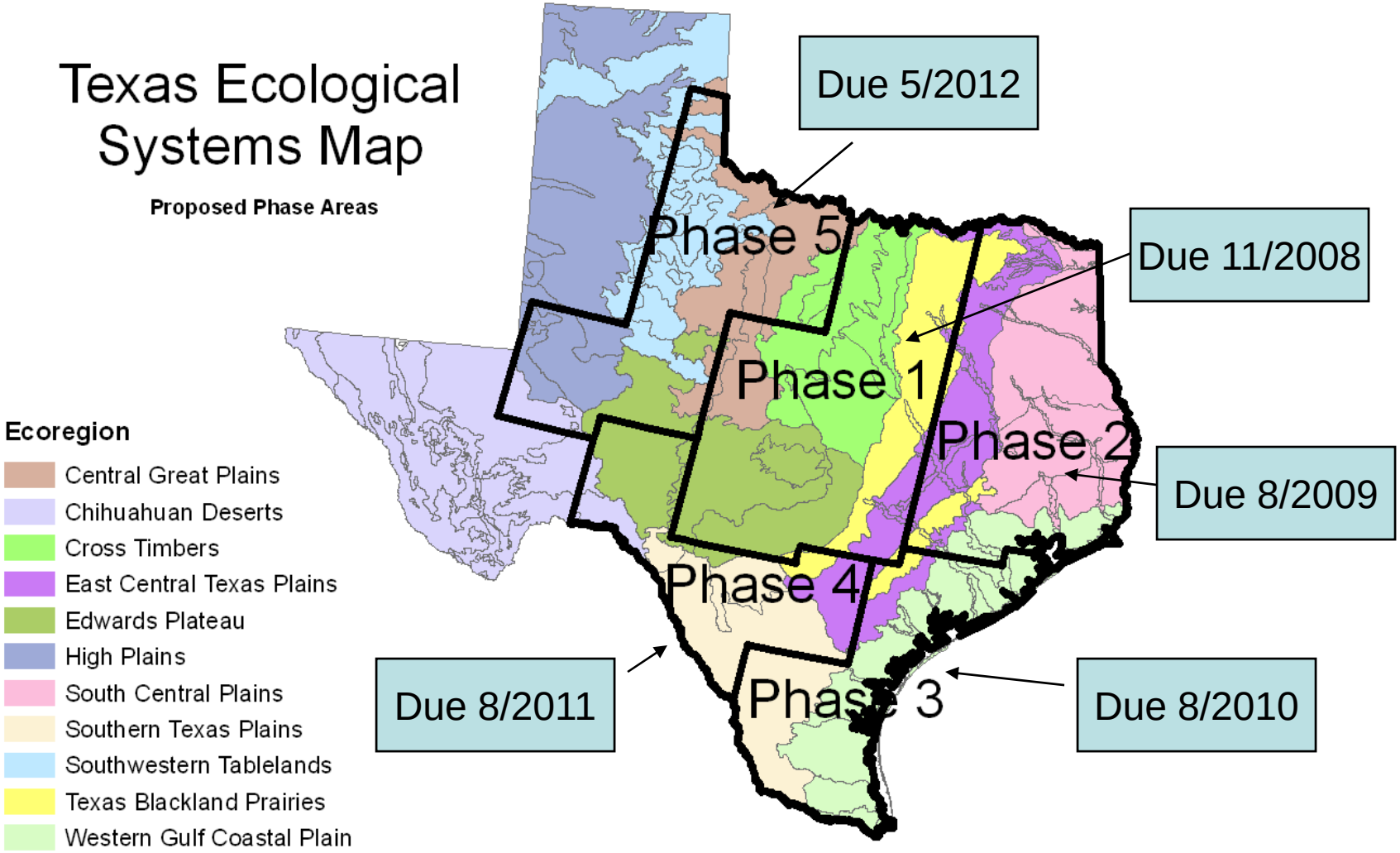
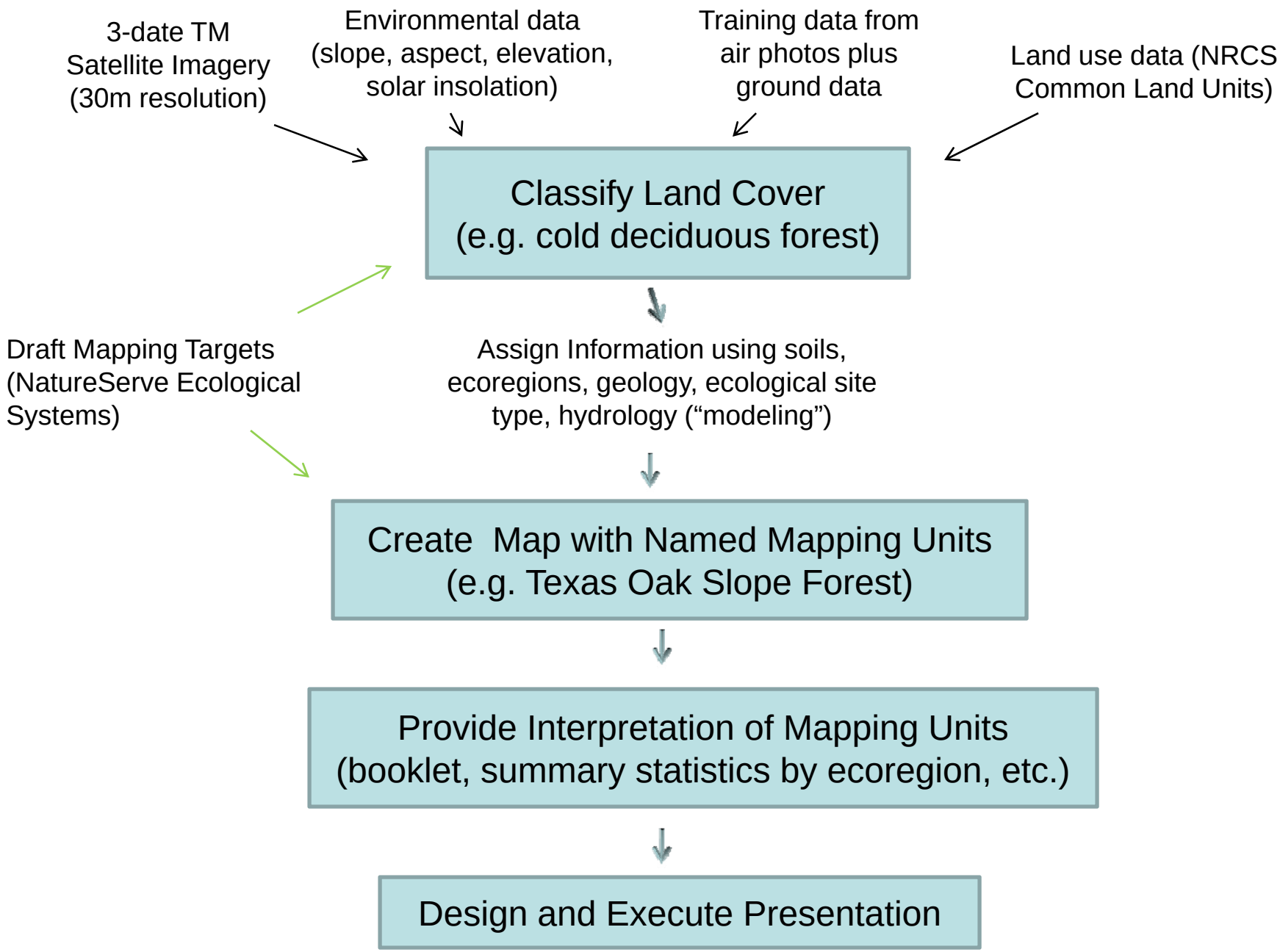
Ecological Systems Classification for Texas



Background

- TPWD wants better land cover for Texas
  - More land cover classes
  - Better spatial resolution
  - Better accuracy (overall 85%)
  - Better ecological interpretation
- Partners Required!
  - MoRAP, University of Missouri
  - TNC, Texas
  - NatureServe, Southeast Region
  - TNRIS
  - NRCS, TXFS, USFS, others


3-date TM Satellite Imagery (30m resolution)
Environmental data (slope, aspect, elevation, solar insolation)
Training data from air photos plus ground data
Land use data (NRCS Common Land Units)
Classify Land Cover (e.g. cold deciduous forest)
Draft Mapping Targets (NatureServe Ecological Systems)
Assign Information using soils, ecoregions, geology, ecological site type, hydrology ("modeling")
Create Map with Named Mapping Units (e.g. Texas Oak Slope Forest)
Provide Interpretation of Mapping Units (booklet, summary statistics by ecoregion, etc.)
Design and Execute Presentation

A FRAMEWORK FOR PLANT COMMUNITY CLASSIFICATION AND CONSERVATION IN TEXAS

DAVID D. DIAMOND, DAVID H. RISKIND, AND STEVE L. ORZELL

Texas Natural Heritage Program, General Land Office, Stephen F. Austin Building, Austin, Texas 78701, and Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744 (DHR)

ABSTRACT.—Seventy-eight late seral stage plant community types are described and classified at the series level (characterized by dominant species or genera). The classification framework used can be expanded to include finer subdivisions at the plant association (defined as a plant community of definite floristic composition within a uniform habitat) level. Community types are ranked according to conservation needs from endangered (1) to secure (4), and 10 (13 percent) are threatened or endangered. Ranking remains partially subjective, but depends on the estimated number of late seral stage relicts, the estimated number of relicts protected, the estimated area occupied by the community type, and the relative threat of severe disturbance. The classification and conservation rankings presented should stimulate debate among users and result in successive refinements. Quantitative data on vegetation are inadequate to provide a finer scale classification of communities for most regions of Texas, and quantitative inventories of resources already in public or private managed natural areas also are lacking. The need for these data, the need for enlightened stewardship of existing natural areas, and the need to consider landscape ecology in preserve design and selection mark the greatest challenges in the future for Texas conservationists. *Key words*: classification; conservation; landscape ecology; plant community.

The land area of Texas is more than 370,000 square kilometers. Climatic regimes range from humid subtropical to arid subtropical to continental steppe (Larkin and Bomar, 1983; Owen and Schmidly, 1986), while geologic substrate ranges from Recent sands and silts to Cretaceous limestones to Precambrian granite (Sellards et al., 1966). This wide variation in climate and geology results in a wide variation in landform, soils, and vegetation. Soils have been classified and mapped to a relatively fine degree across most of Texas. However, there has been no attempt at a fine-scale, state-wide classification of vegetation, although several authors have classified the vegetation at a physiognomic or natural region level (see Tharp, 1939; Gould, 1975; Küchler, 1964; LBJ School of Public Affairs, 1978; Brown et al., 1979; Fig. 1).

An informal approach to classification has generally been adopted by North American ecologists, who have used different approaches and frameworks for different vegetation types and purposes. However, there is merit in acceptance of a standardized classification, because this favors more efficient organization and communication of information among users (see Driscoll et al., 1984). Because conservation efforts generally concentrate on late seral stage, rather than early or mid-successional

The Texas Journal of Science, Vol. 39, No. 3, August, 1987

International Classification of Ecological Communities:

TERRESTRIAL VEGETATION of the UNITED STATES

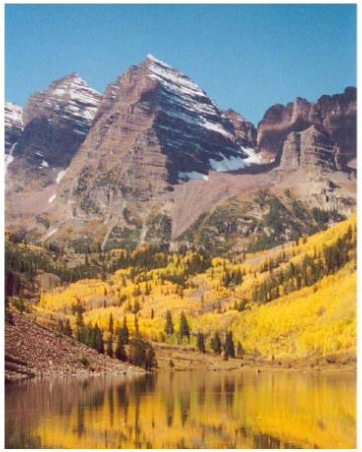
VOLUME I

The National Vegetation Classification System: Development, Status, and Applications

