	3	1	8	1	3
18	V_{LITTER}	5	5	1	2	23	50	5	88	53	54	25	79	93	99	66
19	V_{LOG}	31	0	19	26	31	0	0	23	15	27	6	50	6	0	13
20	V_{WD}	34	0	33	40	39	4	6	51	37	52	16	76	20	10	26

Table 4B. Variable subindex scores for field data collected for the LBCR study at the Caddo National Grasslands Ladonia Unit.

	Variable	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15
1	V_{PATCH}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	V_{DUR}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	V_{POND}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	V_{STRATA}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	V_{SOIL}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	V_{TBA}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.77
10	V_{TDEN}	1.00	1.00	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
11	V_{SNAG}	0.00	1.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00
12	V_{OHOR}	0.20	0.20	0.20	0.20	0.50	0.41	0.20	1.00	0.39	0.50	0.20	0.44	0.49	0.44	0.39
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	0.83	0.66	0.66	0.83	0.66	0.83	0.80	0.73	0.86	0.77	0.66	0.75	0.80	0.83	0.92
16	V_{SSD}	0.62	0.00	0.00	0.00	0.10	0.63	0.83	1.00	0.31	0.50	0.97	0.73	0.93	0.52	1.00
17	V_{GVC}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	V_{LITTER}	0.28	0.28	0.22	0.23	0.50	0.75	0.28	1.00	0.81	0.85	0.50	1.00	1.00	1.00	1.00
19	V_{LOG}	0.99	0.00	1.00	1.00	0.98	0.00	0.00	1.00	1.00	1.00	0.04	0.50	0.72	0.00	1.00
20	V_{WD}	1.00	0.00	1.00	0.93	0.95	0.72	1.00	0.77	0.98	0.76	0.12	0.50	1.00	1.00	1.00

Table 5A. Field data collected for the LBCR study at Pat Mayse WMA.

	Variable	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17
A	**Maturity (1-3)**	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1
B	**Climax (1-3)**	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1
C	**Disturbance (1)**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D	**Notes**																	
1	V_{PATCH}	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	V_{DUR}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	V_{POND}	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
7	V_{STRATA}	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
8	V_{SOIL}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	V_{TBA}	30	25	16	14	21	30	21	23	30	25	23	16	18	25	30	23	25
10	V_{TDEN}	500	450	325	525	525	575	400	350	350	725	375	425	650	325	375	325	475
11	V_{SNAG}	0	50	100	25	25	50	25	75	50	25	100	75	75	25	50	25	25
12	V_{OHOR}	0.0	0.2	0.2	0.0	0.0	0.2	0.6	0.5	0.2	0.2	0.2	0.0	0.0	0.8	0.6	0.5	0.6
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	80	75	73	75	75	73	66	77	89	72	83	81	66	80	66	73	72
16	V_{SSD}	2125	125	1125	1875	250	1000	3250	625	1000	750	1375	1125	250	1500	4125	250	2625
17	V_{GVC}	5	2	4	5	9	4	5	3	1	4	44	3	1	19	20	21	13
18	V_{LITTER}	3	78	40	73	14	90	80	93	53	68	78	43	17	98	93	68	80
19	V_{LOG}	0	52	112	0	13	17	9	29	15	19	49	36	10	31	23	4	9
20	V_{WD}	12	175	118	26	29	75	38	84	54	77	89	52	30	75	49	60	33

Table 5B. Variable subindex scores for field data collected for the LBCR study at the Pat Mayse WMA

