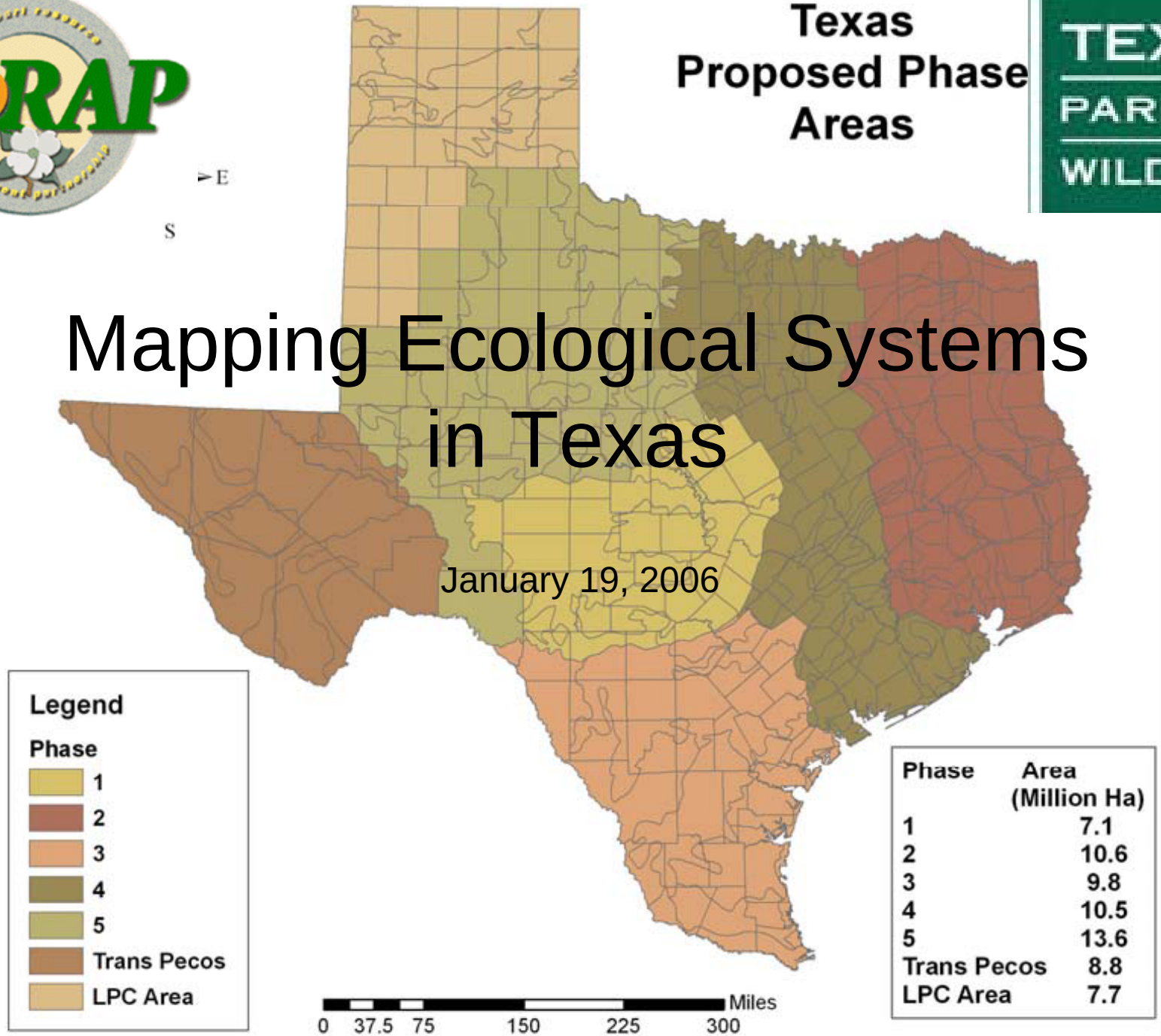
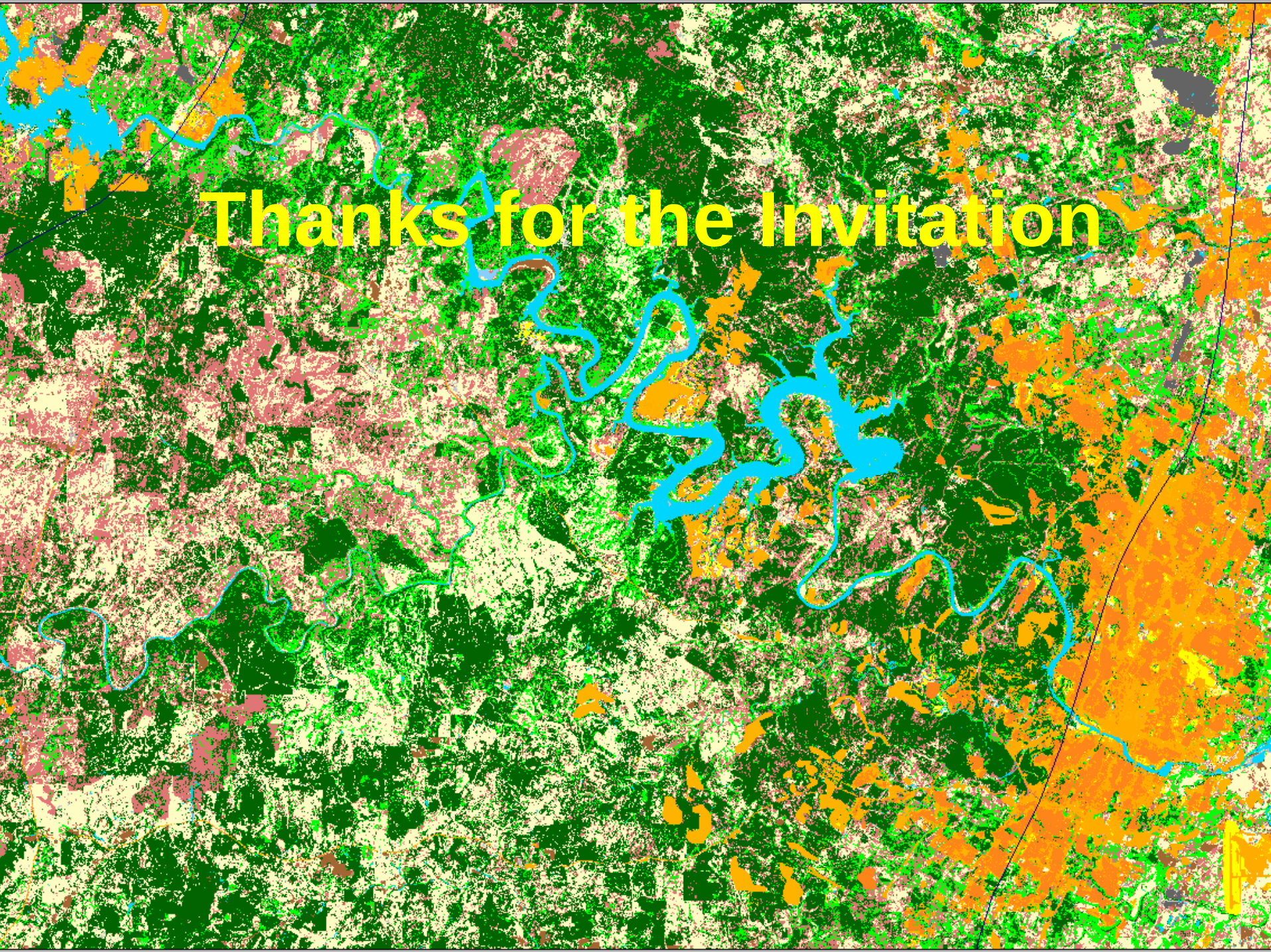
Mapping Ecological Systems in Texas

January 19, 2006



Phase	Area (Million Ha)
1	7.1
2	10.6
3	9.8
4	10.5
5	13.6
Trans Pecos	8.8
LPC Area	7.7


Thanks for the Invitation

Project Background

- TPWD wants better land cover for Texas
  - Better thematic resolution (more land cover classes at approximately the ecological system level)
  - Better spatial resolution (approaching 1:24,000)
  - Better accuracy (overall 85%)
- TPWD wants to work with a contractor
  - Work with NatureServe, TNC, and TPWD to define target land cover classes (ecological systems) for mapping
  - Classify and map ecological systems using satellite imagery and abiotic data

Outline of Presentation

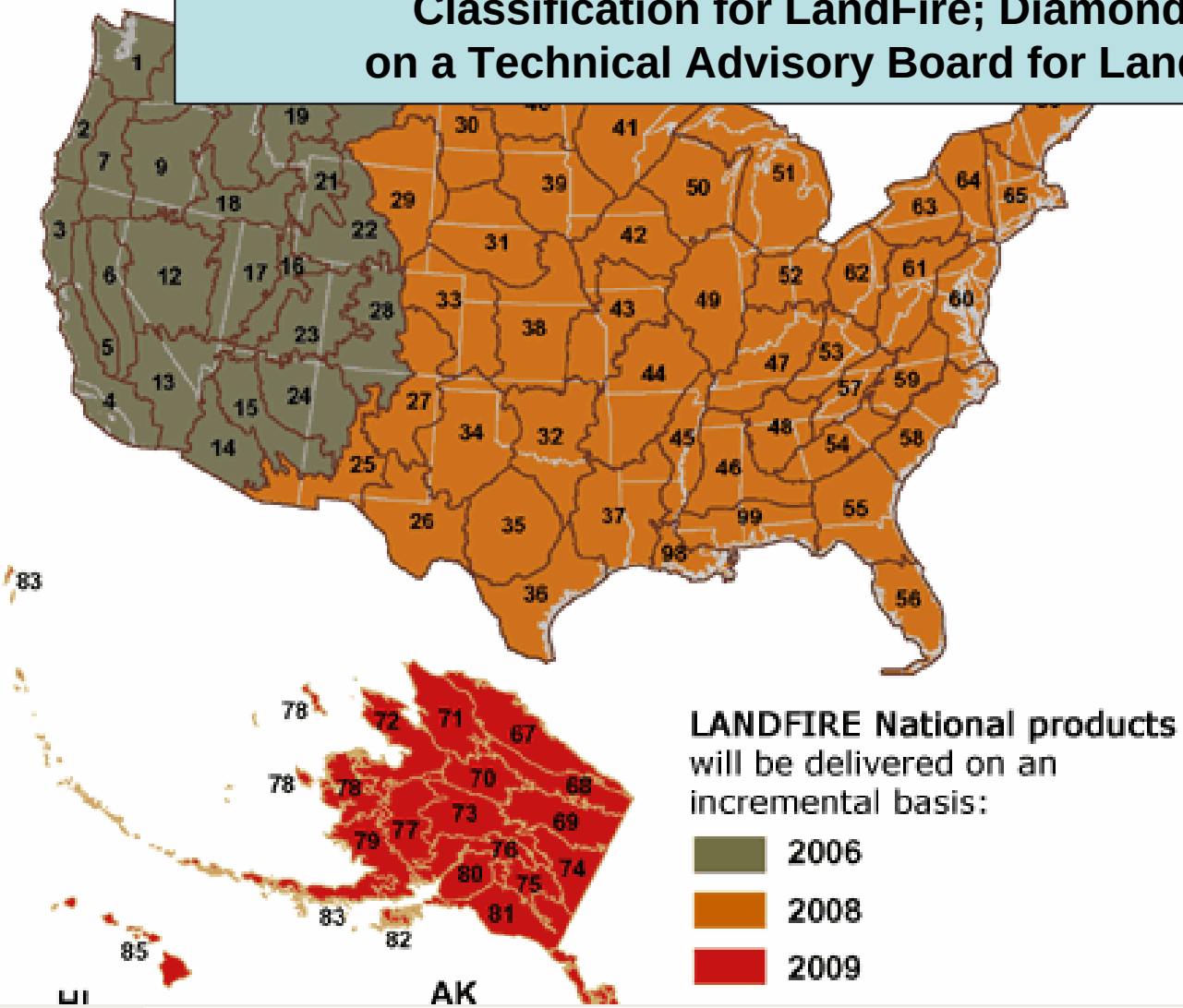
- Ecological systems as mapping targets
- Land cover mapping basics
- Recent work in Texas
- Outline of how we might proceed
- MoRAP Infrastructure, Operations, & Staff
- Questions