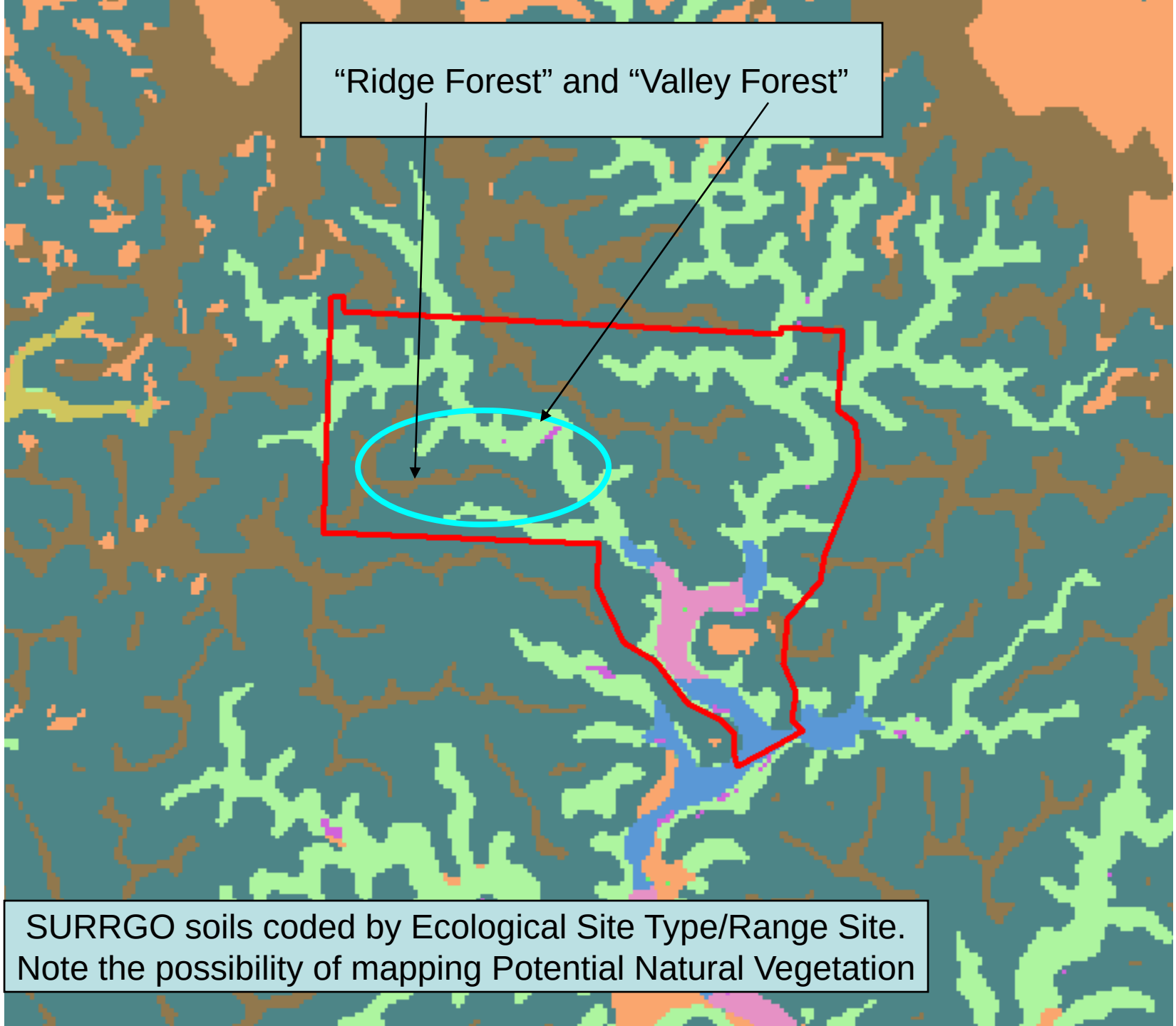
The Nature Conservancy

ECOLOGICAL SYSTEMS OF THE UNITED STATES

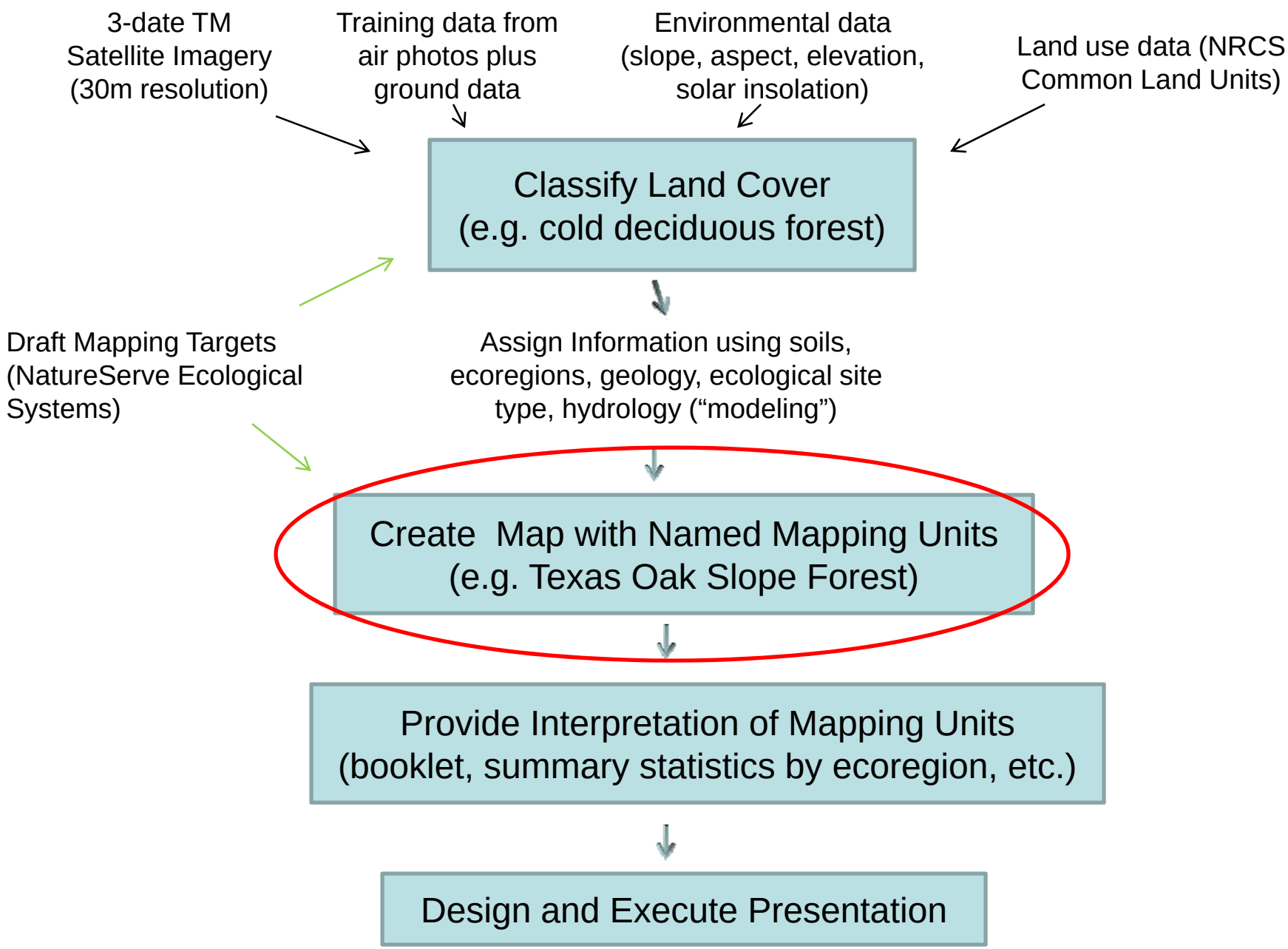
A WORKING CLASSIFICATION OF U.S. TERRESTRIAL SYSTEMS



NatureServe



SURRGO soils coded by Ecological Site Type/Range Site.
Note the possibility of mapping Potential Natural Vegetation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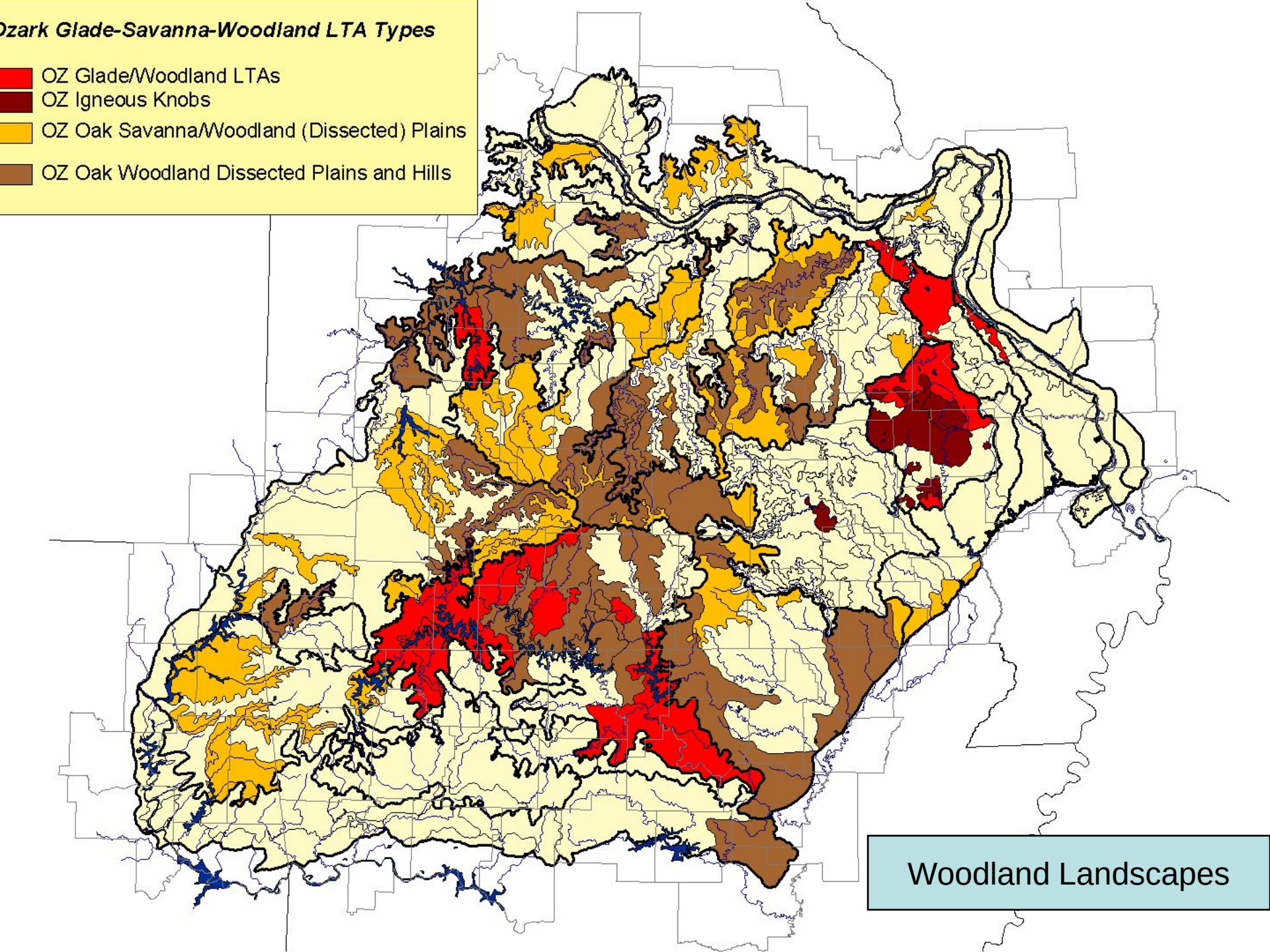
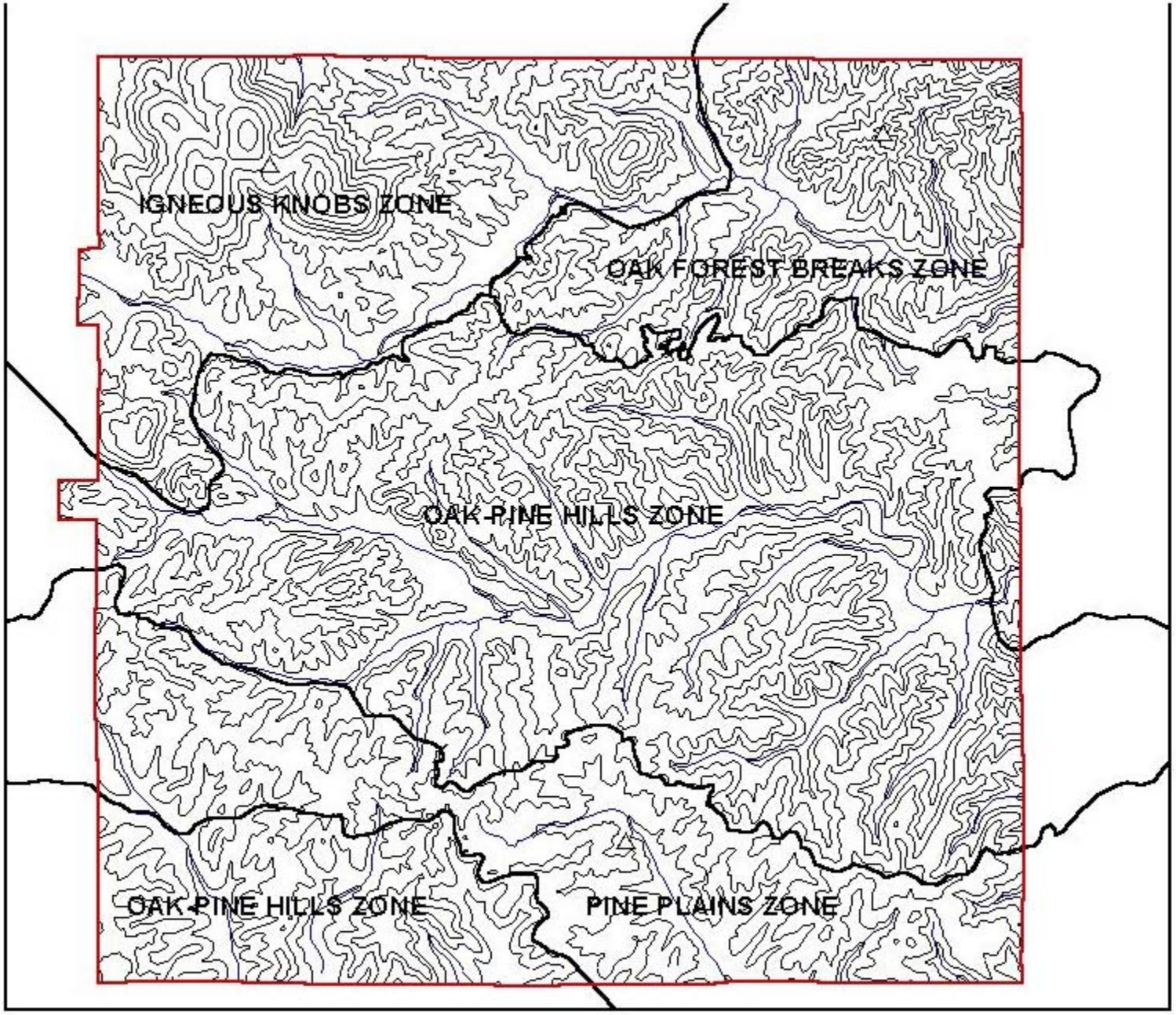
Design and Execute Presentation