Variable		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17
1	V_{PATCH}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	V_{DUR}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	V_{POND}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	V_{STRATA}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	V_{SOIL}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	V_{TBA}	1.00	1.00	0.90	0.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00	1.00
10	V_{TDEN}	1.00	1.00	1.00	0.98	0.98	0.93	1.00	1.00	1.00	0.78	1.00	1.00	0.85	1.00	1.00	1.00	1.00
11	V_{SNAG}	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	V_{OHOR}	0.20	0.30	0.30	0.20	0.20	0.30	0.58	0.49	0.30	0.30	0.30	0.20	0.20	0.70	0.58	0.49	0.58
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	0.80	0.75	0.73	0.75	0.75	0.73	0.66	0.77	0.89	0.72	0.83	0.81	0.66	0.80	0.66	0.73	0.72
16	V_{SSD}	1.00	0.10	0.93	1.00	0.21	0.83	0.69	0.52	0.83	0.62	1.00	0.93	0.21	1.00	0.50	0.21	0.95
17	V_{GVC}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00
18	V_{LITTER}	0.25	1.00	0.50	1.00	0.41	1.00	1.00	1.00	0.81	1.00	1.00	0.56	0.45	1.00	1.00	1.00	1.00
19	V_{LOG}	0.00	0.50	0.50	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.53	0.84	1.00	0.98	1.00	0.50	1.00
20	V_{WD}	1.00	0.50	0.50	1.00	1.00	0.50	0.95	0.50	0.73	0.50	0.50	0.75	1.00	0.50	0.80	0.65	1.00

Table 6A. Field data collected for the LBCR study at Cooper WMA

	Variable	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
A	**Maturity (1-3)**	3	2	1	1	1	1
B	**Climax (1-3)**	3	2	2	2	1	2
C	**Disturbance (1)**	1	1	1	1	1	1
D	**Notes**						
1	V_{PATCH}	2500	2500	2500	2500	2500	2500
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	0	0	0	0	0	0
5	V_{DUR}	0	0	0	0	0	0
6	V_{POND}	20	20	20	20	20	20
7	V_{STRATA}	4	4	4	4	4	4
8	V_{SOIL}	0	0	0	0	0	0
9	V_{TBA}	37	35	35	28	16	28
10	V_{TDEN}	1050	700	475	500	300	225
11	V_{SNAG}	25	25	75	25	50	25
12	V_{OHOR}	0	0	0	0	0	0
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	75	76	83	72	83	83
16	V_{SSD}	2000	1750	1250	1625	1875	2875
17	V_{GVC}	8	5	1	5	16	7
18	V_{LITTER}	7	1	31	93	93	59
19	V_{LOG}	0	14	40	18	18	7
20	V_{WD}	21	30	63	23	57	56

Table 6B. Variable subindex scores for field data collected for the LBCR study at Cooper WMA

Variable		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
1	V_{PATCH}	1.00	1.00	1.00	1.00	1.00	1.00
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	1.00	1.00	1.00	1.00	1.00	1.00
5	V_{DUR}	1.00	1.00	1.00	1.00	1.00	1.00
6	V_{POND}	1.00	1.00	1.00	1.00	1.00	1.00
7	V_{STRATA}	1.00	1.00	1.00	1.00	1.00	1.00
8	V_{SOIL}	1.00	1.00	1.00	1.00	1.00	1.00
9	V_{TBA}	1.00	1.00	1.00	1.00	0.90	1.00
10	V_{TDEN}	0.50	0.80	1.00	1.00	1.00	1.00
11	V_{SNAG}	1.00	1.00	1.00	1.00	1.00	1.00
12	V_{OHOR}	0.20	0.20	0.20	0.20	0.20	0.20
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	0.75	0.76	0.83	0.72	0.83	0.83
16	V_{SSD}	1.00	1.00	1.00	1.00	1.00	0.84
17	V_{GVC}	1.00	1.00	1.00	1.00	1.00	1.00
18	V_{LITTER}	0.30	0.22	0.50	1.00	1.00	0.97
19	V_{LOG}	0.00	1.00	0.74	1.00	1.00	0.87
20	V_{WD}	1.00	1.00	0.60	1.00	0.69	0.69

Table 7A. Field data collected for the LBCR study at Lennox Woods.