Ecological Systems

- TNC began classification of “natural communities” using UNESCO physiognomic/life form/composition method circa 1985; became the National Vegetation Classification (NVC)
- Ecological systems classification grew mainly out of the desire to provide a classification applicable to mapping land cover
- Original nationwide draft completed circa 2002 by NatureServe

Schedule >> LANDFIRE Mapping Zones by Year of Completion

NatureServe is contracted to revise the Ecological Systems Classification for LandFire; Diamond is on a Technical Advisory Board for LandFire



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to view dates
LANDFIRE

Specific dates for
will be posted w

Familiarity NatureServe's Ecological Systems Classification and with Texas Vegetation

Diamond et al. wrote the first TNC classification for TX and participated in the latest revisions for the Edwards Plateau (2006)

Edwards Plateau and Lampasas Cut-Plain Worksheet

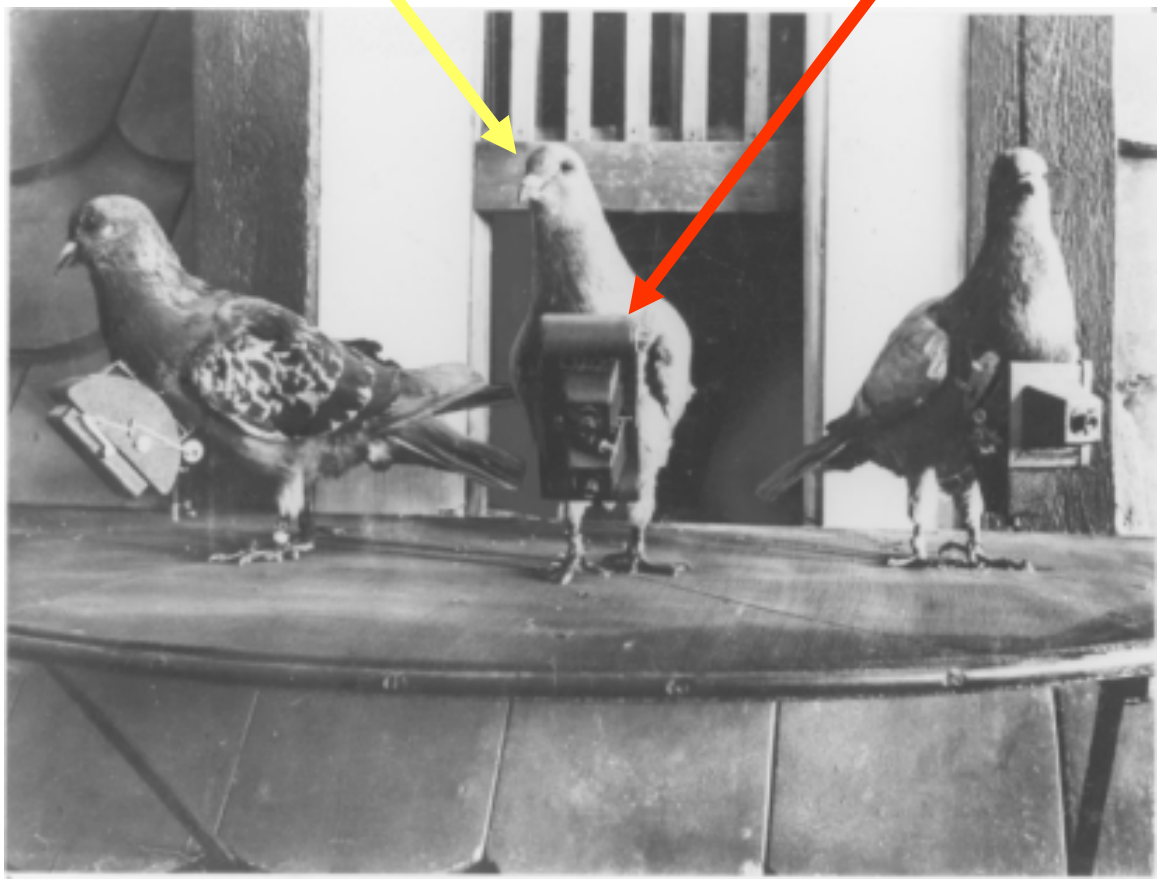
	West Plateau (Dry) (generally Ecoregion 30d, Griffith et al.. 2005)	Llano Uplift	East & South Plateau (Wet)	Lampasas Cut-Plain	
Abiotic Habitat Types	**list systems**	**list systems**	**list systems**	**list systems**	**Diamond Comments**
Typical Soft-bedded Limestone Uplands, including gentle slopes	CES303.660 Edwards Plateau Limestone Savanna and Woodland; CES303.041 Edwards Plateau Limestone Shrubland	na	CES303.660 Edwards Plateau Limestone Savanna and Woodland	CES303.660 Edwards Plateau Limestone Savanna and Woodland	diff in veg in west plateau due to mgmt or 'succession' - do successional communities get to be 'systems' all over the USA?

Note: This document is a good start on identifying what to model/map for the Edwards Plateau & how to go about it

Ecological Systems Summary

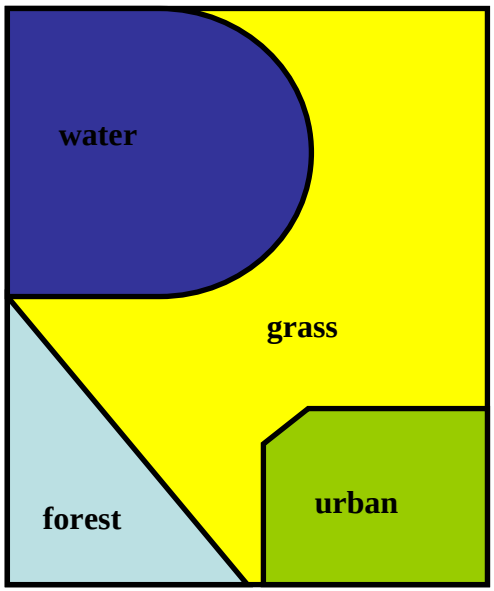
- Ecological systems are designed partly for use in mapping
- A national draft exists & is being modified
- NatureServe is coordinating the classification revision (Pat Comer nationally; Milo Pyne, Judy Teague in the SE region; Maria Melnechuck for the plains; Lee Elliott, local contact)
- USGS is coordinating the LandFire mapping effort ("Dr. Z," – Zhi-Liang Zhu)
- USFS is the overall LandFire lead (Dan Crittenden)
- MoRAP has already contacted these players
- Key is that the revision process needs to stay ahead of mapping efforts; then we must decide what to map and how to map it

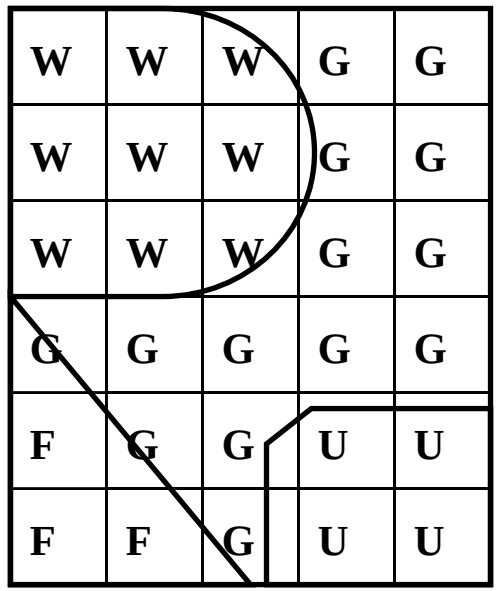
Platform and Sensor

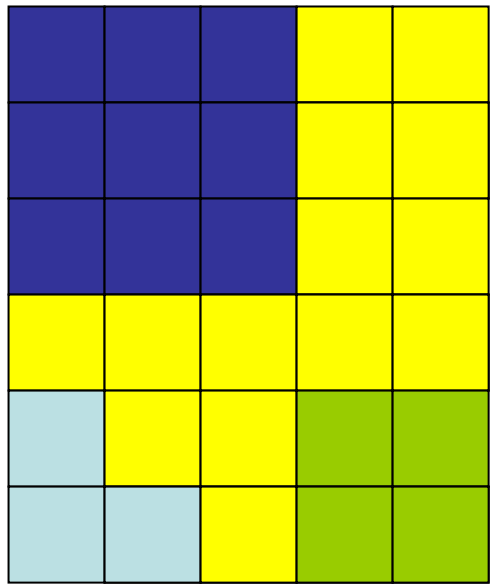


Mapping is Classification of Pixels

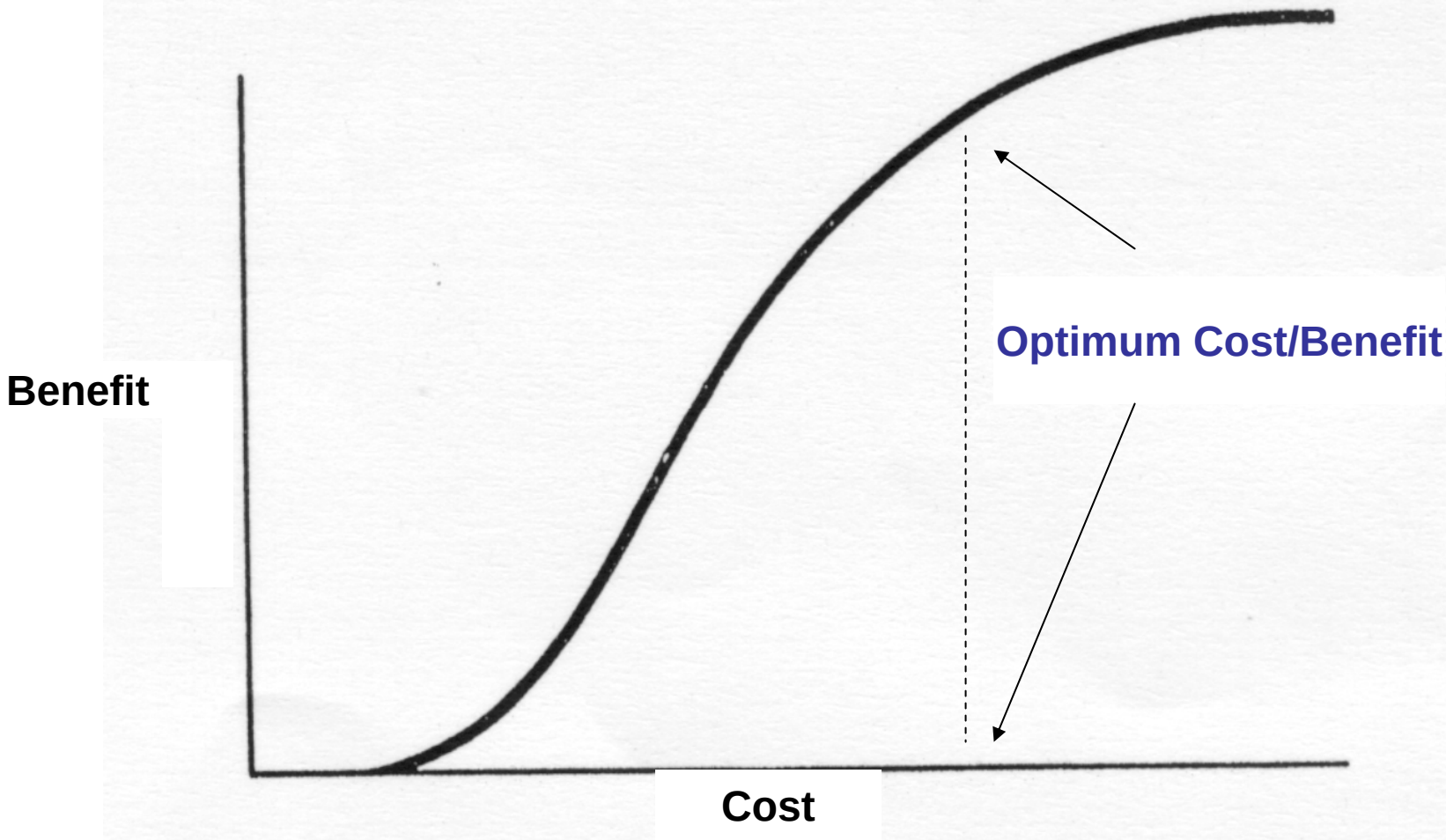
- Create a land cover raster by coding each pixel with a value that represents the land cover type over the majority of that cell's area
- When finished, every cell will have a coded value (**thematic resolution** depends on the number of land cover classes identified)
- Average TM scene is about 34.9 x10^6 pixels