Products/Enduring Value

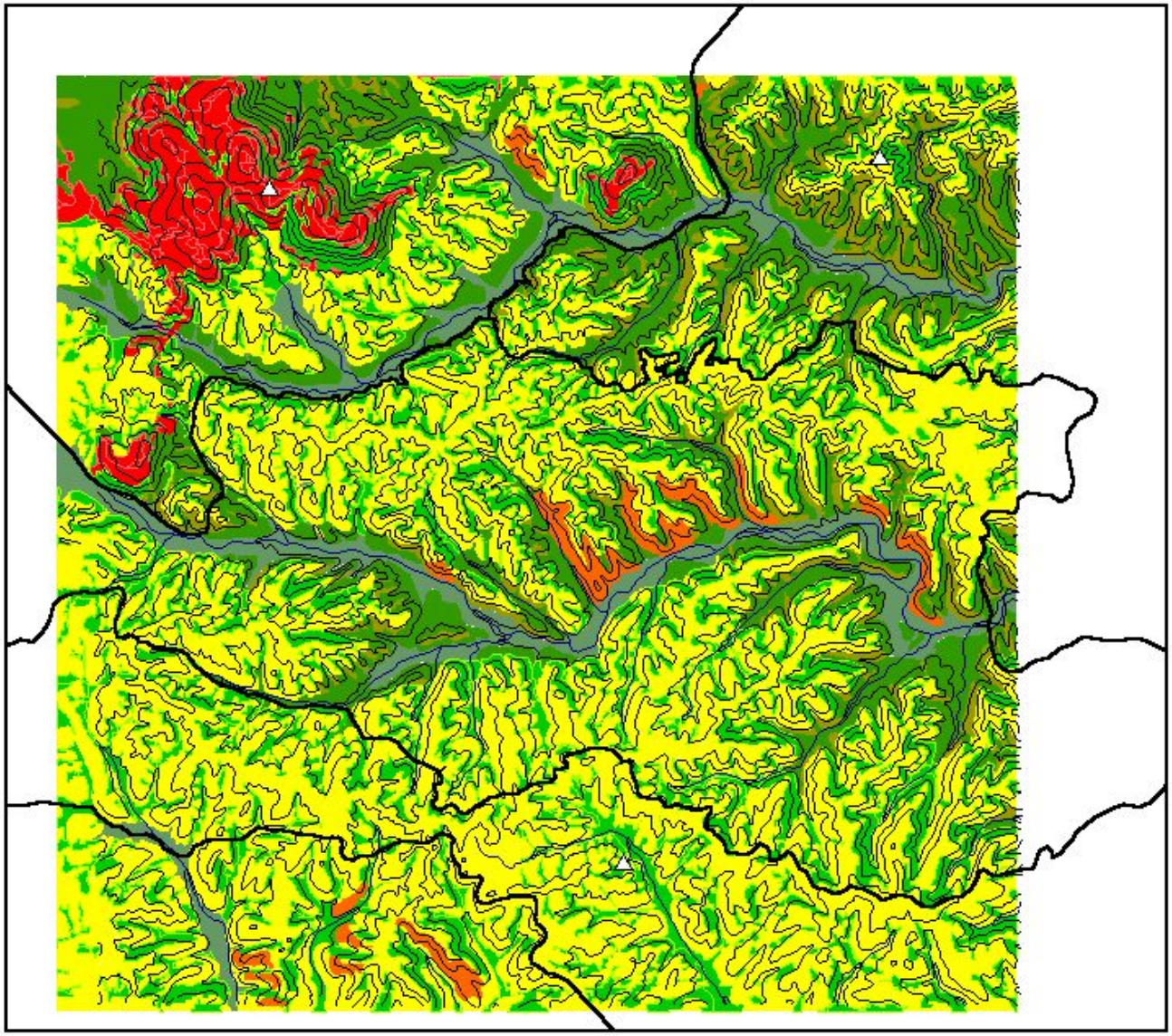
- Potential natural vegetation
- Existing vegetation using an improved classification
- Interpretive Booklet
  - Topo-sequences / landscape profiles of potential and existing vegetation
  - Interpretation of the current land cover (e.g. dynamics, management)
  - Photos
- Ground truth dataset (around 10,000 points)
- User will build their own added value:
  - Context (local, regional, statewide)
  - Management options
  - Conservation opportunity areas
  - Ecological significance and risk (riverine/aquatics as well)
  - Species habitat modeling
  - Development of educational and interpretive materials
  - Change detection


Ozark Glade-Savanna-Woodland LTA Types
OZ Glade/Woodland LTAs
OZ Igneous Knobs
OZ Oak Savanna/Woodland (Dissected) Plains
OZ Oak Woodland Dissected Plains and Hills
Woodland Landscapes

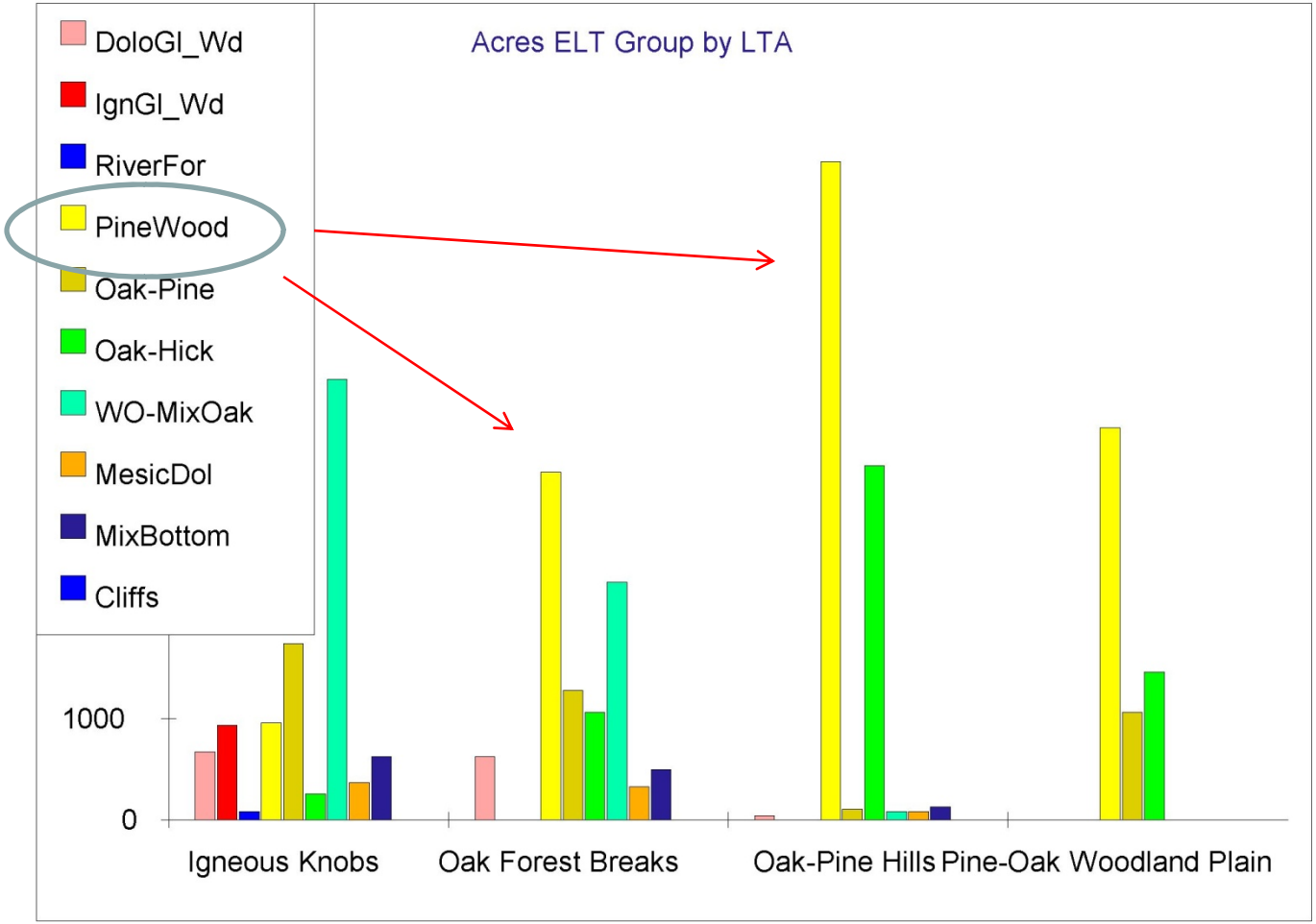
Manage for Woodland Species



Peck Ranch Conservation Area



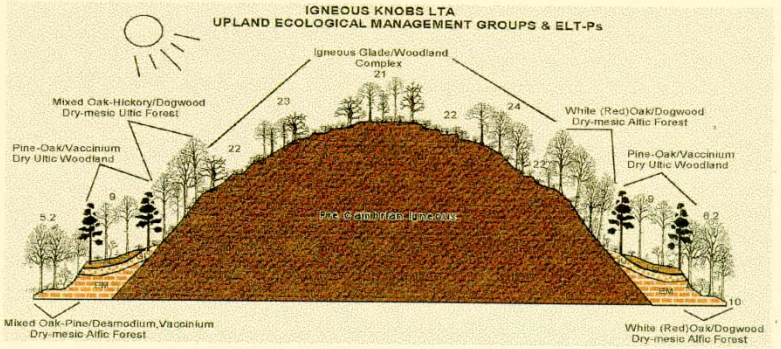
Peck Ranch Conservation Area
Ecological Management Units
EMUs



Peck Ranch
Potential Natural Communities by LTA

PECK RANCH CONSERVATION AREA

MANAGEMENT PLAN



A MANAGEMENT PLAN TO MAINTAIN, ENHANCE AND RESTORE NATIVE PLANT AND ANIMAL COMMUNITIES, AND PROVIDE OUTDOOR RECREATION AND EDUCATION OPPORTUNITIES

April 2000

Outline of Accomplishments

- Internal and external team established
- Introduced and outlined project (Houston)
- Mapping targets drafted/reviewed for Phase 1
- Photo interpreted training data selected & proofed
- Ecological Site Types created from DEM analyses
- > 30 drafts of land cover data completed
- Field data collected (>2700 points)
- Draft land cover reviewed in field
- Modeling data created (links to soils, ecological site types)
- First draft of final map completed

Tasks – Fiscal 2009

- Mapping targets key **to facilitate field data collection** for Phase 2 (**ASAP**)
- Ecological Systems map for Phase 1 (Nov, 2008)
- Phase 1 map legend interpretive booklet (Feb, 2009)
- Phase 2 land cover map (Feb, 2009)
- Phase 2 modeling data layers (May, 2009)
- Final Phase 2 Ecological Systems map (Aug, 2009)

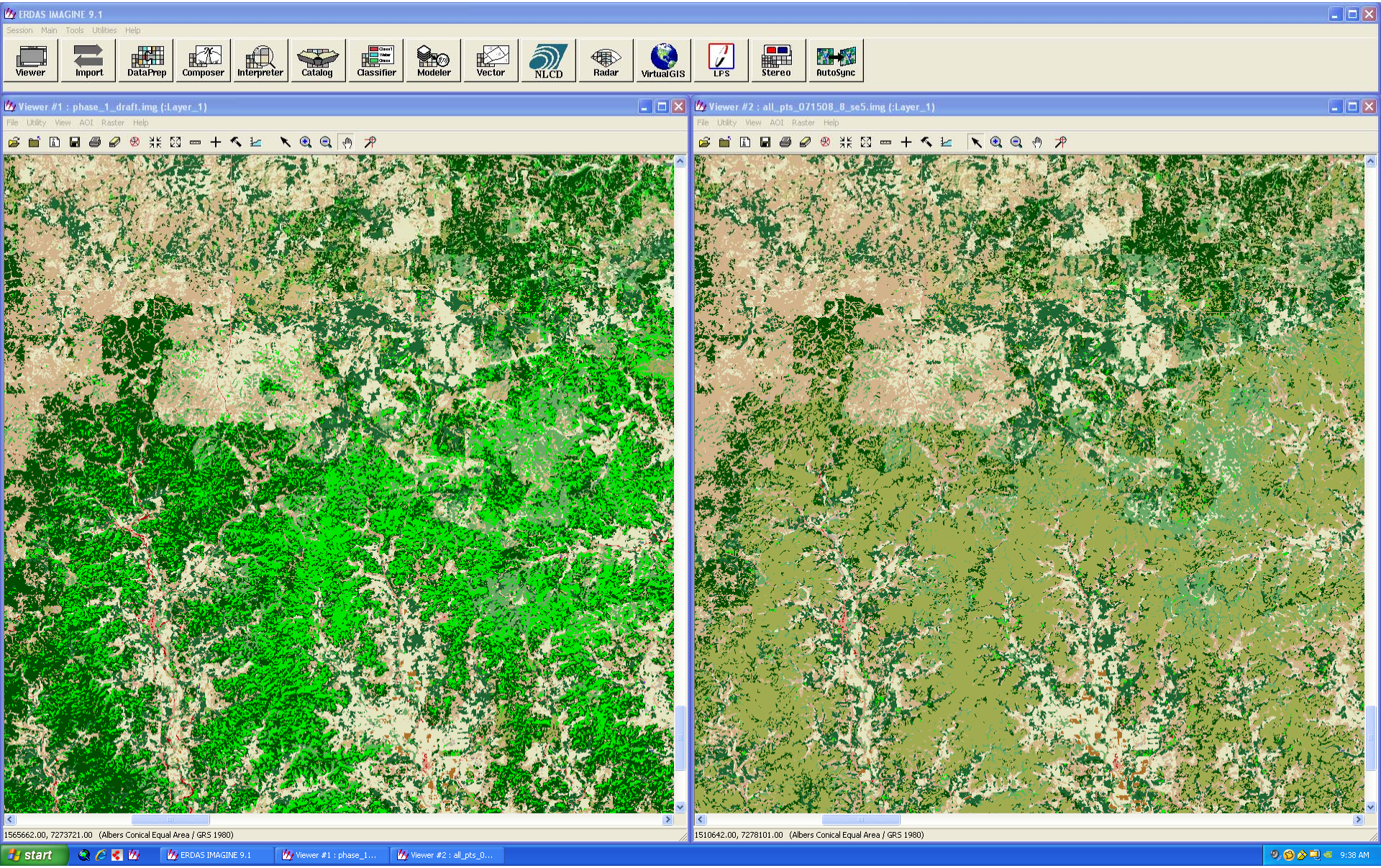
- **Important questions: how are we going to 'circle back around' to make final corrections? How are we going to design and present the final product for P1?**