	Variable	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
A	**Maturity (1-3)**	2	2	2	2	2	2	2	2
B	**Climax (1-3)**	2	2	2	2	2	2	2	2
C	**Disturbance (1)**	1	1	1	1	1	1	1	1
D	**Notes**								
1	V_{PATCH}	2500	2500	2500	2500	2500	2500	2500	2500
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	0	0	0	0	0	0	0	0
5	V_{DUR}	0	0	0	0	0	0	0	0
6	V_{POND}	30	30	30	30	30	30	30	30
7	V_{STRATA}	4	4	4	4	4	4	4	4
8	V_{SOIL}	0	0	0	0	0	0	0	0
9	V_{TBA}	25	23	25	32	35	25	23	23
10	V_{TDEN}	525	350	425	300	550	375	475	325
11	V_{SNAG}	0	25	25	0	0	25	150	0
12	V_{OHOR}	0.3	0.7	0.2	0.2	0.4	0.1	0.5	0.2
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	76	83	71	80	86	89	89	92
16	V_{SSD}	750	3500	2000	2125	625	1125	250	1625
17	V_{GVC}	3	0	2	0	3	1	0	2
18	V_{LITTER}	68	73	11	39	83	14	29	35
19	V_{LOG}	69	0	0	3	0	0	0	0
20	V_{WD}	93	5	3	10	4	4	6	4

Table 7B. Variable subindex scores for field data collected for the LBCR study at Lennox Woods.

Variable		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
1	V_{PATCH}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	V_{BUF30}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	V_{BUF250}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	V_{FREQ}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	V_{DUR}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	V_{POND}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	V_{STRATA}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	V_{SOIL}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	V_{TBA}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	V_{TDEN}	0.98	1.00	1.00	1.00	0.95	1.00	1.00	1.00
11	V_{SNAG}	0.00	1.00	1.00	0.00	0.00	1.00	0.60	0.00
12	V_{OHOR}	0.39	0.65	0.34	0.34	0.44	0.25	0.50	0.34
13	V_{AHOR}	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
14	V_{COMP}	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	V_{TCOMP}	0.76	0.83	0.71	0.80	0.86	0.89	0.89	0.92
16	V_{SSD}	0.62	0.58	1.00	1.00	0.52	0.93	0.21	1.00
17	V_{GVC}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	V_{LITTER}	1.00	1.00	0.36	0.50	1.00	0.41	0.50	0.50
19	V_{LOG}	0.50	0.00	0.00	0.41	0.00	0.00	0.00	0.00
20	V_{WD}	0.50	0.98	0.69	1.00	0.87	0.72	1.00	0.72

Species Grouping

Table 8. Modified LBCR HGM species grouping for determining V_{TCOMP}.

Group 1		Group 2		Group 3	
Pecan	*Carya illinoinensis*	Box Elder	*Acer negundo*	Eastern Redbud	*Cercis canadensis*
Sugarberry	*Celtis laevigata*	Red Maple	*Acer rubrum*	Hawthorn	*Crataegus spp.*
Ash	*Fraxinus spp.*	Hickory Spp.	*Carya spp.*	Honey Locust	*Gleditsia triacanthos*
Bur Oak	*Quercus macrocarpa*	Dogwood	*Cornus spp.*	Eastern Red Cedar	*Juniperus virginiana*
Water Oak	*Quercus nigra*	Persimmon	*Diospyros spp.*	Bois D'Arc	*Maclura pomifera*
Willow Oak	*Quercus phellos*	Black Walnut	*Juglans nigra*	Eastern Cottonwood	*Populus deltoides*
Shumard Oak	*Quercus shumardii*	Sycamore	*Platanus occidentalis*	Black Willow	*Salix nigra*
Elm	*Ulmus spp.*	Overcup Oak	*Quercus lyrata*	Soapberry	*Sapindus spp.*
		Cherrybark Oak	*Quercus pagoda*		

Group 1 = Common dominants in reference standard sites
Group 2 = Species commonly present in reference standard sites, but dominance generally indicates man-made or natural disturbance
Group 3 = Uncommon, minor or shrub species in reference standard sites, but may dominate in degraded systems

Tree Count by Species

Table 9A. Tree count by species for plots at Caddo National Grasslands Bois D'Arc Unit.