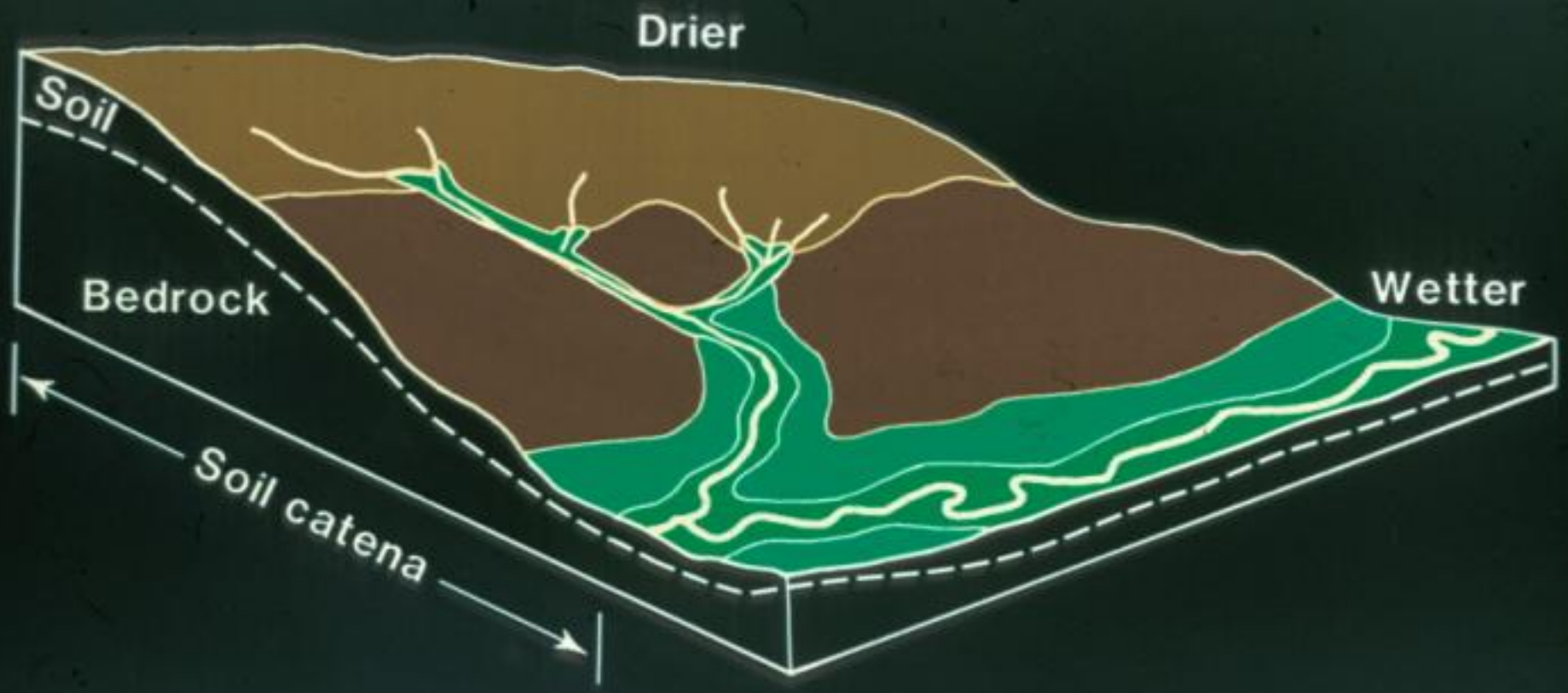
Perfect Results are Too Costly



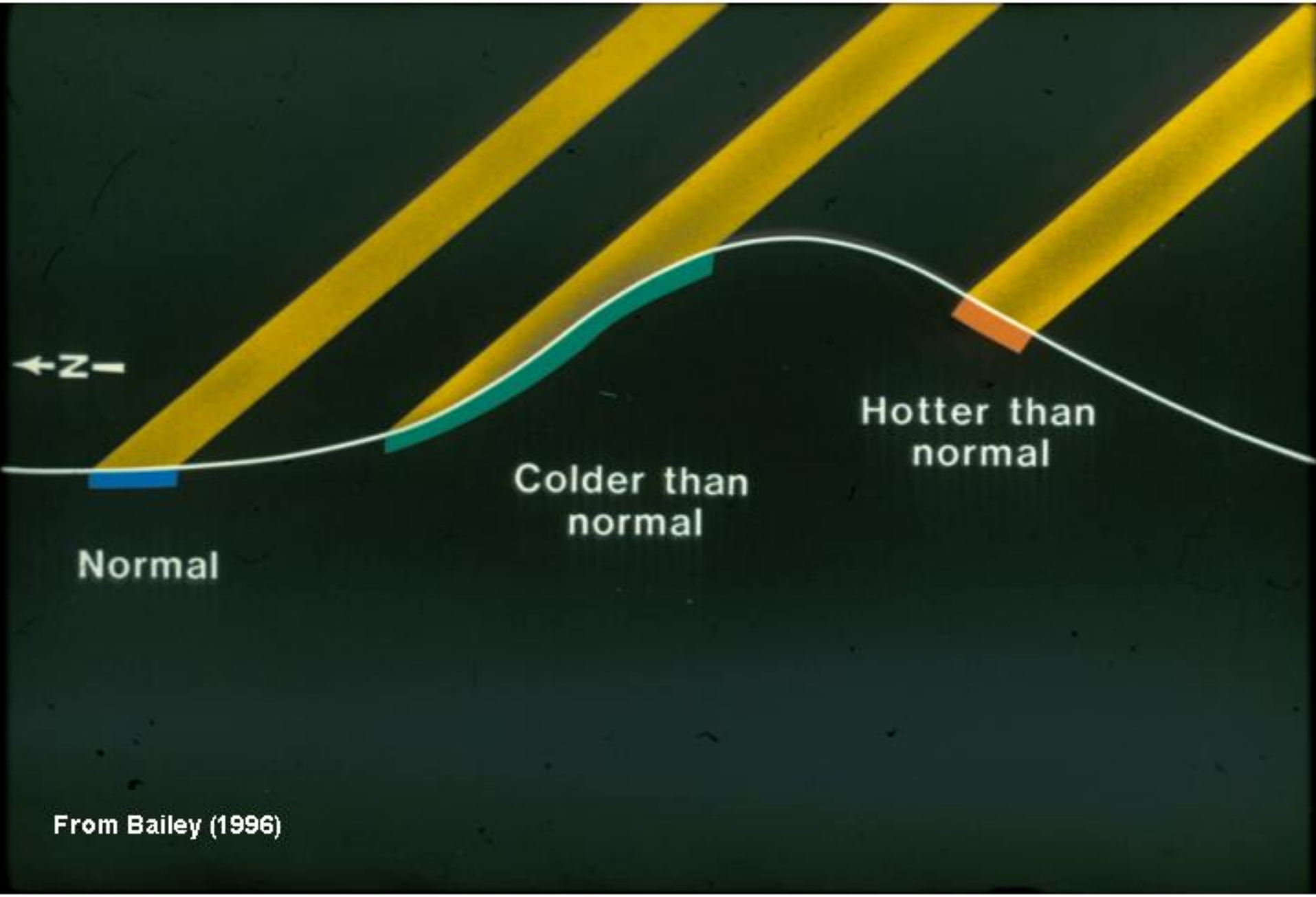
Satellite ETM+ merged data or ETM+/SPOT merged data are optimum spatial resolution for this project

Achieving Higher Thematic Resolution

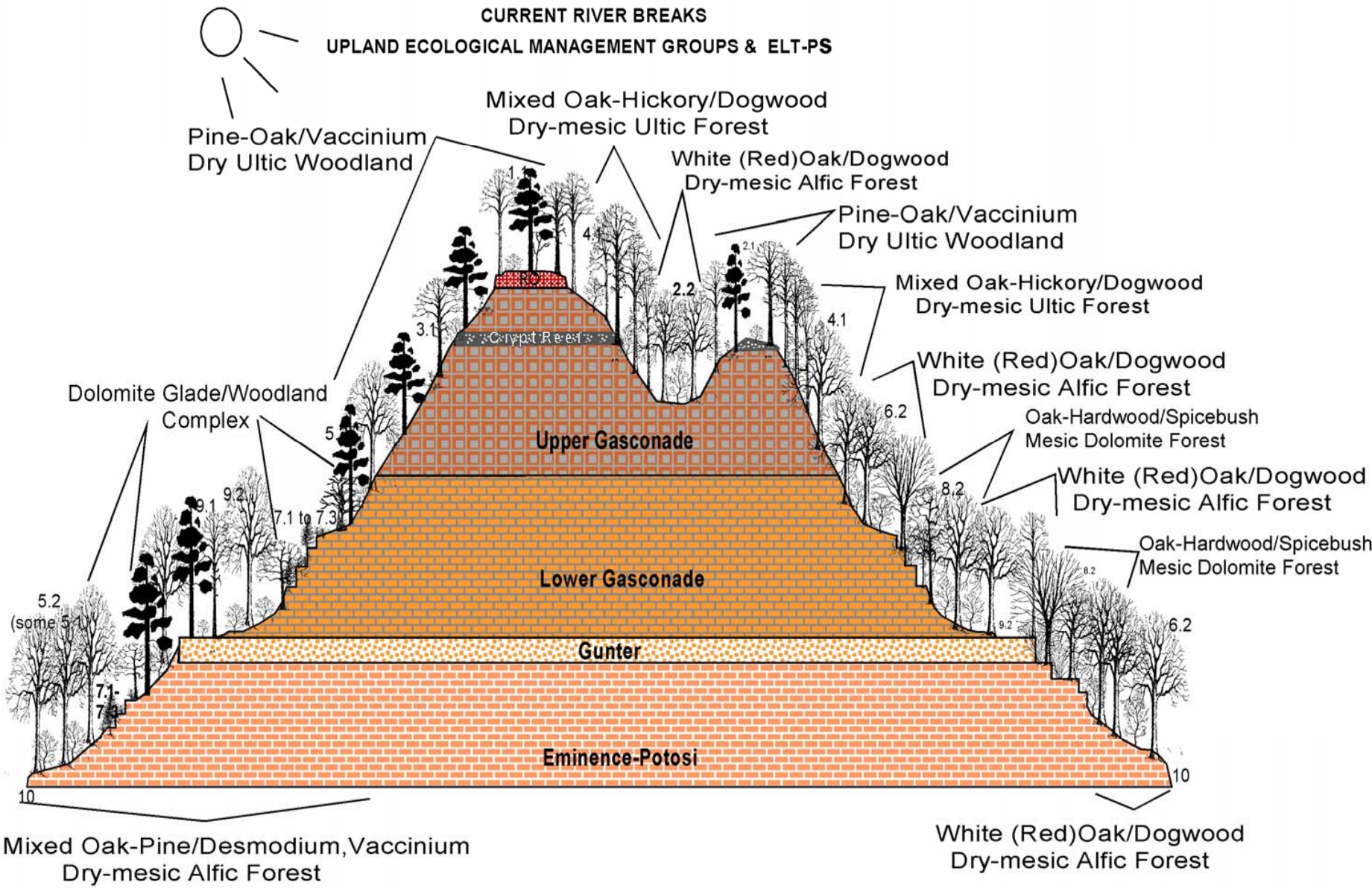
- Satellite data alone are not sufficient to map all ecological systems (“thematic resolution”)
- Therefore, environmental data are needed



From Bailey (1996)