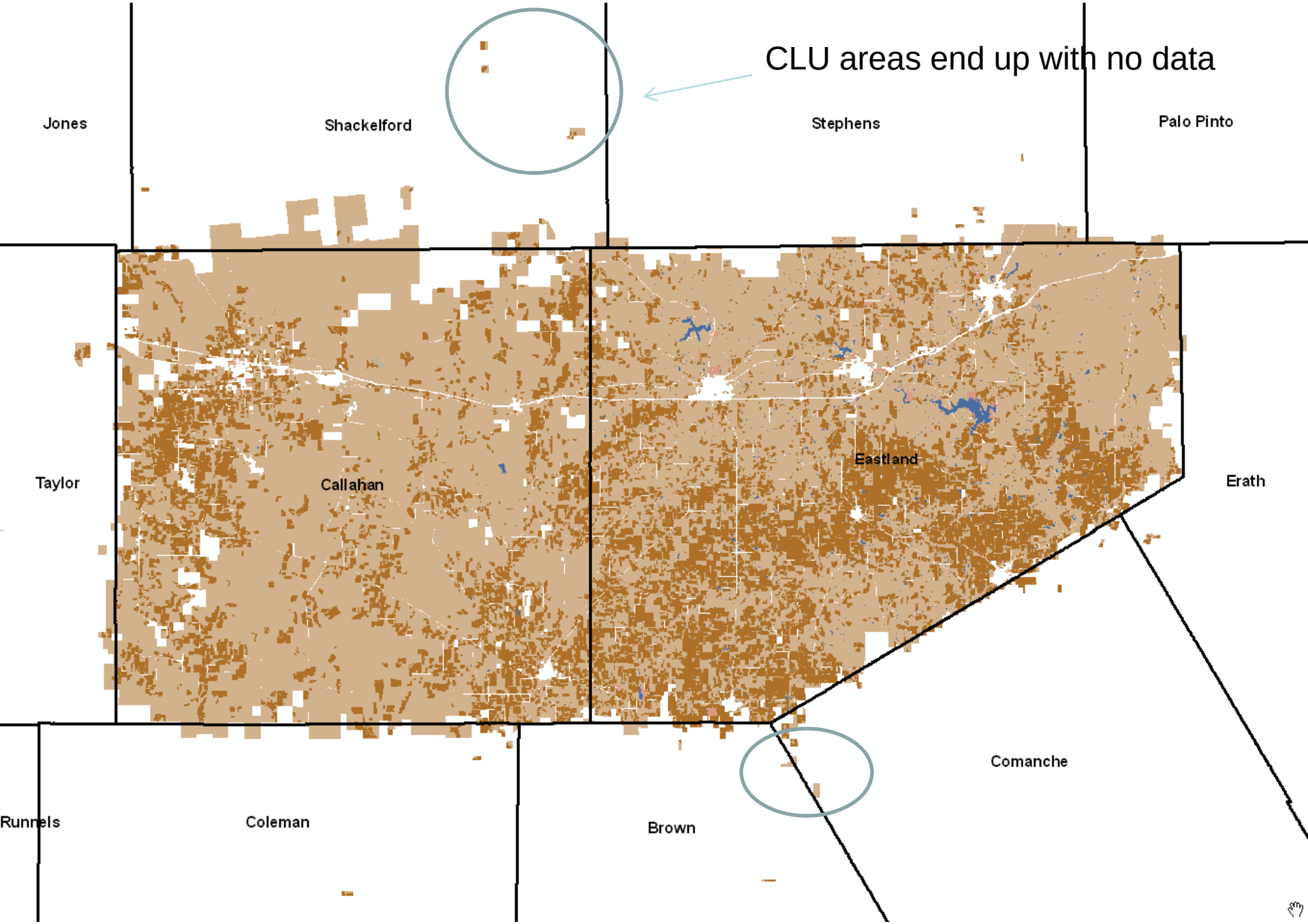
Remote Sensing Synopsis

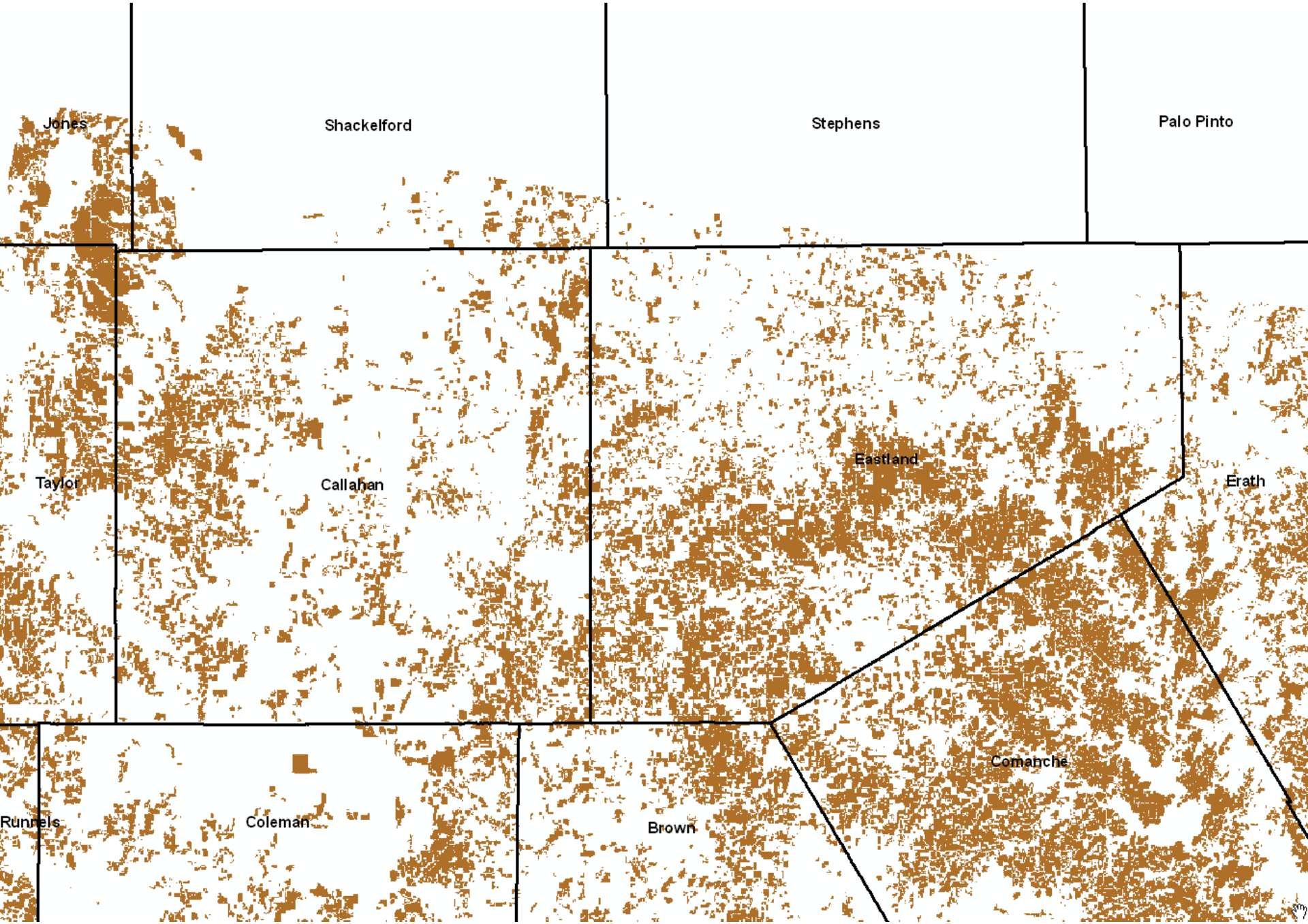
- Many drafts produced (>30)
- Decision Tree Classifier used
- Continuous as well as categorical data used – current model includes 3-date imagery mosaic plus:
  - elevation, slope, aspect, CLUs, %canopy, %impervious, solar insolation, landscape position
- 8099 training points, 91% accuracy for those points

On-going work

- Addition of a few sample points can completely change the classification – more data are being added
- CLU polygons are mapped outside of county boundaries; multiple counties map same area (sometimes differently)
- Appending CLU files results in holes where data should exist, and places where more than one land use is mapped
- Alternative approach (raster modeling) used to develop a crop area map


ERDAS IMAGINE 9.1
Session Main Tools Utilities Help
Viewer
Import
DataPrep
Composer
Interpreter
Catalog
Classifier
Modeler
Vector
NLCD
Radar
VirtualGIS
LPS
Stereo
AutoSync
Viewer #1 : phase_1_draft.img (:Layer_1)
File Utility View AOI Raster Help
1565662.00, 7273721.00 (Albers Conical Equal Area / GRS 1980)
Viewer #2 : all_pts_071508_8_se5.img (:Layer_1)
File Utility View AOI Raster Help
1510642.00, 7278101.00 (Albers Conical Equal Area / GRS 1980)
start
ERDAS IMAGINE 9.1
Viewer #1 : phase_1...
Viewer #2 : all_pts_0...
9:38 AM