	Fraxinus pennsylvanica Green Ash	Celtis laevigata Sugarberry	Ulmus crassifolia Cedar Elm	Quercus macrocarpa Bur Oak	Ulmus americana American Elm	Maclura pomifera Bois D'Arc
Plot 1	12	12	0	0	0	0
Plot 2	10	16	0	0	0	0
Plot 3	16	17	0	0	0	0
Plot 4	9	5	7	1	0	0
Plot 5	18	0	13	0	0	0
Plot 6	14	5	1	0	0	0
Plot 7	19	10	1	0	0	0
Plot 8	4	1	0	0	2	6
Plot 9	7	3	2	0	0	6
Plot 10	16	6	3	0	0	0
Plot 11	6	8	2	0	0	1
Plot 12	14	14	0	0	0	2
Plot 13	3	5	6	0	0	2
Plot 14	0	5	5	0	0	1

Table 9A continued.

	Sapindus spp. Soapberry	Total # Trees	Total # Quercus spp.	% Quercus spp.	Total # Hard Mast Producers	% Hard Mast Producers
Plot 1	0	24	0	0	0	0
Plot 2	0	26	0	0	0	0
Plot 3	0	33	0	0	0	0
Plot 4	0	22	1	4.5	1	4.5
Plot 5	0	31	0	0	0	0
Plot 6	0	20	0	0	0	0
Plot 7	0	30	0	0	0	0
Plot 8	0	13	0	0	0	0
Plot 9	0	18	0	0	0	0
Plot 10	0	25	0	0	0	0
Plot 11	0	17	0	0	0	0
Plot 12	0	30	0	0	0	0
Plot 13	0	16	0	0	0	0
Plot 14	2	13	0	0	0	0

Table 9B. Tree count by species for plots at Caddo National Grasslands Ladonia Unit.

	Fraxinus pennsylvanica Green Ash	Celtis laevigata Sugarberry	Ulmus crassifolia Cedar Elm	Quercus macrocarpa Bur Oak	Ulmus americana American Elm	Maclura pomifera Bois D'Arc	Sapindus spp. Soapberry
Plot 1	3	2	1	0	0	6	0
Plot 2	3	7	6	1	0	3	0
Plot 3	4	6	1	0	0	0	0
Plot 4	2	6	1	0	0	0	2

Table 9B continued.

	Diospyros virginiana Persimmon	Platanus occidentalis Sycamore	Total # Trees	Total # Quercus spp.	% Quercus spp.	Total # Hard Mast Producers	% Hard Mast Producers
Plot 1	0	0	12	0	0	0	0
Plot 2	0	0	20	1	5	1	5
Plot 3	0	0	11	0	0	0	0
Plot 4	1	1	13	0	0	0	0

Table 9C. Tree count by species for plots at White Oak WMA.

	Fraxinus pennsylvanica Green Ash	Celtis laevigata Sugarberry	Ulmus crassifolia Cedar Elm	Ulmus americana American Elm	Maclura pomifera Bois D'Arc	Sapindus spp. Soapberry	Diospyros virginiana Persimmon	Quercus lyrata Overcup Oak
Plot 1	0	0	0	0	0	0	0	15
Plot 2	0	0	0	0	0	0	0	12
Plot 3	2	0	0	0	0	0	0	5
Plot 4	0	0	0	0	0	0	0	11
Plot 5	0	0	0	0	0	0	0	6
Plot 6	0	0	0	0	0	0	0	7
Plot 7	1	0	0	0	0	0	0	3
Plot 8	1	2	7	0	0	0	0	2
Plot 9	0	2	7	0	0	0	0	0
Plot 10	0	0	2	0	0	0	0	5
Plot 11	0	1	3	0	1	0	1	4
Plot 12	1	0	0	2	0	0	0	3
Plot 13	0	2	0	3	0	0	0	1
Plot 14	0	0	0	0	0	0	0	2
Plot 15	0	0	0	0	0	0	0	0

Table 9C continued.