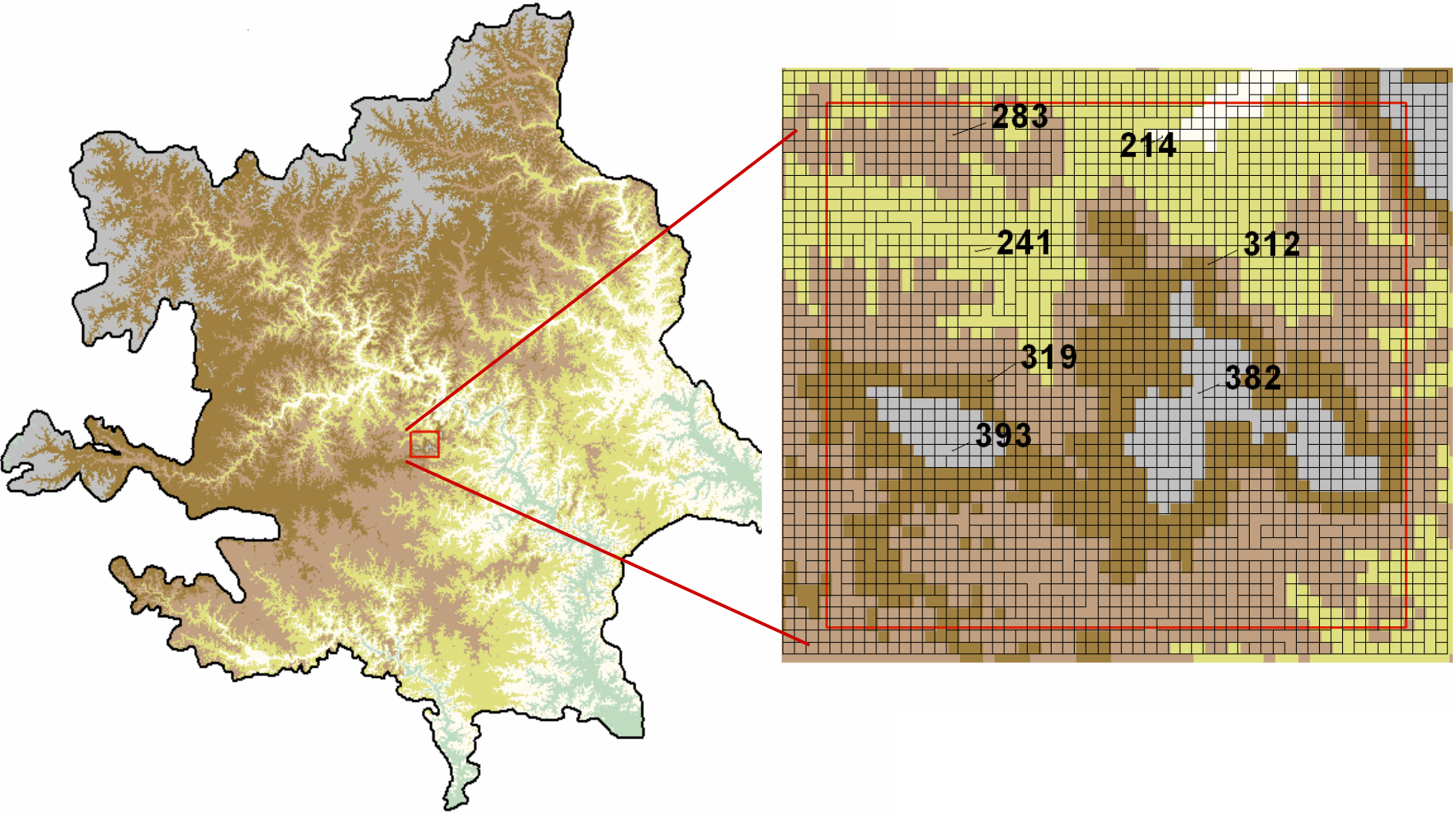
From Bailey (1996)


CURRENT RIVER BREAKS
UPLAND ECOLOGICAL MANAGEMENT GROUPS & ELT-PS
Pine-Oak/Vaccinium
Dry Ultic Woodland
Mixed Oak-Hickory/Dogwood
Dry-mesic Ultic Forest
White (Red)Oak/Dogwood
Dry-mesic Alfic Forest
Pine-Oak/Vaccinium
Dry Ultic Woodland
Mixed Oak-Hickory/Dogwood
Dry-mesic Ultic Forest
White (Red)Oak/Dogwood
Dry-mesic Alfic Forest
Oak-Hardwood/Spicebush
Mesic Dolomite Forest
White (Red)Oak/Dogwood
Dry-mesic Alfic Forest
Oak-Hardwood/Spicebush
Mesic Dolomite Forest
Dolomite Glade/Woodland
Complex
1.1
4.1
2.1
2.2
4.1
3.1
Crypt Rest
6.2
5.1
Upper Gasconade
9.1
9.2
7.1 to 7.3
8.2
Lower Gasconade
5.2
(some 5.1)
9.2
6.2
Gunter
7.1-
7.4
Eminence-Potosi
10
10
Mixed Oak-Pine/Desmodium,Vaccinium
Dry-mesic Alfic Forest
White (Red)Oak/Dogwood
Dry-mesic Alfic Forest

Analysis of Relatively Fine-resolution Abiotic Variation

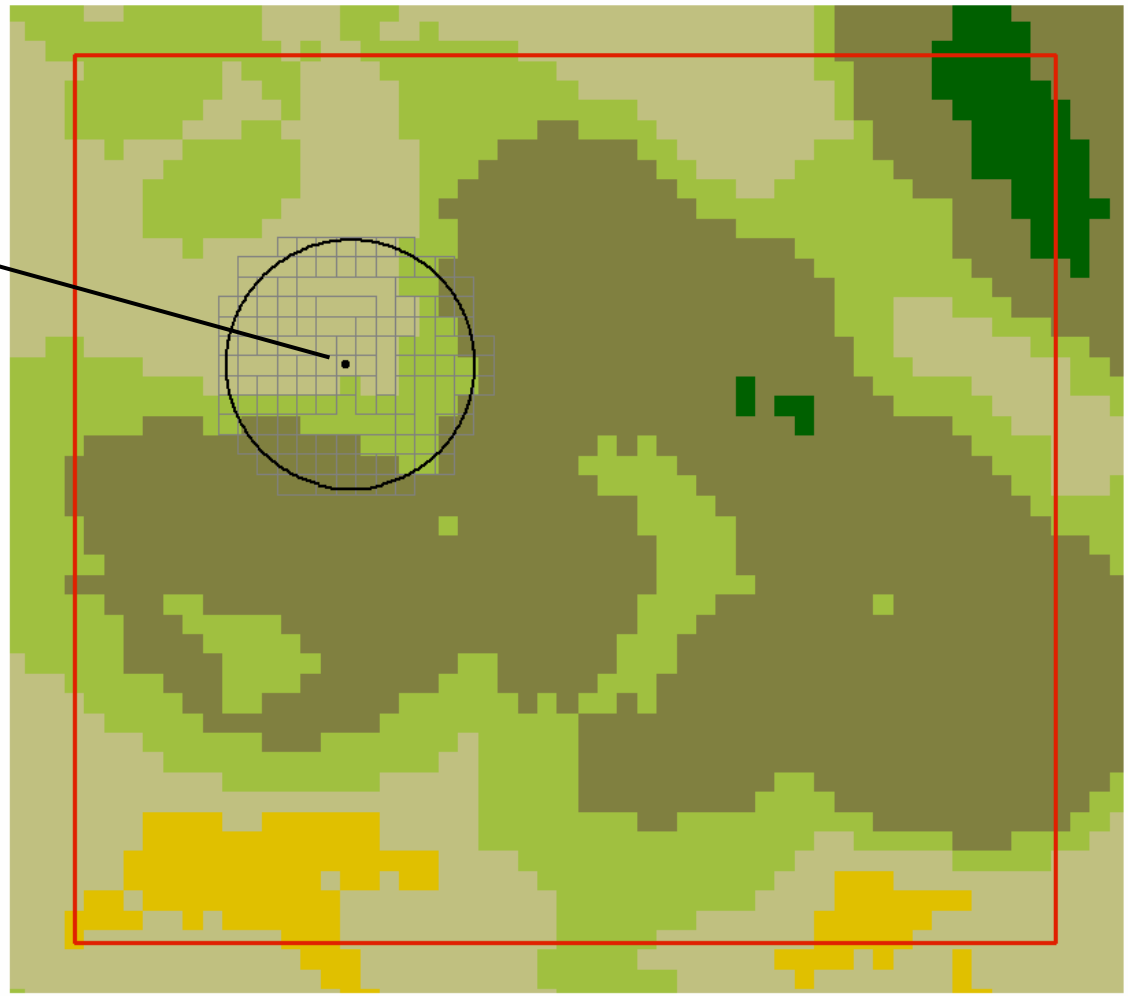
- Two basic, relatively uniform, datasets:
  - Digital elevation models (30m available statewide; 10m in the works)
  - SSURGO soils (digital county soil surveys available across most of the state)
- BEG 15’ Geologic Quads (Geologic Atlas of Texas, 1:250,000) are also available and may prove useful, especially where SSURGO soils data are not available

Modeling abiotic variables: Digital Elevation Models (DEMs) - elevation is represented by a regular grid with elevation values



Neighborhood analysis example: the elevation range surrounding the center cell is relief

Example: Total relief within the circle is the difference between highest and lowest cell



How the Size of a Sliding Window Impacts the Generation of Landforms

C. Diane True, Taisia Gordon, and Dr. David Diamond
Missouri Resource Assessment Partnership

Point: there is a lot to landform and Abiotic Site Type modeling and we have lots of experience

Some Metrics from DEMs

- Slope (percent)
- Exposure (N, S, E, W)
- Solar Insolation (a function of slope, exposure, and shading)
- Land position (high or low relative to neighbors)
- Relative Moisture Indices (how many pixels drain to and away from a spot, and how fast)
- Land shape (concave, convex)
- The last two are especially sensitive to neighborhood size

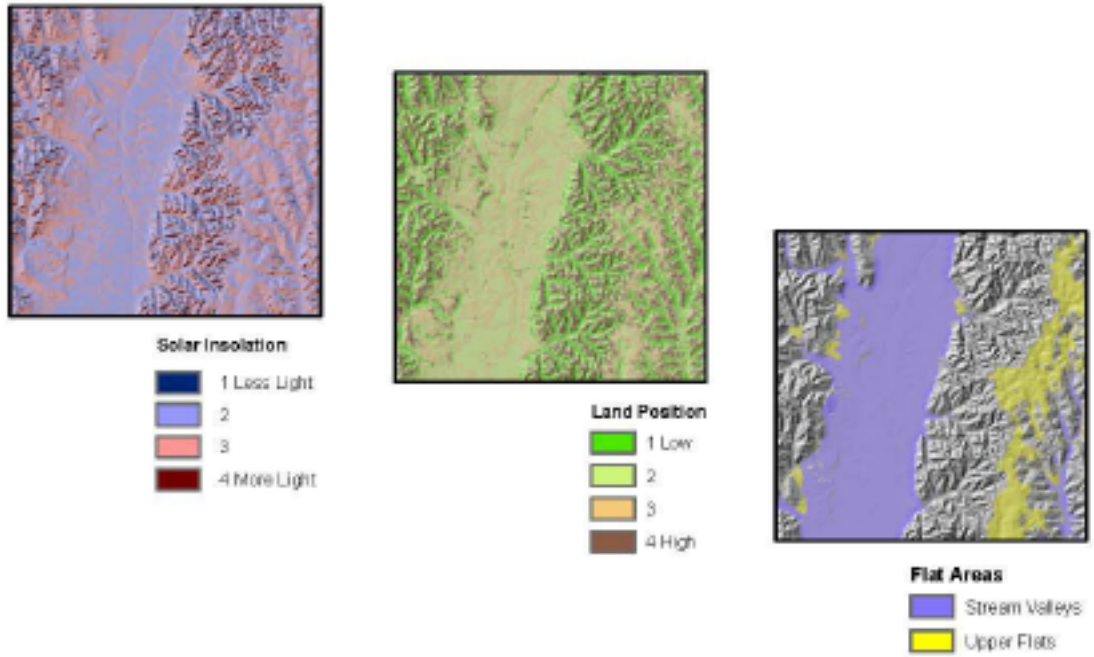
Abiotic Site Types for the Lower Midwest: Solar Insolation, Land Position, and Flats

Flats include high flats and floodplain flats

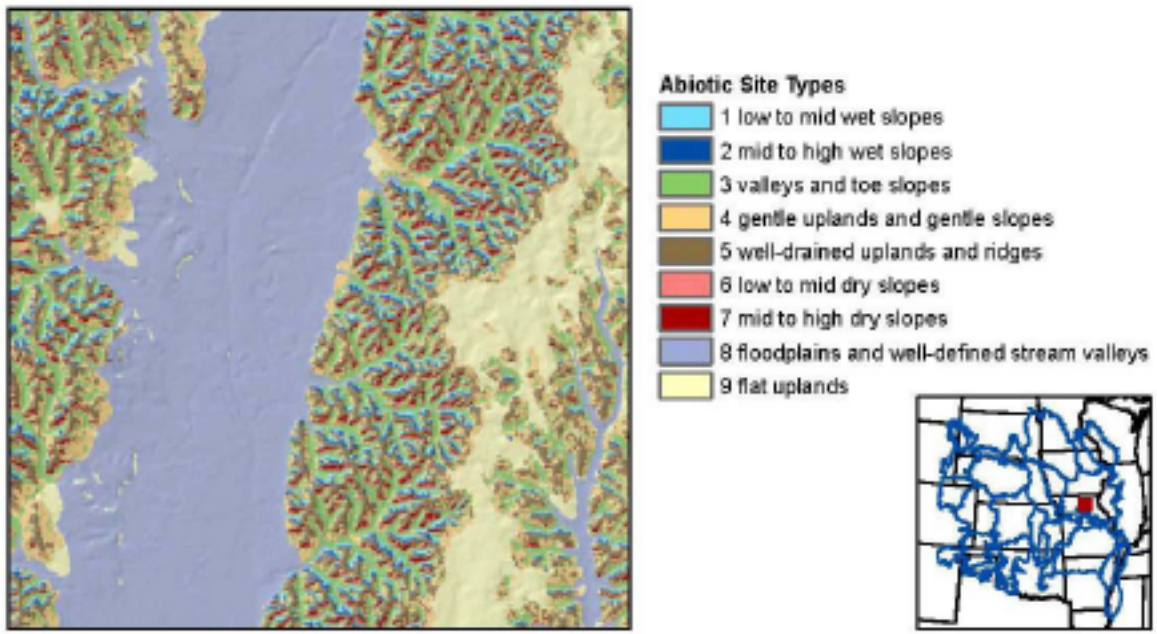
Modeling of floodplain flats is difficult!