CLU areas end up with no data
Jones
Shackelford
Stephens
Palo Pinto
Taylor
Callahan
Eastland
Erath
Comanche
Runnels
Coleman
Brown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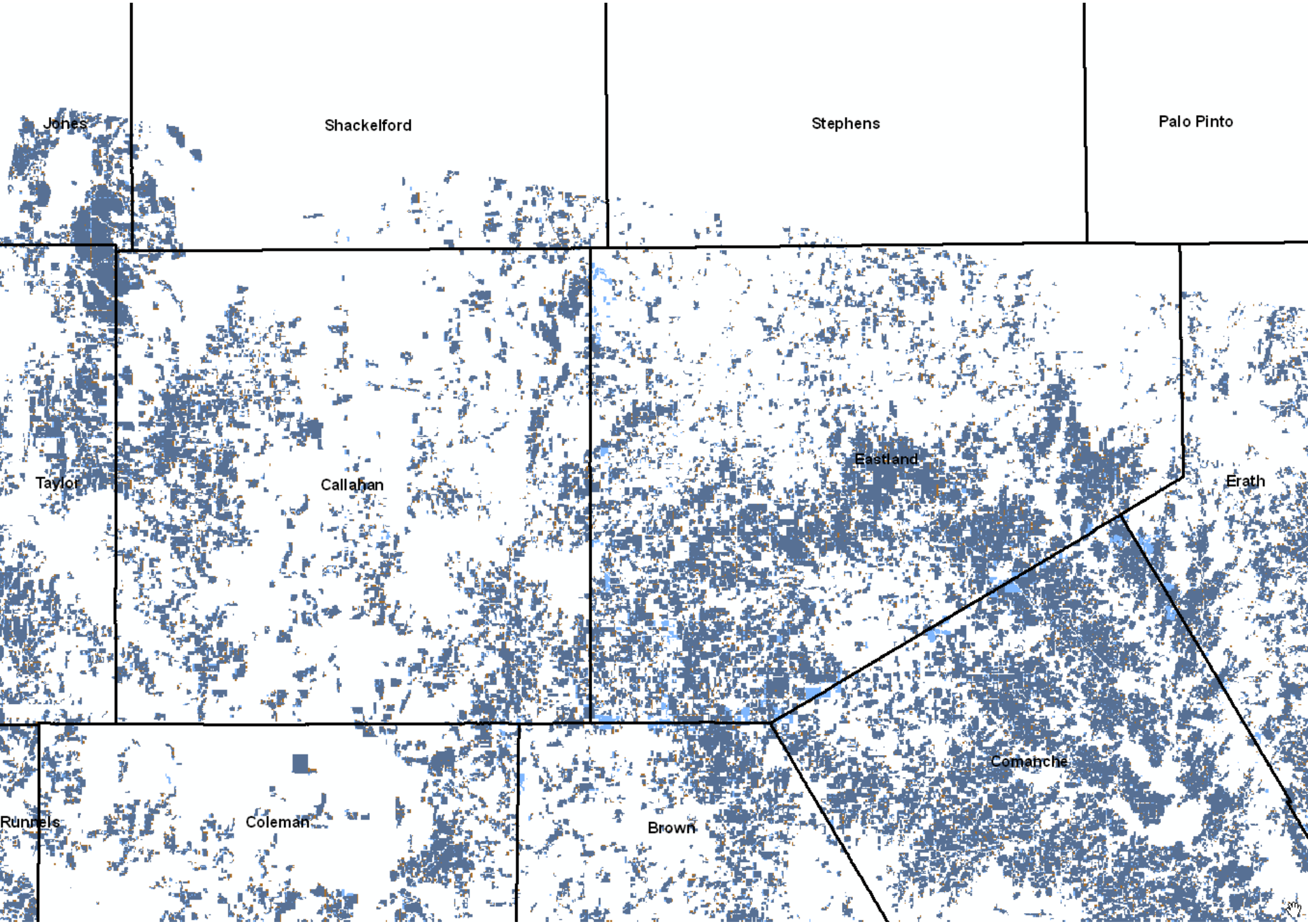
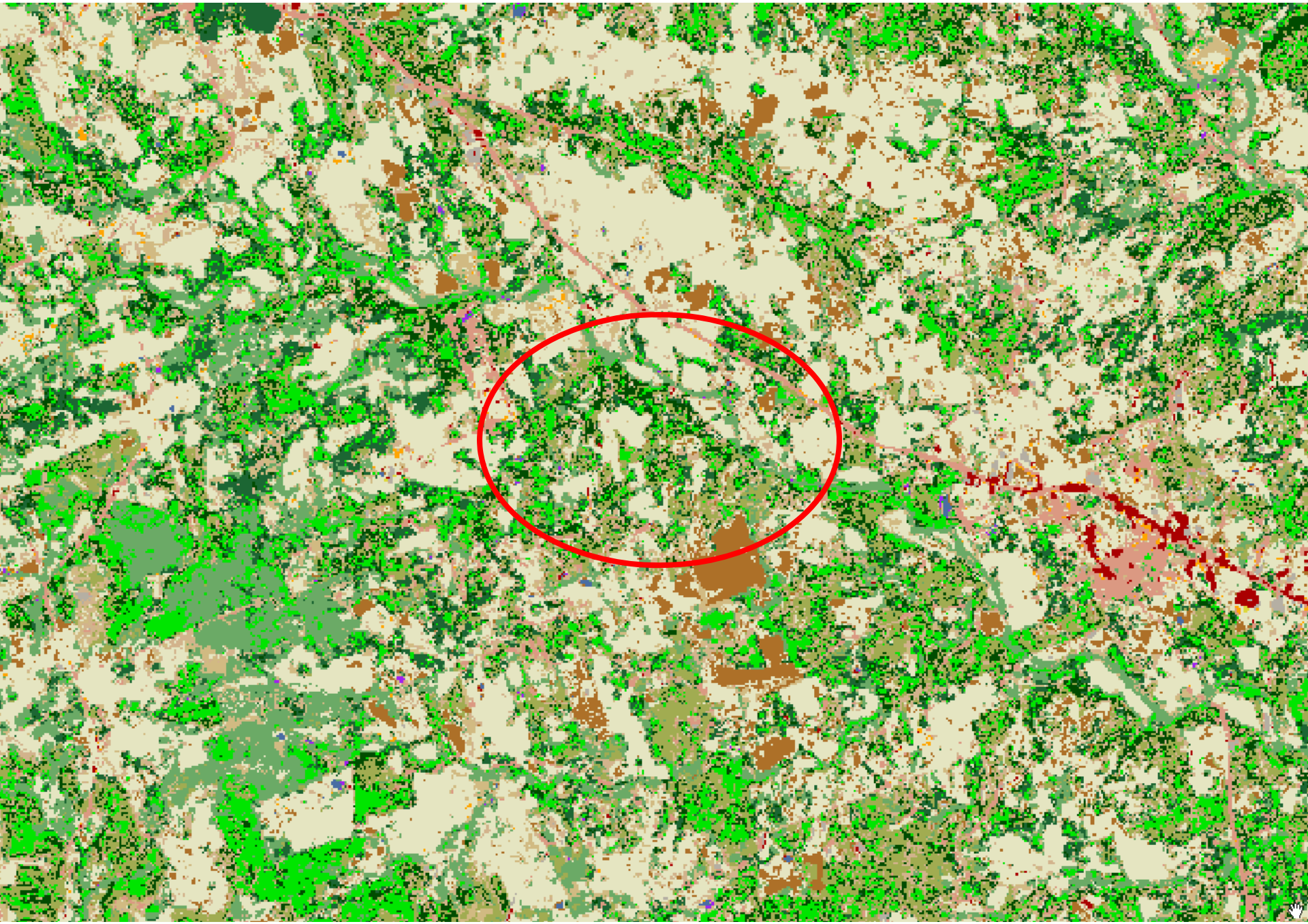
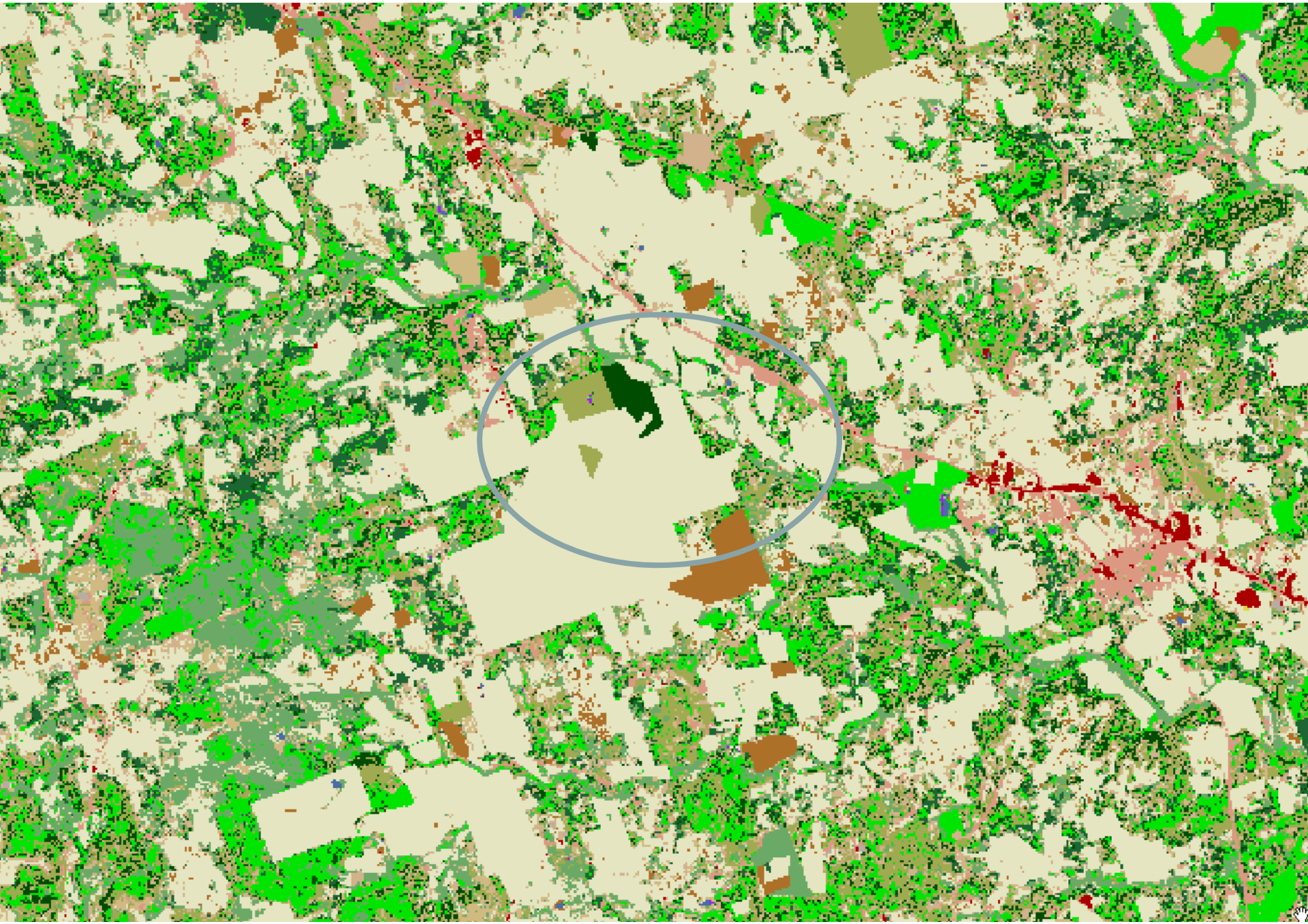

Jones
Shackelford
Stephens
Palo Pinto
Taylor
Callahan
Eastland
Erath
Comanche
Runnels
Coleman
Brown

Remote Sensing – More Work!

- Using CLU's as a means of cleaning up the classification results in the introduction of multiple errors (use CLUs in classification directly)
- Using image objects generated from NAIP imagery results in the introduction of nodata values (no solution yet – use 'smart eliminate'?)
- Initial mosaics of Phase 2 imagery are being developed





Some Lessons – Remote Sensing

- Photo-interpretation to collect training data successful (need leaf on & leaf off; GIS-mapped parks were helpful)
- Use of urban impervious & forest canopy from NLCD
- Use of decision trees as a classifier successful
- Field data collection methods and speed excellent
- Increased thematic resolution by adding forest types
- Possibly added too many forest types that are subtly different (e.g. mixed evergreen versus other types)
- Classification confusion: juniper as a shrub versus a tree; dense deciduous shrubland versus forest; sparse forest versus shrubland; grass / shrub & grass / crop separation

Modeling Synopsis

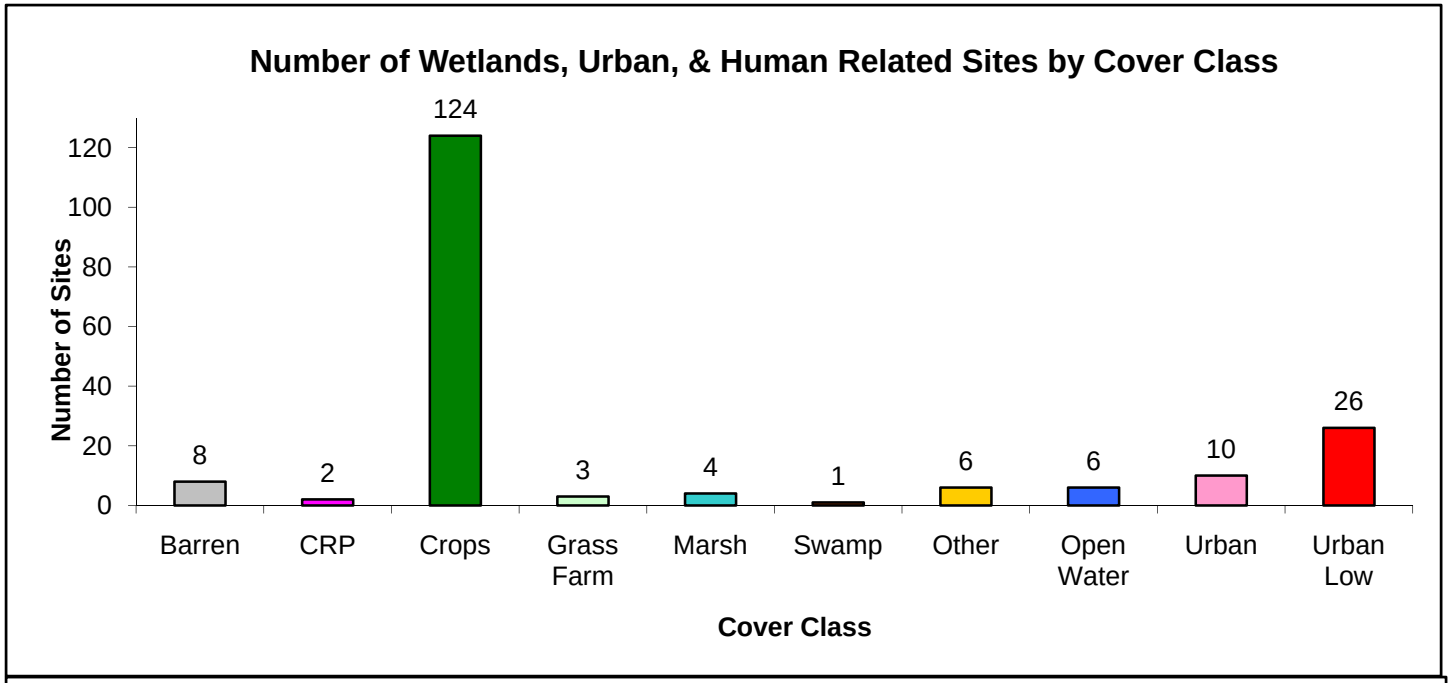
- Examined SSURGO, GAT, Ecological Site Types (ESTs)
- Modeled:
  - Historic vegetation to ESTs and to soils (Ecoclass)
  - Interpretation of current land cover to ESTs and soils (e.g. evergreen forest on site type XX is ZZ mapping system)
- SSURGO soils required much ‘fixing’
  - Many ecoclasses mapped in disparate locations – after much worry, multiple fixes were applied
  - No ecoclasses for many polygons – fixes applied
  - Flooding regime not consistent – fixes applied
- Initial modeling (completed this week) needs revision that will take much time