	Carya illinoinensis Pecan	Planera aquatica Water Elm	Quercus nigra Water Oak	Ulmus rubra Slippery Elm	Gleditsia triacanthos Honey Locust	Quercus pagoda Cherrybark Oak	Quercus phellos Willow Oak	Quercus alba White Oak
Plot 1	1	0	0	0	0	0	0	0
Plot 2	0	1	0	0	0	0	0	0
Plot 3	0	0	0	0	0	0	0	0
Plot 4	0	0	1	0	0	0	0	0
Plot 5	0	2	0	0	0	0	0	0
Plot 6	2	0	0	0	0	0	0	0
Plot 7	1	0	2	1	0	0	0	0
Plot 8	0	0	0	0	1	0	0	0
Plot 9	0	0	0	0	1	1	1	0
Plot 10	0	1	3	0	0	0	0	0
Plot 11	0	0	2	0	0	0	0	0
Plot 12	0	0	6	0	0	4	1	0
Plot 13	0	0	0	0	0	1	3	0
Plot 14	0	0	0	0	0	4	2	1
Plot 15	0	0	3	0	0	1	2	0

Table 9C continued.

	Carpinus caroliniana American Hornbeam	Liquidambar styraciflua Sweetgum	Total # Trees	Total # Quercus spp.	% Quercus spp.	Total # Hard Mast Producers	% Hard Mast Producers
Plot 1	0	0	16	15	93.8	16.0	100.0
Plot 2	0	0	13	12	92.3	12.0	92.3
Plot 3	0	0	7	5	71.4	5.0	71.4
Plot 4	0	0	12	12	100.0	12.0	100.0
Plot 5	0	0	8	6	75.0	6.0	75.0
Plot 6	0	0	9	7	77.8	9.0	100.0
Plot 7	0	0	8	5	62.5	6.0	75.0
Plot 8	0	0	13	2	15.4	2.0	15.4
Plot 9	0	0	12	2	16.7	2.0	16.7
Plot 10	0	0	11	8	72.7	8.0	72.7
Plot 11	0	0	12	6	50.0	6.0	50.0
Plot 12	1	1	19	14	73.7	14.0	73.7
Plot 13	0	0	10	5	50.0	5.0	50.0
Plot 14	0	3	15	9	60.0	9.0	60.0
Plot 15	0	1	7	6	85.7	6.0	85.7

Table 9D. Tree count by species for plots at Cooper WMA.

	Fraxinus pennsylvanica Green Ash	Celtis laevigata Sugarberry	Ulmus crassifolia Cedar Elm	Quercus macrocarpa Bur Oak	Maclura pomifera Bois D'Arc
Plot 1	8	32	1	1	0
Plot 2	7	15	1	1	1
Plot 3	5	5	1	0	0
Plot 4	0	10	1	0	0
Plot 5	1	9	0	0	0
Plot 6	0	1	0	0	0

Table 9D continued.

	Sapindus spp. Soapberry	Carya illinoinensis Pecan	Quercus nigra Water Oak	Quercus shumardii Shumard Oak	Acer negundo Box Elder
Plot 1	0	0	0	0	0
Plot 2	0	0	1	2	0
Plot 3	0	1	5	2	0
Plot 4	1	2	0	1	5
Plot 5	0	1	0	1	0
Plot 6	0	6	1	0	1

Table 9D continued.

	Total # Trees	Total # Quercus spp.	% Quercus spp.	Total # Hard Mast Producers	% Hard Mast Producers
Plot 1	42	1	2.4	1	2.4
Plot 2	28	4	14.3	4	14.3
Plot 3	19	7	36.8	8	42.1
Plot 4	20	1	5.0	3	15.0
Plot 5	12	1	8.3	2	16.7
Plot 6	9	1	11.1	7	77.8

Table 9E. Tree count by species for plots at Pat Mayse WMA.