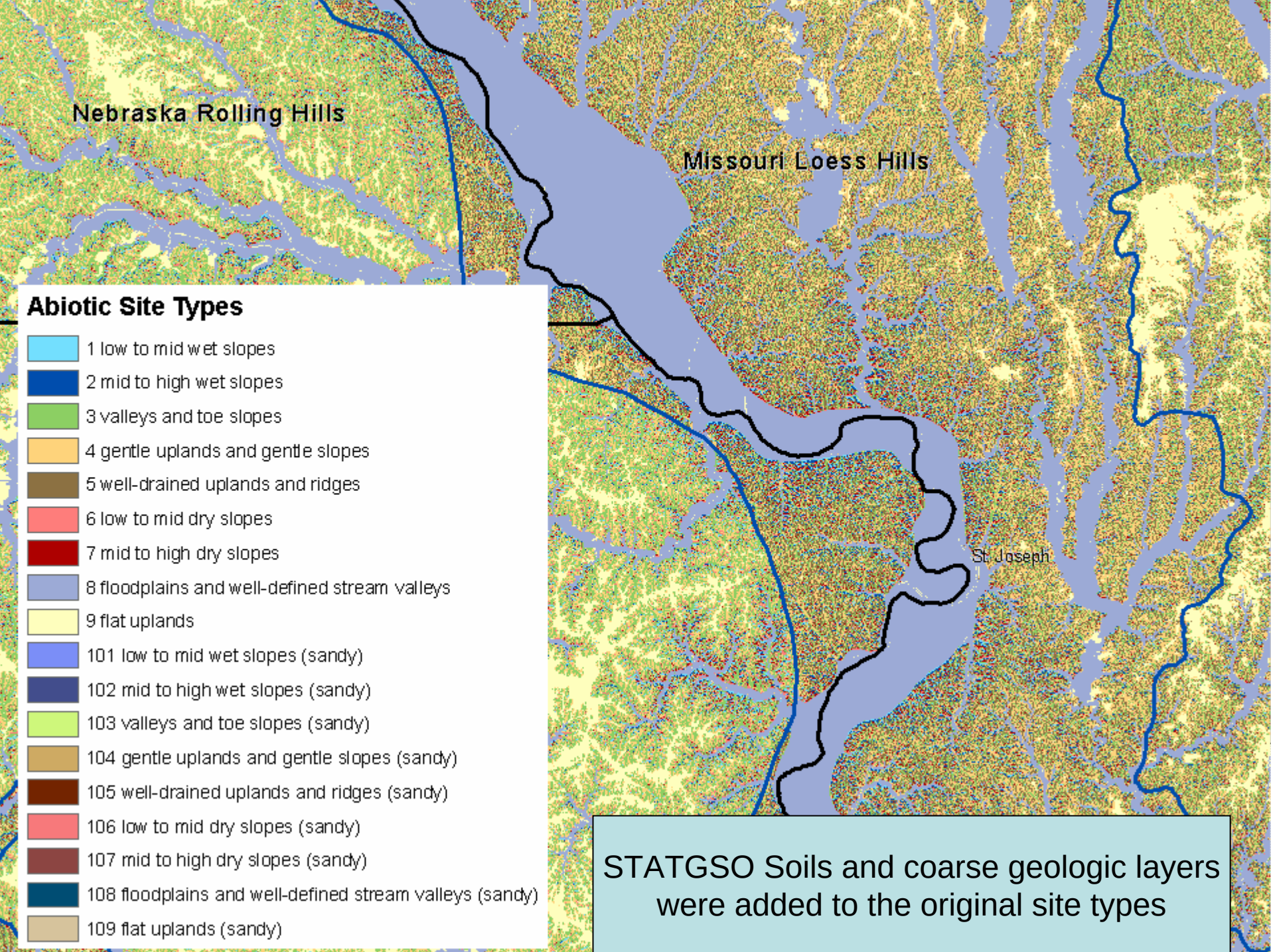
Key Note: DEMs are not perfect. In flats, many more pixels are assigned the elevation of the isoline, making it impossible to model subtle elevation variation. This is not corrected by the new 10 meter DEMs.