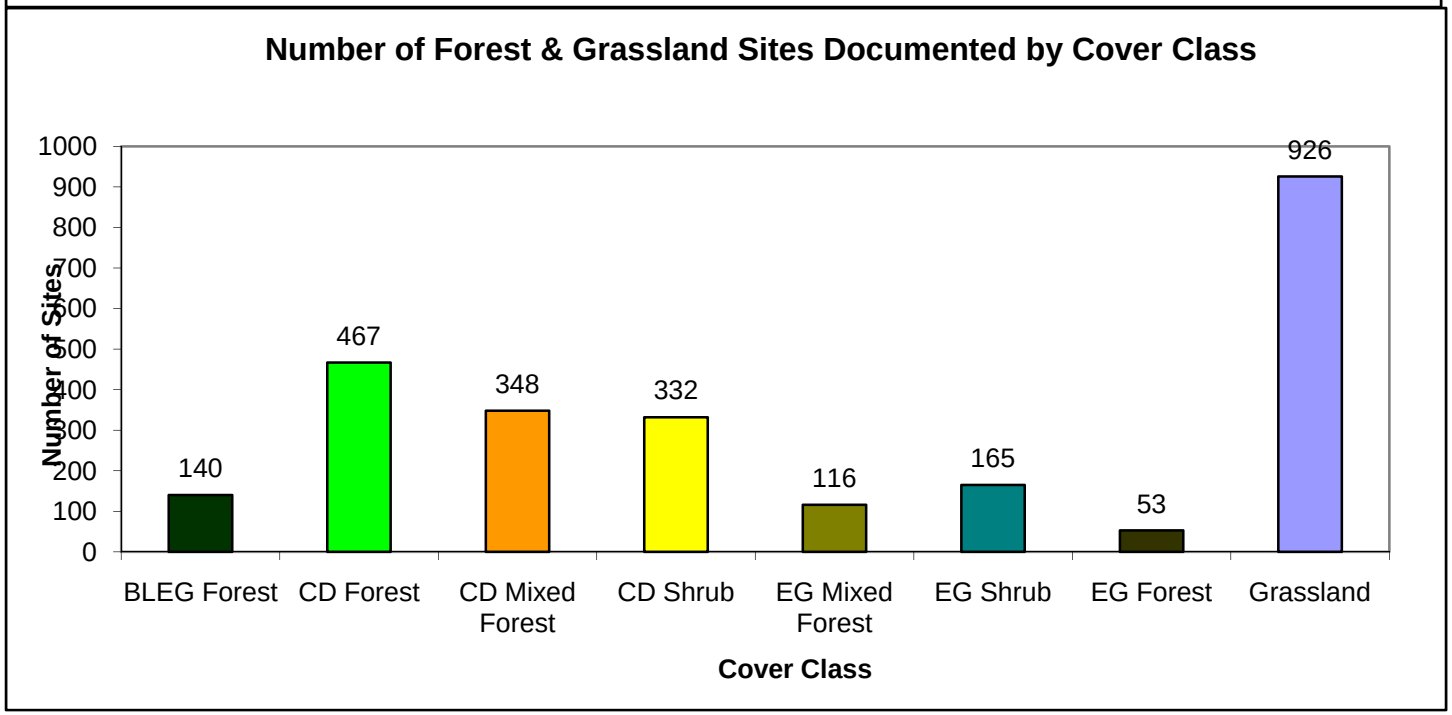
Some Lessons: Modeling

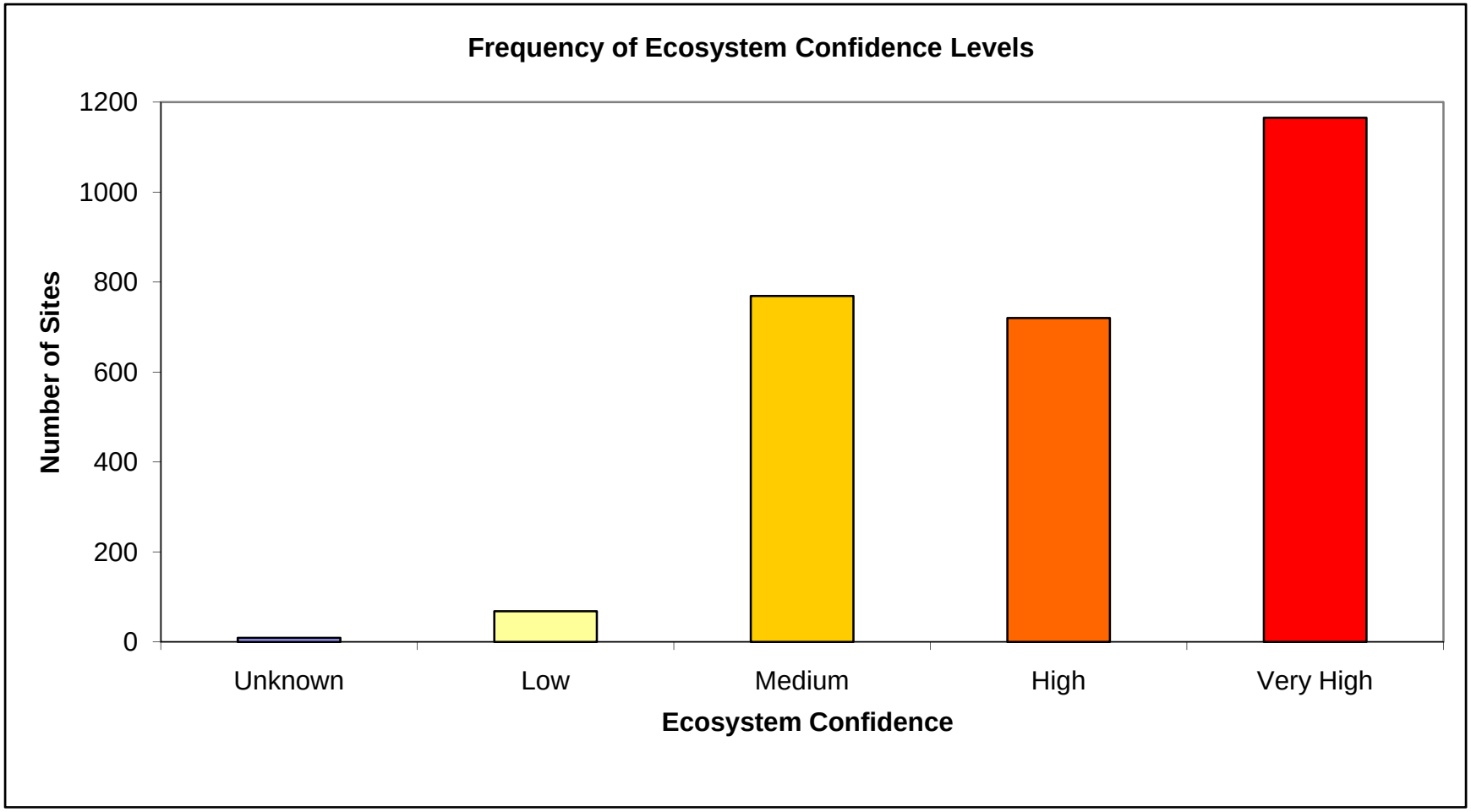
- Abiotic Site Types tied to ecoregions leave hard boundaries for historic vegetation
- GAT surface geology also suffers in resolution, but was used to interpret soils
- SSURGO soils appear the best pick, but suffer from inconsistency and are not complete:
  - where they are mapped (across counties and sometimes within counties); in urban areas
  - resolution among counties
  - how ecological sites are assigned and described
  - Inferring hydrology of floodplains (size, frequency and duration of flooding) is problematic
- Use of existing EORs for RS training was not possible

Field Data Collection Synopsis

- Collected October 3, 2007 – July 10, 2008
- Data collected at 2738 sites in 75 field days
  - 1165 sites classified with the highest confidence level, 68 sites classified with lowest confidence
  - 58 ecological subsystems and 18 cover classes documented


Number of Wetlands, Urban, & Human Related Sites by Cover Class
Number of Sites
0
20
40
60
80
100
120
8
2
124
3
4
1
6
6
10
26
Barren
CRP
Crops
Grass Farm
Marsh
Swamp
Other
Open Water
Urban
Urban Low
Cover Class


Number of Forest & Grassland Sites Documented by Cover Class
Number of Sites
0
100
200
300
400
500
600
700
800
900
1000
140
467
348
332
116
165
53
926
BLEG Forest
CD Forest
CD Mixed Forest
CD Shrub
EG Mixed Forest
EG Shrub
EG Forest
Grassland
Cover Class


Frequency of Ecosystem Confidence Levels
Number of Sites
1200
1000
800
600
400
200
0
Unknown
Low
Medium
High
Very High
Ecosystem Confidence

1500

BLANCO

FieldData

Page 1 | Page 2 | Picture | Symbology | Geography

OBJECTID	0
SampleDate	1/ 1/2008
TeamLead	
SiteID	1
PhotoID	1
EcoSysName	
EcoSysConf	
LandCover	
Woody_PC	
BLEG_PC	
CEG_PC	
Tree_PC	
Shrub_PC	
Herb_PC	
Tree_1	
Tree_2	
Tree_3	
Shrub_1	
Shrub_2	

ok

•1 Field Data

- •Collected October 3, 2007 – July 10, 2008
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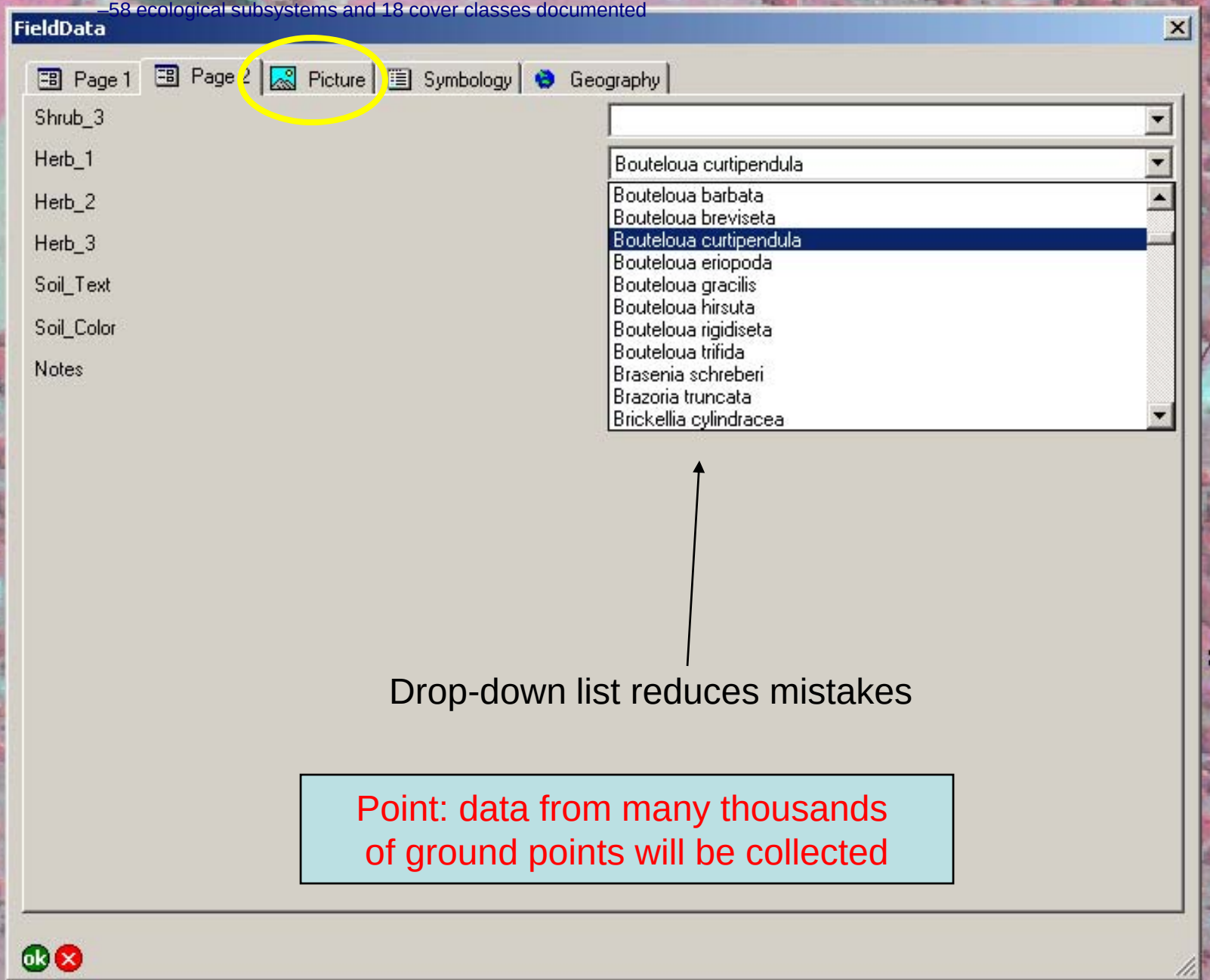


Drop-down list reduces mistakes

Point: data from many thousands of ground points will be collected

Some Lessons: Field Data

- Need good target keys as soon as possible
- Need known locations of selected sub-systems up-front if possible
- Field review of draft land cover is helpful (our initial trip to the field together was informative)
- Shall we continue to collect soils data?