	Fraxinus pennsylvanica Green Ash	Celtis laevigata Sugarberry	Ulmus crassifolia Cedar Elm	Quercus macrocarpa Bur Oak	Maclura pomifera Bois D'Arc	Platanus occidentalis Sycamore	Carya illinoinensis Pecan
Plot 1	0	4	5	0	0	2	0
Plot 2	0	4	2	0	0	0	6
Plot 3	2	5	1	0	0	1	4
Plot 4	13	2	4	0	0	0	2
Plot 5	1	6	12	0	0	0	0
Plot 6	0	0	2	0	0	0	6
Plot 7	0	0	0	0	2	0	2
Plot 8	1	0	2	0	0	0	0
Plot 9	0	0	3	1	0	0	0
Plot 10	0	17	7	0	1	0	1
Plot 11	0	9	2	0	0	0	1
Plot 12	0	1	7	0	3	0	1
Plot 13	4	10	10	0	1	0	1
Plot 14	0	2	6	0	0	0	1
Plot 15	5	3	3	0	1	0	0
Plot 16	0	1	1	1	7	0	3
Plot 17	1	1	7	0	3	0	4

Table 9E continued.

	Quercus nigra Water Oak	Gleditsia triacanthos Honey Locust	Quercus shumardii Shumard Oak	Juniperus virginiana Eastern Red Cedar	Carya ovata Shagbark Hickory	Quercus stellata Post Oak	Carya cordiformis Bitternut Hickory
Plot 1	0	0	4	0	0	0	0
Plot 2	0	0	0	0	0	0	0
Plot 3	0	0	0	0	0	0	0
Plot 4	0	0	0	0	0	0	0
Plot 5	1	0	0	0	0	0	0
Plot 6	13	1	0	1	0	0	0
Plot 7	5	0	0	7	0	0	0
Plot 8	11	0	0	0	0	0	0
Plot 9	9	0	0	0	0	0	0
Plot 10	0	0	0	0	0	0	2
Plot 11	3	0	0	0	0	0	0
Plot 12	0	0	1	0	3	1	0
Plot 13	0	0	0	0	0	0	0
Plot 14	3	0	0	0	0	0	0
Plot 15	2	0	0	0	0	0	0
Plot 16	0	0	0	0	0	0	0
Plot 17	3	0	0	0	0	0	0

Table 9E continued.

	Ulmus alata Winged Elm	Acer negundo Box Elder	Total # Trees	Total # Quercus spp.	% Quercus spp.	Total # Hard Mast Producers	% Hard Mast Producers
Plot 1	0	0	15	4	26.7	4	26.7
Plot 2	0	6	18	0	0.0	6	33.3
Plot 3	0	0	13	0	0.0	4	30.8
Plot 4	0	0	21	0	0.0	2	9.5
Plot 5	1	0	21	1	4.8	1	4.8
Plot 6	0	0	23	13	56.5	19	82.6
Plot 7	0	0	16	5	31.3	7	43.8
Plot 8	0	0	14	11	78.6	11	78.6
Plot 9	1	0	14	10	71.4	10	71.4
Plot 10	0	0	28	0	0.0	3	10.7
Plot 11	0	0	15	3	20.0	4	26.7
Plot 12	0	0	17	2	11.8	6	35.3
Plot 13	0	0	26	0	0.0	1	3.8
Plot 14	0	0	12	3	25.0	4	33.3
Plot 15	1	0	15	2	13.3	2	13.3
Plot 16	0	0	13	1	7.7	4	30.8
Plot 17	0	0	19	3	15.8	7	36.8

Table 9F. Tree count by species for plots at Lennox Woods.