Solar Insolation + Land Position + Flats



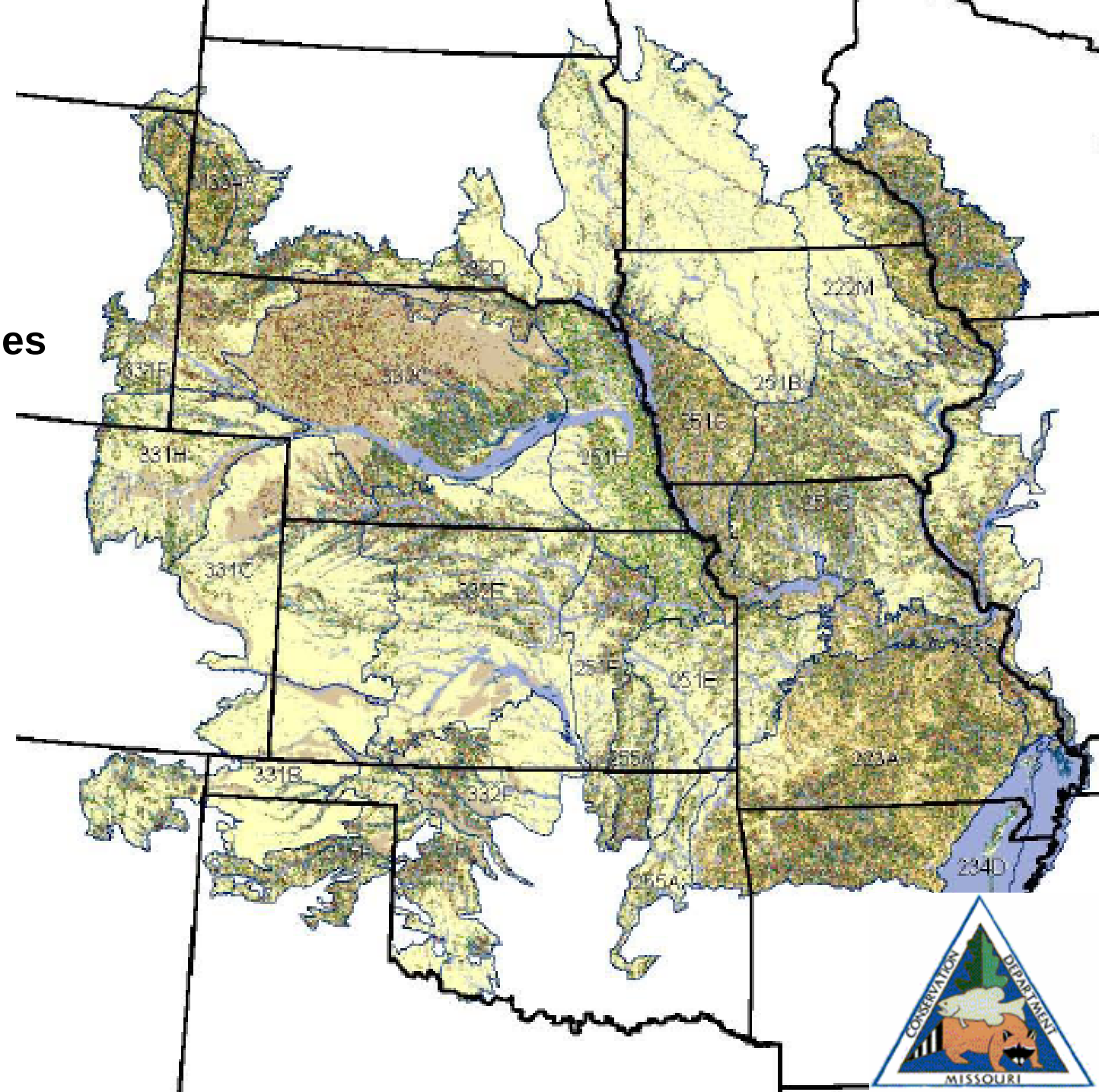
= Site Type



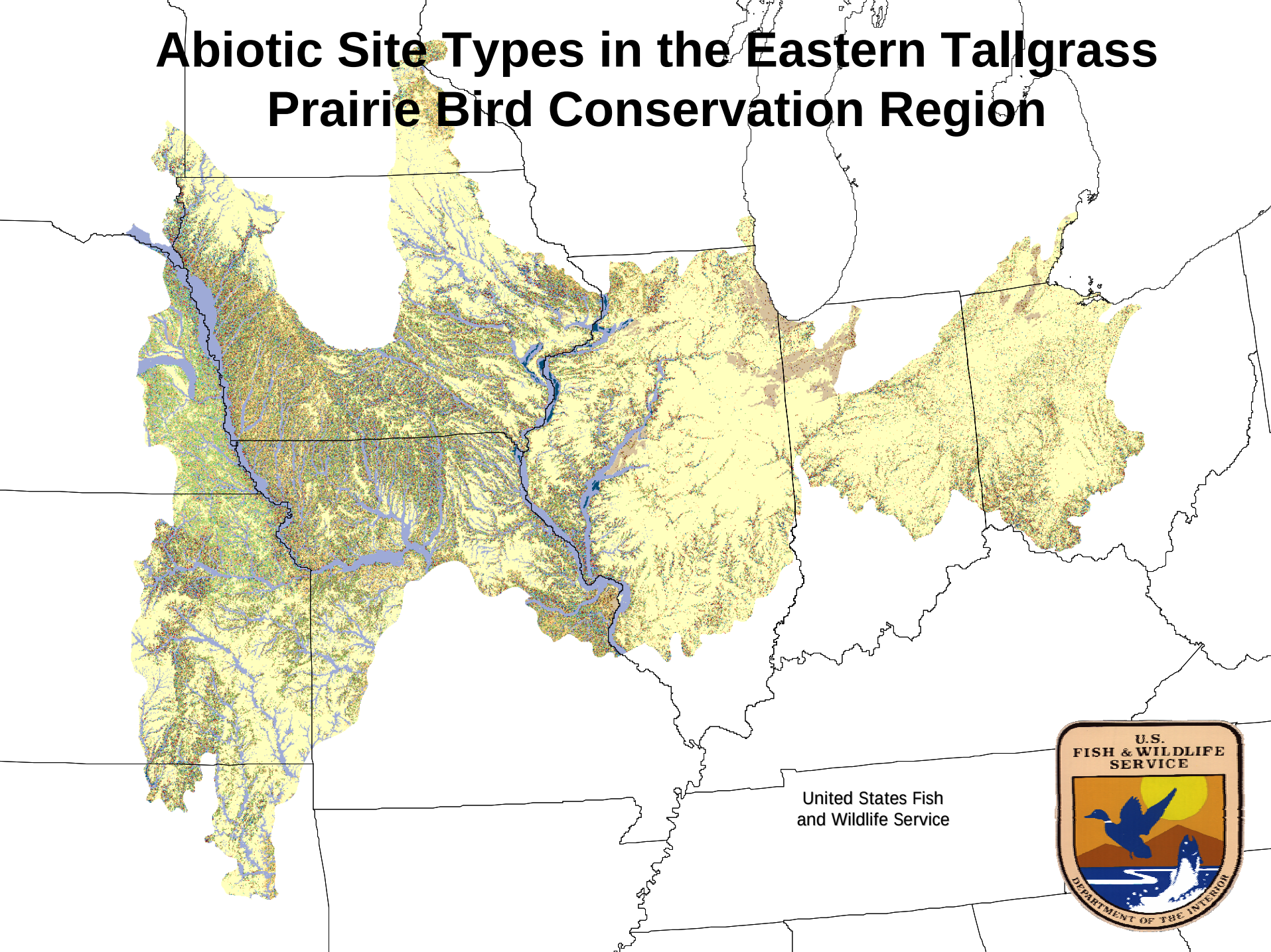


STATGSO Soils and coarse geologic layers were added to the original site types

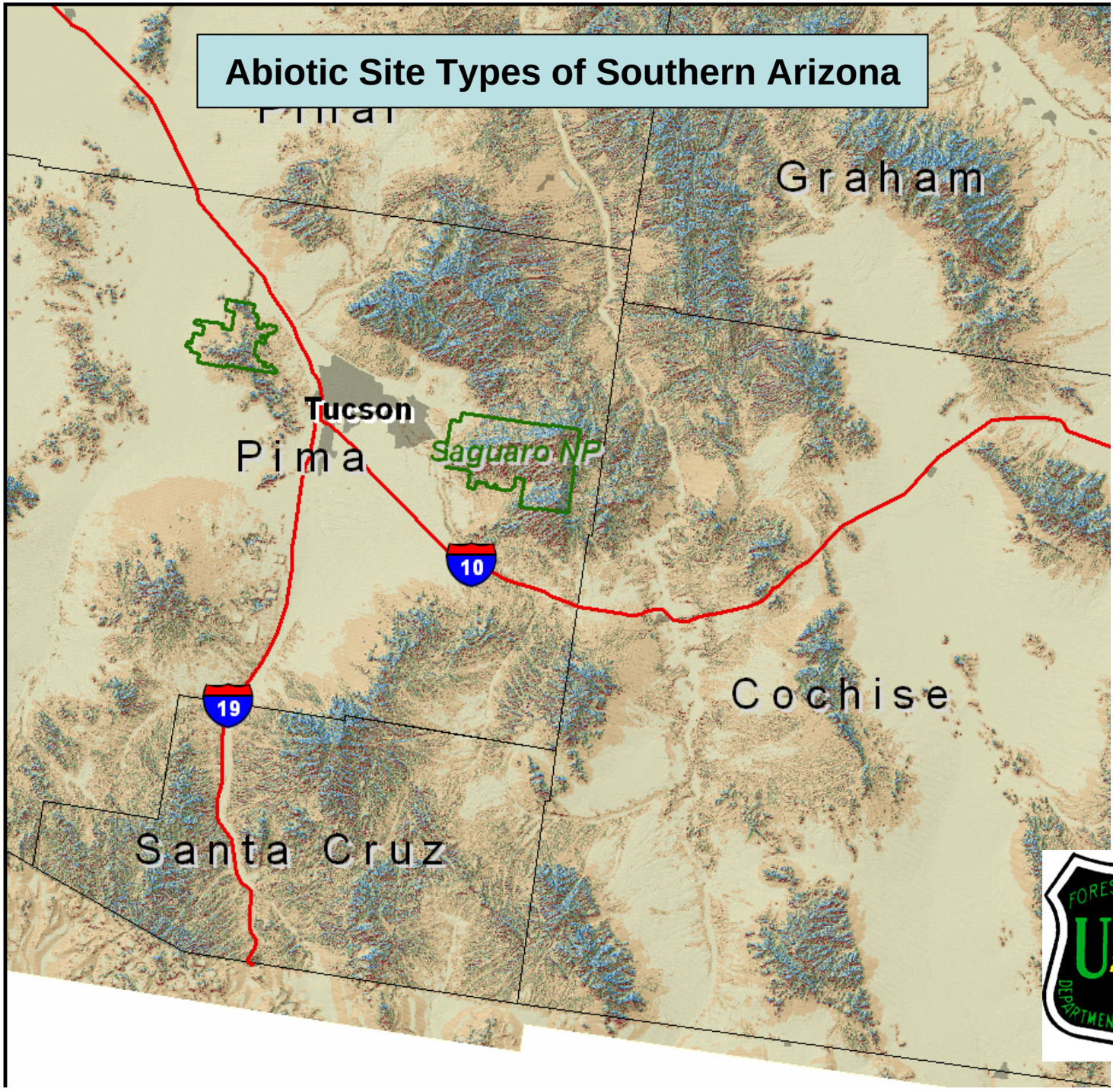
Abiotic Site Types for the Lower Midwest



Abiotic Site Types in the Eastern Tallgrass Prairie Bird Conservation Region



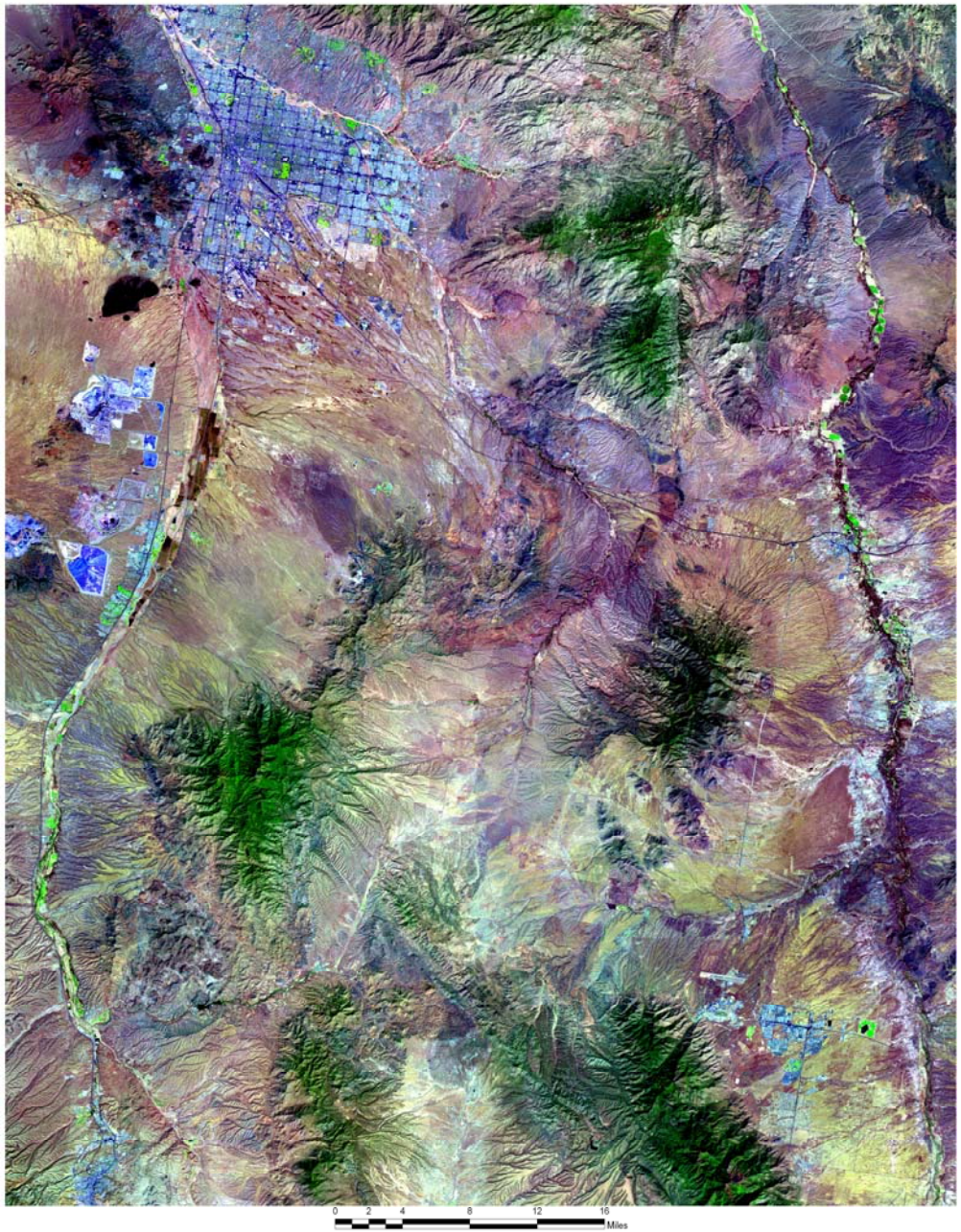
Abiotic Site Types of Southern Arizona



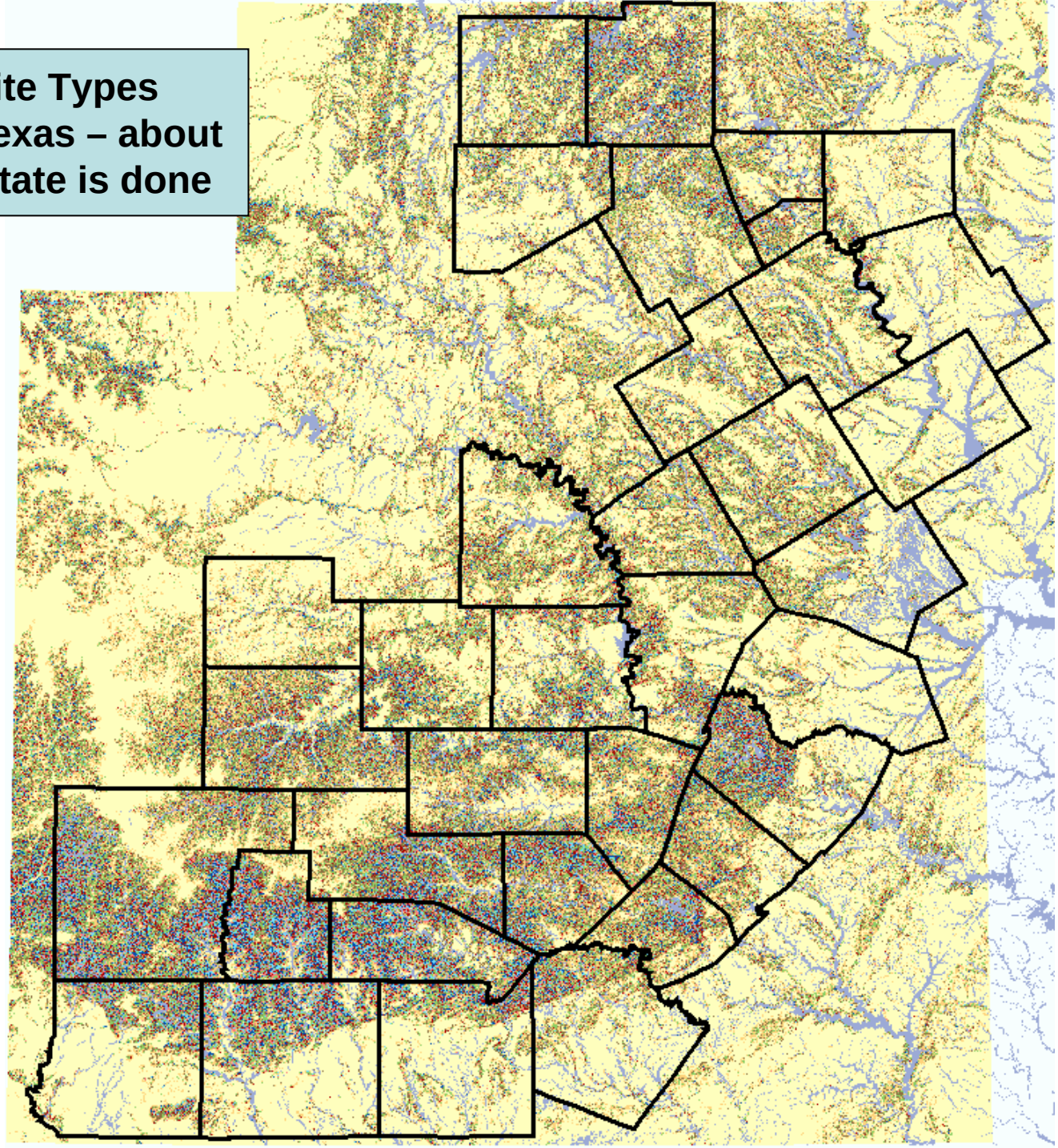
Landsat 7
Enhanced Thematic Mapper Imagery