Tasks – Fiscal 2009

- Mapping targets key **to facilitate field data collection** for Phase 2 (**ASAP**)
- Ecological Systems map for Phase 1 (Nov, 2008)
- Phase 1 map legend interpretive booklet (Feb, 2009)
- Phase 2 land cover map (Feb, 2009)
- Phase 2 modeling data layers (May, 2009)
- Final Phase 2 Ecological Systems map (Aug, 2009)

- **Important questions: how are we going to 'circle back around' to make final corrections? How are we going to design and present the final product for P1?**

Tasks – This Meeting

- Review status: discuss what to do and what not to do in Phase 2
- Draft Mapping Targets, Phase 2
- Discuss how to model & map targets P2
- Discuss how to finish P1 (clarify modeling)
- Other possible topics
  - Who is the target audience for the interpretive booklet?
  - What will the interpretive booklet contain?
  - How will the booklet be put together?
  - How will we name the map units?
  - How will we design the final map for P1?

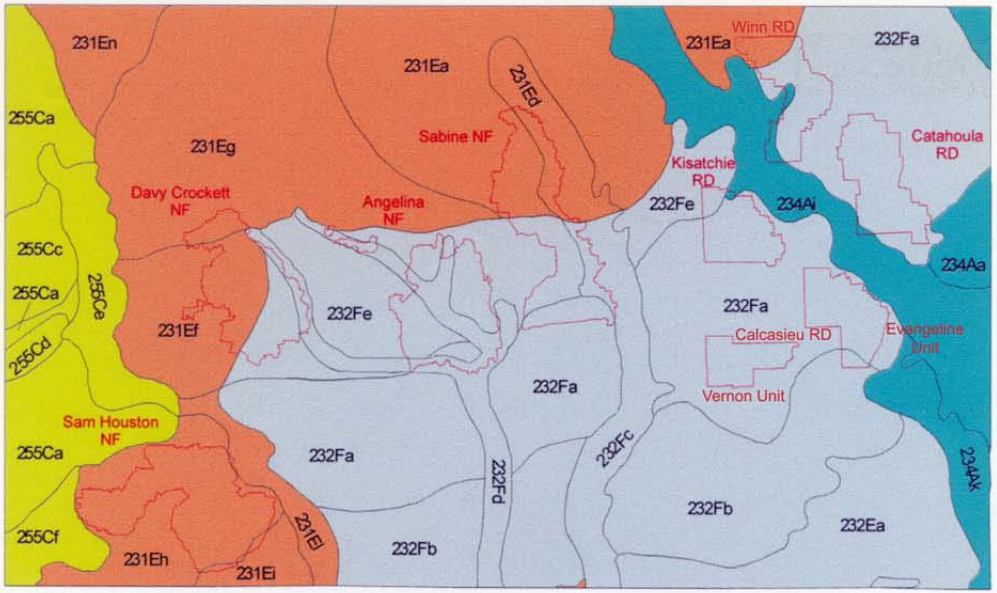
Cut to:

- 1. EXECL Tables
- 2. GIS to look at modeling layers
- 3. GIS to look at land cover
- 4. GIS to look at draft Ecological Systems Map

FIELD GUIDE

ECOLOGICAL CLASSIFICATION SYSTEM

FOR THE NATIONAL FORESTS AND ADJACENT AREAS OF THE WEST GULF COASTAL PLAIN: 2nd APPROXIMATION



National forest boundary

Province
- Lower Mississippi Riverine Forest
- Outer Coastal Plain Mixed Forest
- Prairie Parkland (Subtropical)
- Southeastern Mixed Forest

N W E S

Ecological Subregions of the Western Gulf Coastal Plain

LIST OF MAP UNITS

231 SOUTHEASTERN MIXED FOREST PROVINCE
- 231E MIDDLE COASTAL PLAINS, WESTERN SECTION
  - 231Ea South Central Arkansas Subsection
  - 231Ed Sabine Alluvial Valley Subsection
  - 231Ef Piney Woods Transition Subsection
  - 231Eg Sand Hills Subsection
  - 231Eh Southern Loam Hills Subsection
  - 231Ei Southwest Flatwoods Subsection
  - 231El Trinity Alluvial Valley Subsection
  - 231En East Texas Timberland-Cross Timbers Subsection

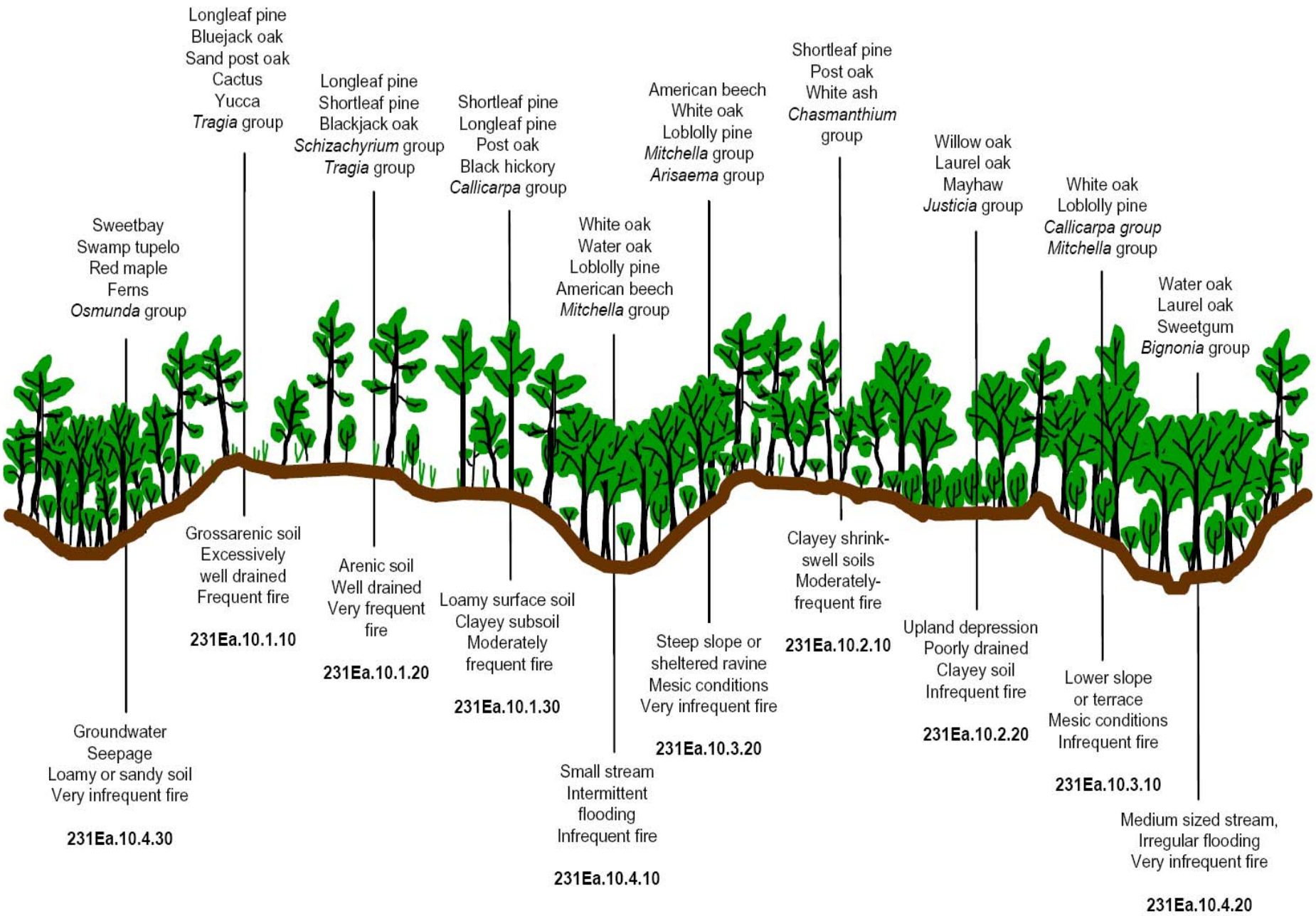
232 OUTER COASTAL PLAIN MIXED FOREST PROVINCE
- 232E LOUISIANA COAST PRAIRIES AND MARSHES SECTION
  - 232Ea Gulf Coast Prairies Subsection
- 232F COASTAL PLAINS AND FLATWOODS, WESTERN GULF SECTION
  - 232Fa Southern Loam Hills Subsection
  - 232Fb Southwest Flatwoods Subsection
  - 232Fc Sabine Alluvial Valley Subsection
  - 232Fd Neches Alluvial Valley Subsection
  - 232Fe Piney Woods Transition Subsection

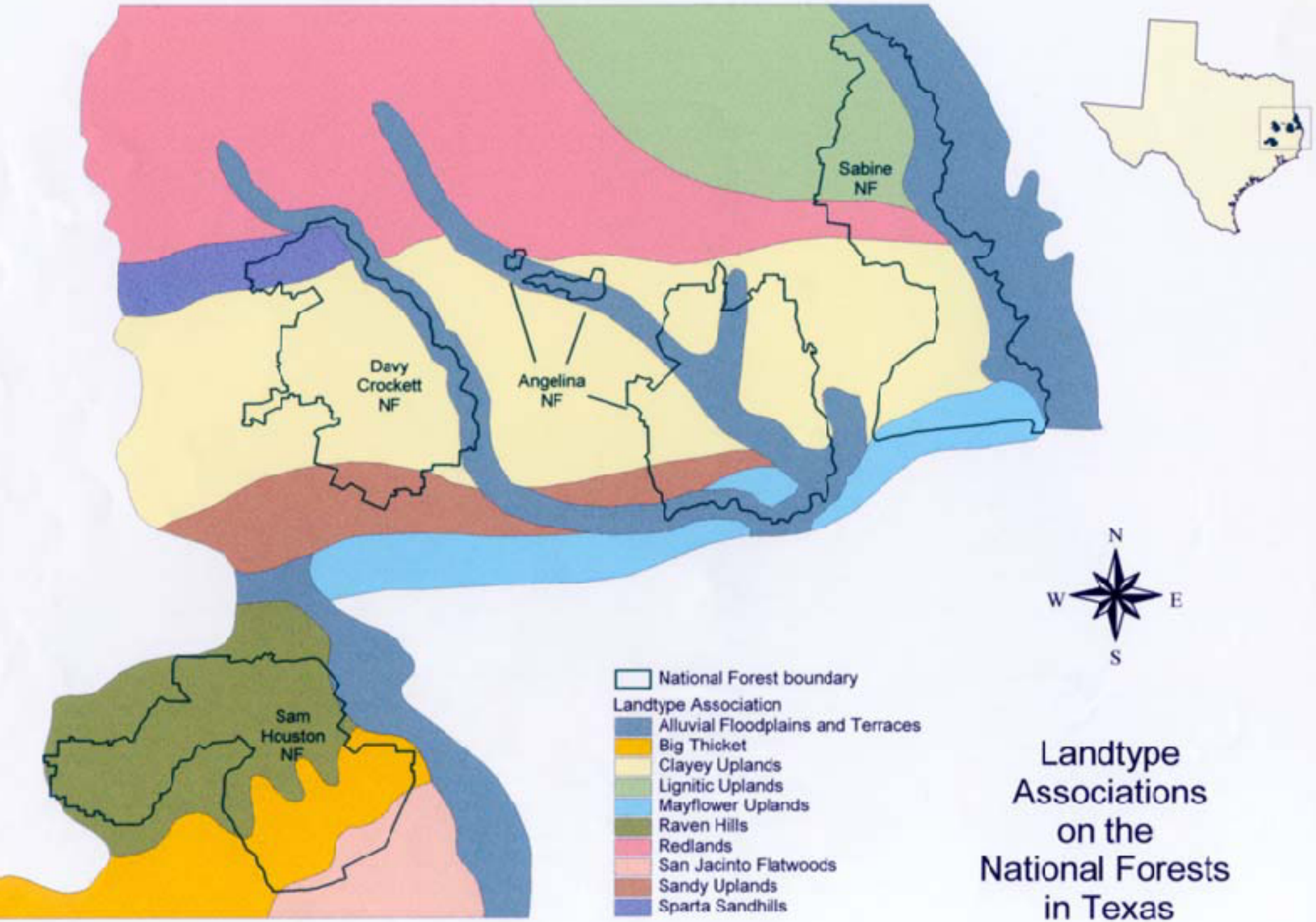
234 LOWER MISSISSIPPI RIVERINE FOREST PROVINCE
- 234A MISSISSIPPI ALLUVIAL BASIN SECTION
  - 234Aa Southern Mississippi River Alluvial Plain Subsection
  - 234Ai Red River Alluvial Plain Subsection
  - 234Ak Opelousas Ridge Subsection

255 PRAIRIE PARKLAND (SUBTROPICAL) PROVINCE
- 255C OAK WOODS AND PRAIRIES SECTION
  - 255Ca Texas Claypan Savannah Subsection
  - 255Cc Interior Savannah Subsection
  - 255Cd Interior Blackland Prairie Subsection
  - 255Ce Trinity Alluvial Valley Subsection
  - 255Cf Southern Blackland Prairie Subsection

Source: Ecological Units of the Eastern United States: First Approximation (Keys et al. 1995).