	Fraxinus pennsylvanica Green Ash	Celtis laevigata Sugarberry	Ulmus americana American Elm	Quercus nigra Water Oak	Quercus shumardii Shumard Oak	Carya ovata Shagbark Hickory	Carya cordiformis Bitternut Hickory	Quercus falcata Southern Red Oak
Plot 1	0	1	0	1	0	0	7	0
Plot 2	0	0	1	6	0	0	1	0
Plot 3	0	0	0	1	0	4	0	0
Plot 4	0	0	0	4	0	1	0	0
Plot 5	0	0	0	1	2	8	0	0
Plot 6	0	0	1	1	0	2	3	1
Plot 7	0	0	1	3	0	12	0	1
Plot 8	1	0	0	3	0	8	0	0

Table 9F continued.

	Pinus taeda Loblolly Pine	Pinus echinata Shortleaf Pine	Acer rubrum Red Maple	Quercus alba White Oak	Carya texana Black Hickory	Cornus spp. Dogwood	Carpinus caroliniana American Hornbeam	Liquidambar styraciflua Sweetgum
Plot 1	0	0	0	1	0	2	1	1
Plot 2	0	0	0	2	1	1	0	2
Plot 3	0	1	1	2	0	0	2	6
Plot 4	3	0	0	2	0	0	0	2
Plot 5	0	0	0	0	0	1	0	10
Plot 6	0	0	0	5	0	0	0	2
Plot 7	0	0	0	1	0	0	0	1
Plot 8	0	0	0	1	0	0	0	0

Table 9F continued.

	Ulmus alata Winged Elm	Total # Trees	Total # Quercus spp.	% Quercus spp.	Total # Hard Mast Producers	% Hard Mast Producers
Plot 1	7	21	2	9.5	9	42.9
Plot 2	0	14	8	57.1	10	71.4
Plot 3	0	17	3	17.6	7	41.2
Plot 4	0	12	6	50.0	7	58.3
Plot 5	0	22	3	13.6	11	50.0
Plot 6	0	15	7	46.7	12	80.0
Plot 7	0	19	5	26.3	17	89.5
Plot 8	0	13	4	30.8	12	92.3

Calculations

Original East Texas FCI Models

a. Detain Floodwater.

$$FCI = V_{FREQ} \times \left[\frac{(V_{LOG} + V_{GVC} + V_{SSD} + V_{TDEN})}{4}\right]$$

b. Detain Precipitation.

$$FCI = \frac{\left[V_{POND} + \frac{(V_{OHOR} + V_{LITTER})}{2}\right]}{2}$$

c. Cycle Nutrients.

$$FCI = \frac{\left[\frac{(V_{TBA} + V_{SSD} + V_{GCV})}{3} + \frac{(V_{OHOR} + V_{AHOR} + V_{WD} + V_{SNAG})}{4}\right]}{2}$$

d. Export Organic Carbon.

$$FCI = V_{FREQ} \times \frac{\left[\frac{(V_{LITTER} + V_{OHOR} + V_{WD} + V_{SNAG})}{4} + \frac{(V_{TBA} + V_{SSD} + V_{GVC})}{3}\right]}{2}$$

e. Maintain Plant Communities.

$$FCI = \left[\left\{\frac{\frac{[V_{TBA} + V_{TDEN}]}{2} + V_{COMP}}{2}\right\} \times \left[\frac{(V_{SOIL} + V_{DUR} + V_{POND})}{3}\right]\right]^{1/2}$$

f. Provide Habitat for Fish and Wildlife.

$$FCI = \left\{\begin{matrix}\left[\frac{(V_{FREQ} + V_{DUR} + V_{POND})}{3}\right] \times \left[\frac{(V_{TCOMP} + V_{STRATA} + V_{SNAG} + V_{TBA})}{4}\right] \\ \times \left[\frac{(V_{LOG} + V_{OHOR})}{2}\right] \times V_{PATCH}\end{matrix}\right\}^{1/4}$$

Modified Fannin County Models

a. Detain Floodwater.

$$FCI = V_{FREQ} \times \left[\frac{(V_{LOG} + V_{GVC} + V_{SSD} + V_{TDEN})}{4}\right]$$

b. Detain Precipitation.

$$FCI = \frac{\left[V_{POND} + \frac{(V_{OHOR} + V_{LITTER})}{2}\right]}{2}$$

c. Cycle Nutrients.