Mosaic of
April 5, 2000
and
April 12, 2000

Proof of Concept Area



Abiotic Site Types for Central Texas – about 1/3rd of the state is done



TEXAS PARKS & WILDLIFE

mlramap - Windows Picture and Fax Viewer

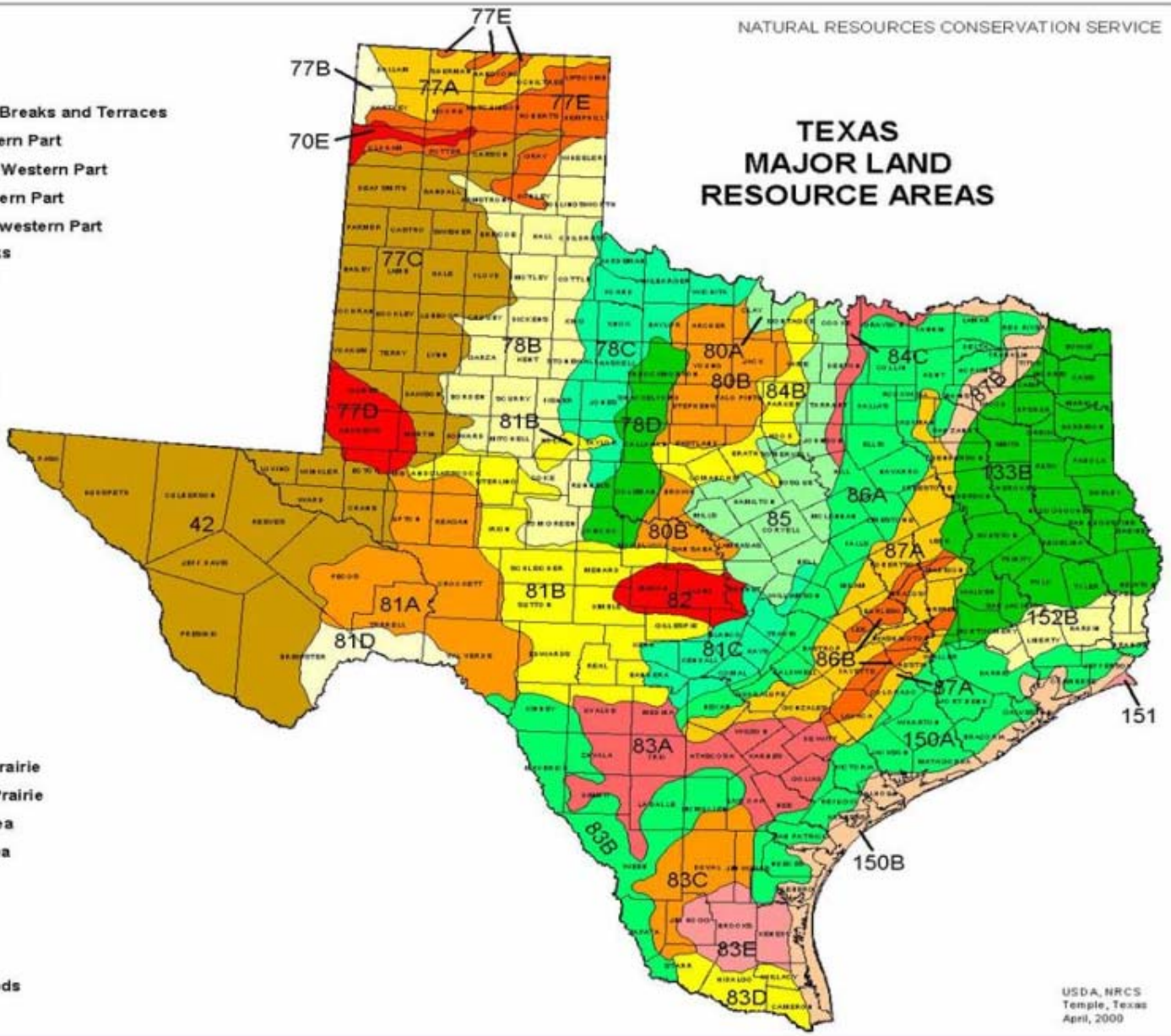
U. S. DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

TEXAS MAJOR LAND RESOURCE AREAS

LEGEND

42	Trans-Pecos
70E	Upper Pecos and Canadian Breaks and Terraces
77A	Southern High Plains Northern Part
77B	Southern High Plains North Western Part
77C	Southern High Plains Southern Part
77D	Southern High Plains Southwestern Part
77E	Southern High Plains Breaks
78B	Rolling Plains Western Part
78C	Rolling Plains Eastern Part
78D	Rolling Limestone Prairie
80A	Central Rolling Red Prairie
80B	Texas North Central Prairie
81A	Western Edwards Plateau
81B	Central Edwards Plateau
81C	Eastern Edwards Plateau
81D	Southern Edwards Plateau
82A	Texas Central Basin
83A	Northern Rio Grande Plain
83B	Western Rio Grande Plain
83C	Central Rio Grande Plain
83D	Lower Rio Grande Plain
83E	Sandsheet Prairie
84B	West Cross Timbers
84C	East Cross Timbers
85	Grand Prairie
86A	Northern Texas Blackland Prairie
86B	Southern Texas Blackland Prairie
87A	Southern Texas Claypan Area
87B	Northern Texas Claypan Area
133B	East Texas Timberlands
150A	Gulf Coast Prairie
150B	Gulf Coast Saline Prairie
151	Gulf Coast Marsh
152B	Western Gulf Coast Flatwoods



USDA, NRCS
Temple, Texas
April, 2000

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Use of SSURGO Soils

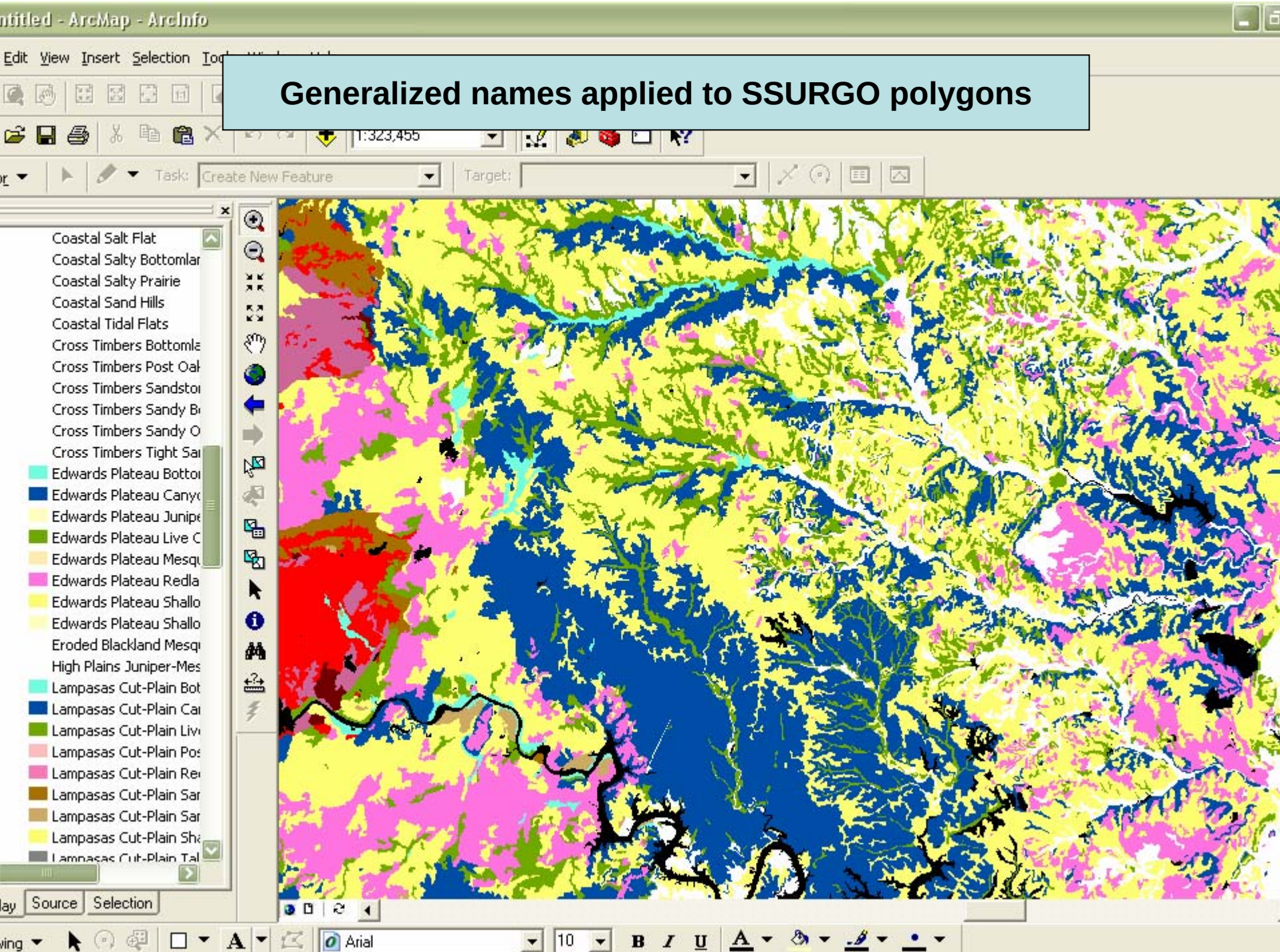
ecoclassid	ecoclassna	Functional Ecological System Title	Generalized NRCS "Climax" Plant Community - notes from the eFOTG	Landform from the eFOTG	Notes
000XY999TX	ON SITE INVESTIGATION IS NEEDED				what the crap?
R077AY010TX	ROUGH BREAKS PE 25-36	High Plains Juniper-Mesquite Breaks			not in database
R078AY117TX	CLAYEY UPLAND PE 34-42	Rolling Plains Mesquite-Tobosa Grassland			not in database
R078AY118TX	CLAY FLAT PE 34-42	Rolling Plains Mesquite-Tobosa Grassland	midgrass prairie	flats in upland valleys	
R078AY119TX	CLAY LOAM PE 34-42	Rolling Plains Mesquite-Blue Grama Grassland	midgrass juniper savanna		