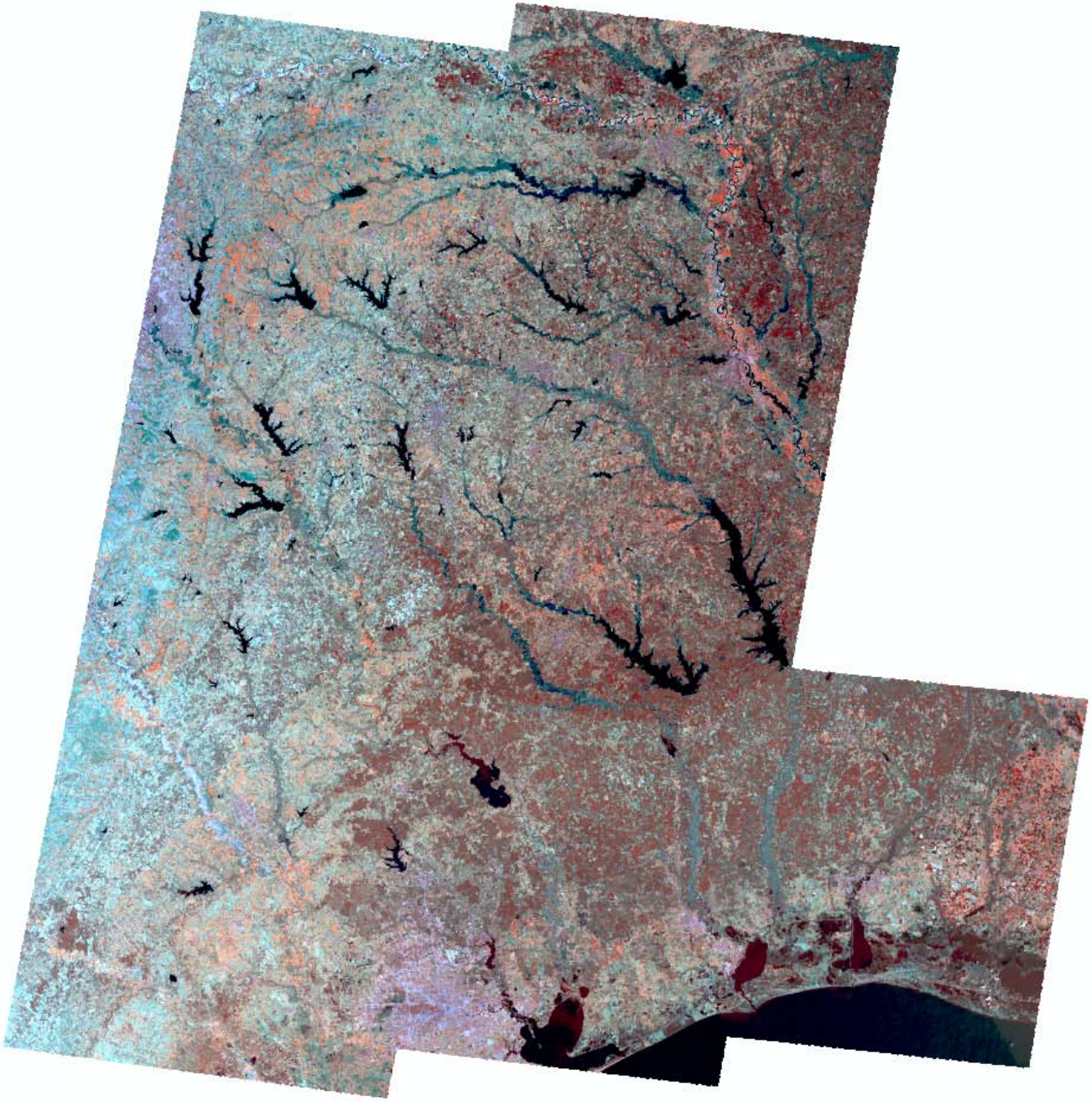
Figure 3.2. Map of national forest boundaries and their occurrence on the ecological subregions of the western Gulf coastal plain.


Sweetbay
Swamp tupelo
Red maple
Ferns
Osmunda group
Groundwater
Seepage
Loamy or sandy soil
Very infrequent fire
231Ea.10.4.30
Longleaf pine
Bluejack oak
Sand post oak
Cactus
Yucca
Tragia group
Grossarenic soil
Excessively
well drained
Frequent fire
231Ea.10.1.10
Longleaf pine
Shortleaf pine
Blackjack oak
Schizachyrium group
Tragia group
Arenic soil
Well drained
Very frequent
fire
231Ea.10.1.20
Shortleaf pine
Longleaf pine
Post oak
Black hickory
Callicarpa group
Loamy surface soil
Clayey subsoil
Moderately
frequent fire
231Ea.10.1.30
White oak
Water oak
Loblolly pine
American beech
Mitchella group
Small stream
Intermittent
flooding
Infrequent fire
231Ea.10.4.10
American beech
White oak
Loblolly pine
Mitchella group
Arisaema group
Steep slope or
sheltered ravine
Mesic conditions
Very infrequent fire
231Ea.10.3.20
Shortleaf pine
Post oak
White ash
Chasmanthium
group
Clayey shrink-
swell soils
Moderately-
frequent fire
231Ea.10.2.10
Willow oak
Laurel oak
Mayhaw
Justicia group
Upland depression
Poorly drained
Clayey soil
Infrequent fire
231Ea.10.2.20
White oak
Loblolly pine
Callicarpa group
Mitchella group
Lower slope
or terrace
Mesic conditions
Infrequent fire
231Ea.10.3.10
Water oak
Laurel oak
Sweetgum
Bignonia group
Medium sized stream,
Irregular flooding
Very infrequent fire
231Ea.10.4.20

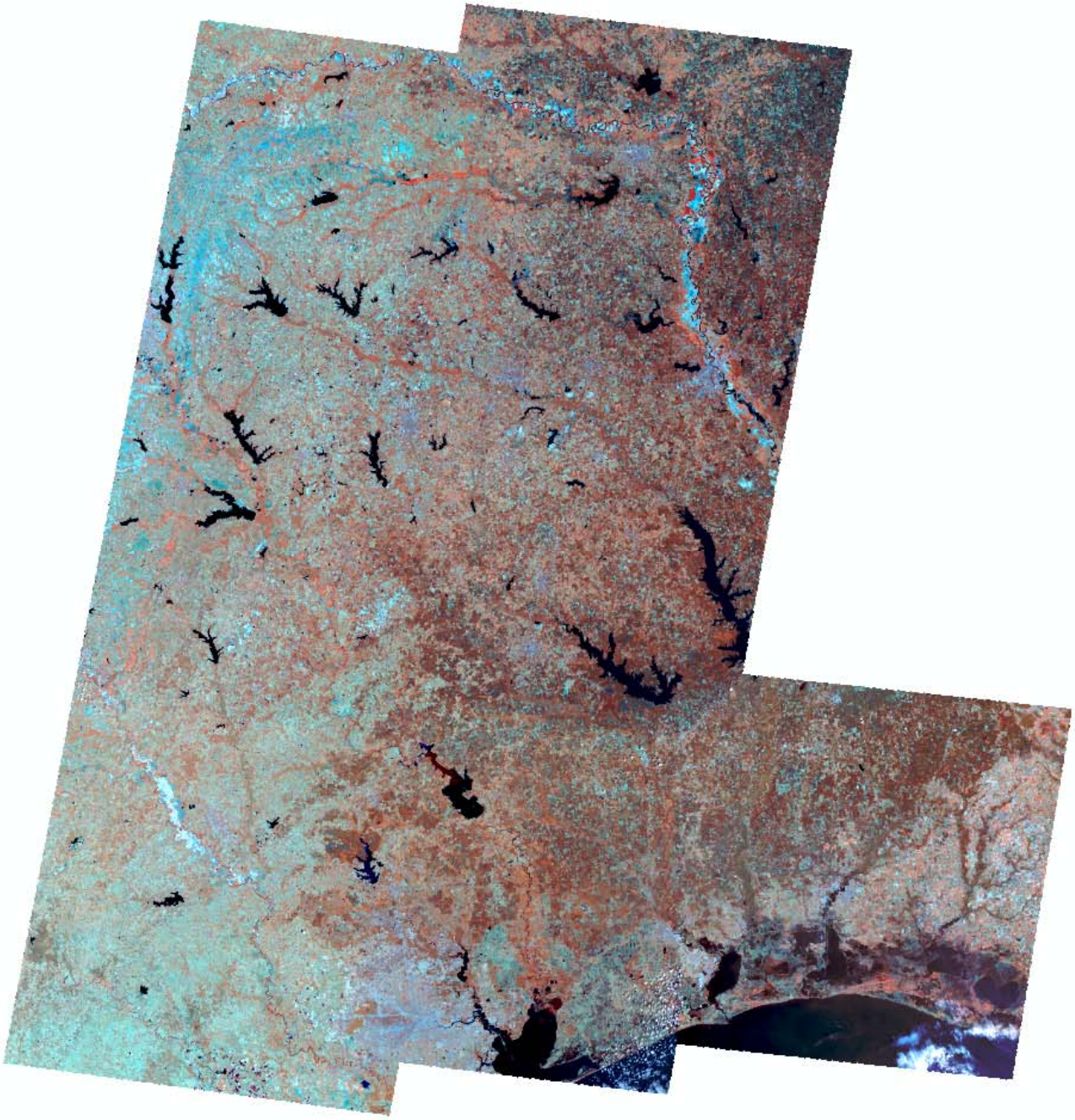
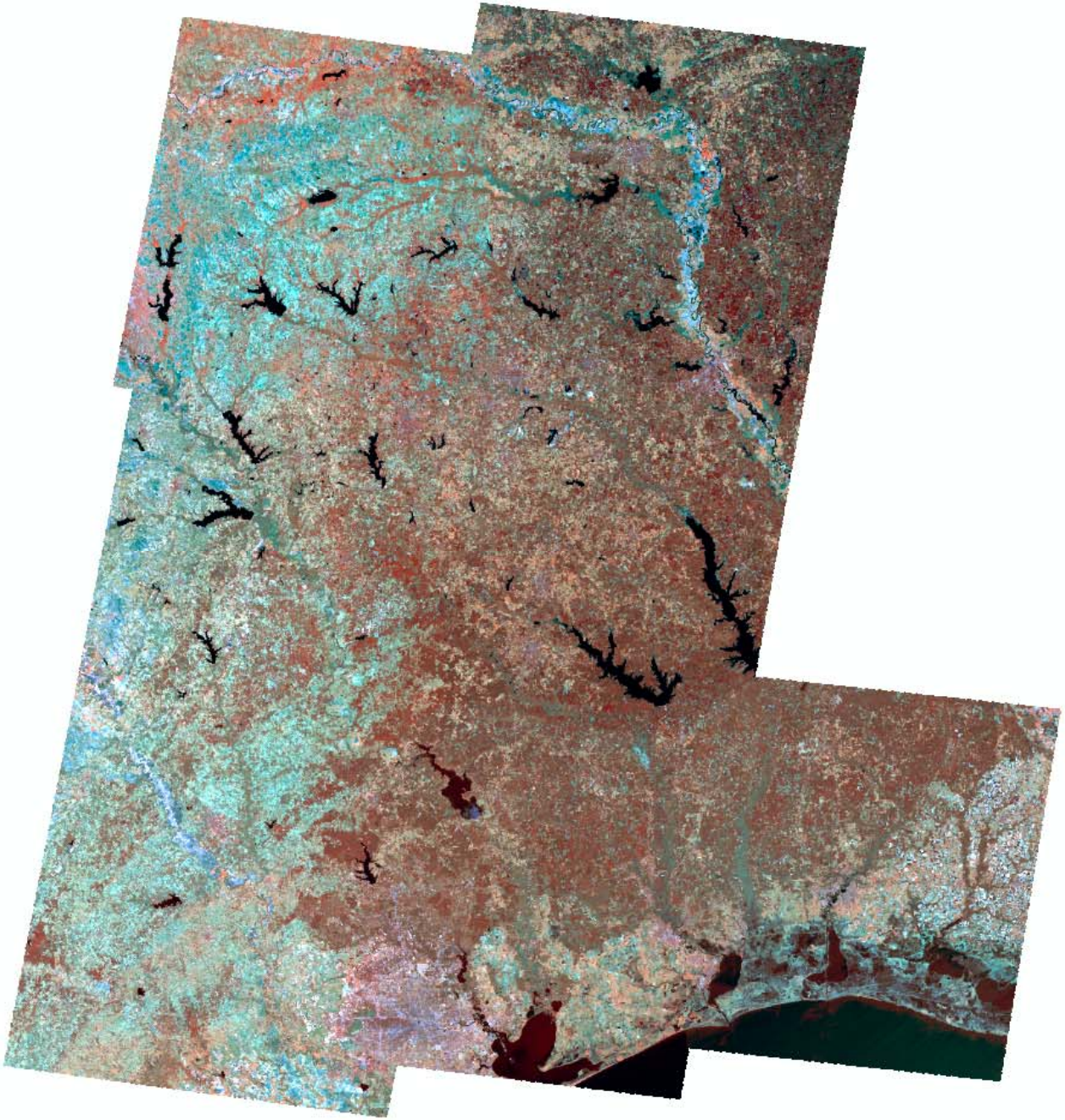


Landtype Associations on the National Forests in Texas

Spring



Summer



Fall