$$FCI = \frac{\left[\frac{(V_{TBA} + V_{SSD} + V_{GCV})}{3} + \frac{(V_{OHOR} + V_{WD} + V_{SNAG})}{3}\right]}{2}$$

d. Export Organic Carbon.

$$FCI = V_{FREQ} \times \frac{\left[\frac{(V_{LITTER} + V_{OHOR} + V_{WD} + V_{SNAG})}{4} + \frac{(V_{TBA} + V_{SSD} + V_{GVC})}{3}\right]}{2}$$

e. Maintain Plant Communities.

$$FCI = \left[\left\{\frac{\frac{[V_{TBA} + V_{TDEN}]}{2} + V_{COMP}}{2}\right\} \times \left[\frac{(V_{SOIL} + V_{DUR} + V_{POND})}{3}\right]\right]^{1/2}$$

f. Provide Habitat for Fish and Wildlife.

$$FCI = \left\{\left[\frac{(V_{FREQ} + V_{DUR} + V_{POND})}{3}\right] \times \left[\frac{(V_{TCOMP} + V_{STRATA} + V_{SNAG} + V_{TBA})}{4}\right] \times \left[\frac{(V_{LOG} + V_{OHOR})}{2}\right] \times V_{PATCH}\right\}^{1/4}$$

Modified Fannin County Flats Models

$a.\ Detain\ Floodwater.$ Not Assessed.

$b.\ Detain\ Precipitation.$

$$FCI = \frac{\left[V_{POND} + \frac{(V_{OHOR} + V_{LITTER})}{2}\right]}{2}$$

$c.\ Cycle\ Nutrients.$

$$FCI = \frac{\left[\frac{(V_{TBA} + V_{SSD} + V_{GCV})}{3} + \frac{(V_{OHOR} + V_{WD} + V_{SNAG})}{3}\right]}{2}$$

$d.\ Export\ Organic\ Carbon.$ Not Assessed.

$e.\ Maintain\ Plant\ Communities.$

$$FCI = \left[\left\{\frac{\frac{[V_{TBA} + V_{TDEN}]}{2} + V_{COMP}}{2}\right\} \times \left[\frac{(V_{SOIL} + V_{POND})}{2}\right]\right]^{1/2}$$

$f.\ Provide\ Habitat\ for\ Fish\ and\ Wildlife.$

$$FCI = \left\{ \begin{array}{l} V_{POND} \times \left[\frac{(V_{TCOMP} + V_{STRATA} + V_{SNAG} + V_{TBA})}{4}\right] \\ \times \left[\frac{(V_{LOG} + V_{OHOR})}{2}\right] \times V_{PATCH} \end{array} \right\}^{1/4}$$

Adjusted Quality Index Calculation for V_{TCOMP}

$$Initial\ Quality\ Index = \frac{\begin{bmatrix}(\#\ of\ dominants\ from\ Group\ 1\ \times 1.0) + (\#\ of\ dominants\ from\ Group\ 2\ \times 0.66) + \\ (\#of\ dominants\ from\ Group\ 3\ \times 0.33)\end{bmatrix}}{\#\ of\ dominants\ from\ Groups\ 1, 2, and\ 3}$$

$$\boldsymbol{VSI = Adjusted\ Quality\ Index}$$

Where if there are <u>3</u> or more dominants from Groups 1 and 2:

$$Adjusted\ Quality\ Index = 1.0\ \times Initial\ Quality\ Index$$

Where if there are <u>2</u> dominants from Groups 1 and 2:

$$Adjusted\ Quality\ Index = 0.66\ \times Initial\ Quality\ Index$$

Where if there is <u>1</u> dominant from Groups 1 and 2:

$$Adjusted\ Quality\ Index = 0.33\ \times Initial\ Quality\ Index$$

And if there are <u>0</u> dominants from Groups 1 and 2:

$$Adjusted\ Quality\ Index = 0.10\ \times Initial\ Quality\ Index$$