Electronic Field Office Technical Guide – George Peacock

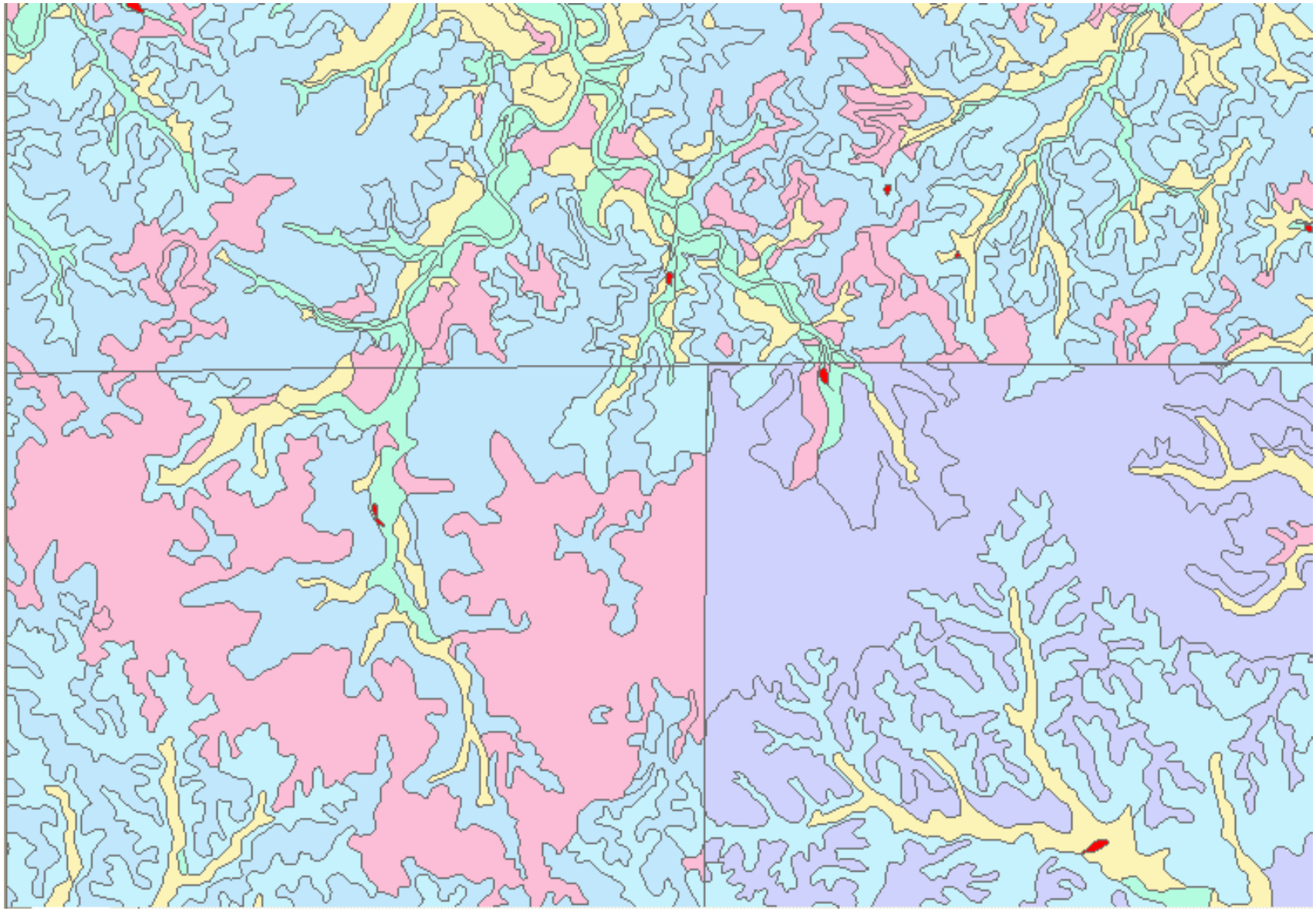
I have assigned generalized, uniform names to most SSURGO polygons by interpreting the eFOTG

R081CY574TX	Shallow PE 44+	Edwards Plateau Shallow Live Oak Savanna	mid and tall grasses with oak mottes; goes to juniper shrubland type might be too shallow to develop much of a taller woodland	says this one is mainly on slopes of stair step topography interspersed with very shallow or other types	
R081XY340TX	STEEP REDLAND PE 31-44	Edwards Plateau Canyon Mixed Woodland			not in the database
R082AY374TX	Schist 31-44	Llano Uplift Live Oak Savanna	midgrass live oak savanna; persimmon, whitebrush, catclaw listed as invaders	gentle uplands	
R082XY364TX	DEEP SAND PE 31-44	Llano Uplift Sandy Oak Savanna	post oak/blackjack with tall grasses; does not say what it goes to maybe white brush/oak?	rolling uplands 1-5%	
R082XY365TX	GRANITE GRAVEL PE 31-44	Llano Uplift Post Oak Savanna	open tallgrass post oak blackjack savanna; mesquite and whitebrush invade and ash juniper is listed too, which is a little odd but..	undulating uplands	

Generalized names applied to SSURGO polygons

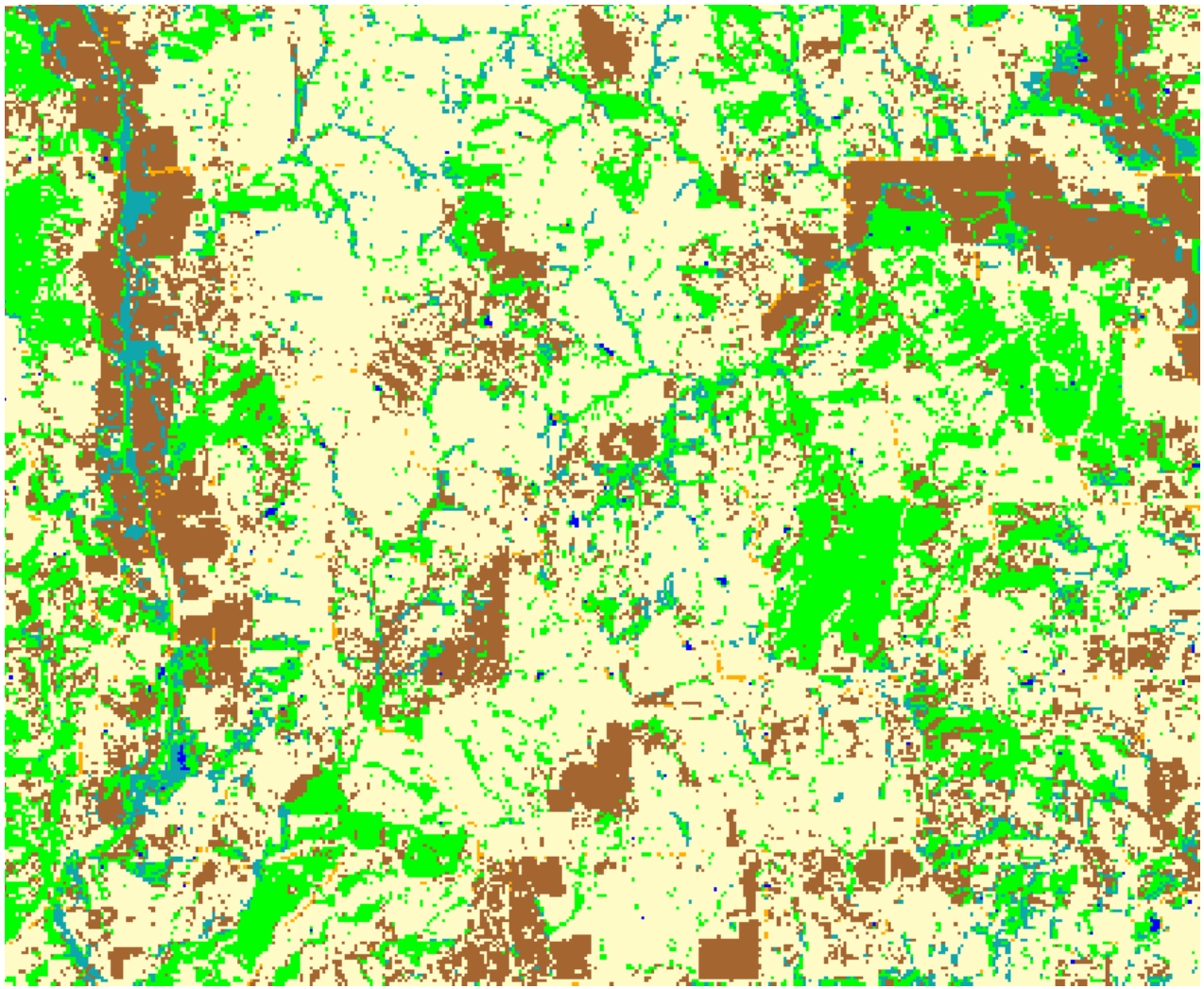


County Edge Matching: a common problem



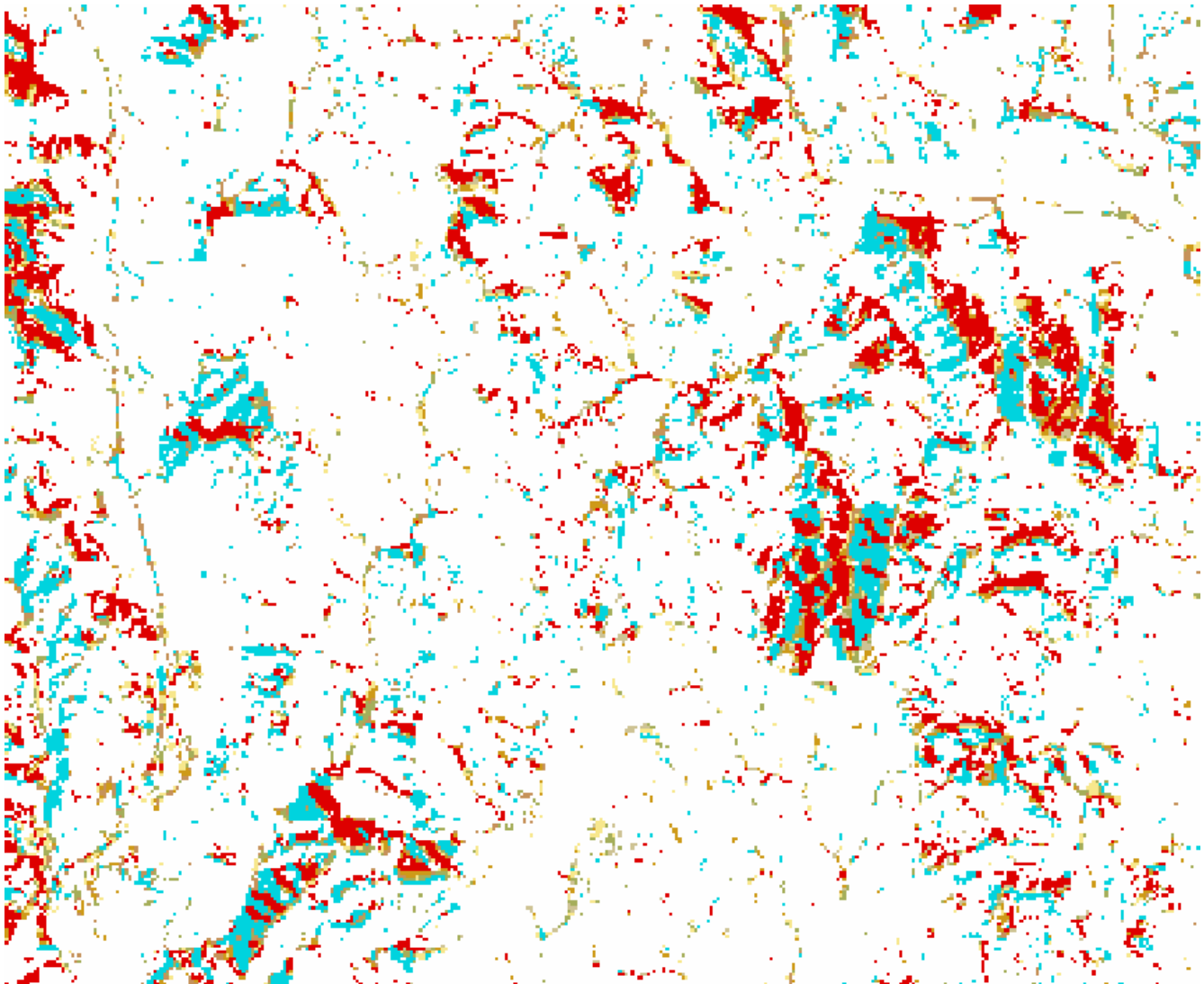
The upshot: abiotic variables & soils can be used to help model current vegetation (e.g. ecological systems)

NLCD Land Cover: Forest, Grassland, Cropland



The upshot: abiotic variables can be used to model current vegetation (e.g. ecological systems)

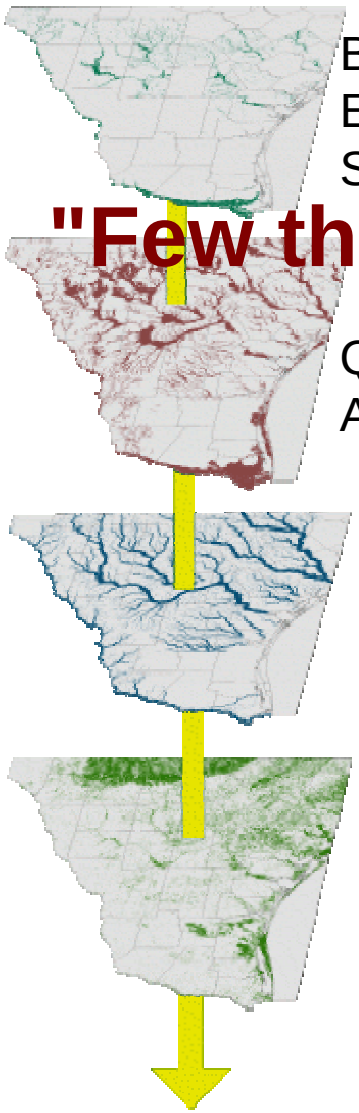
Forest Habitat: Mesic Forest versus Dry Forest



Ecological Systems Modeling Decision Rule Key

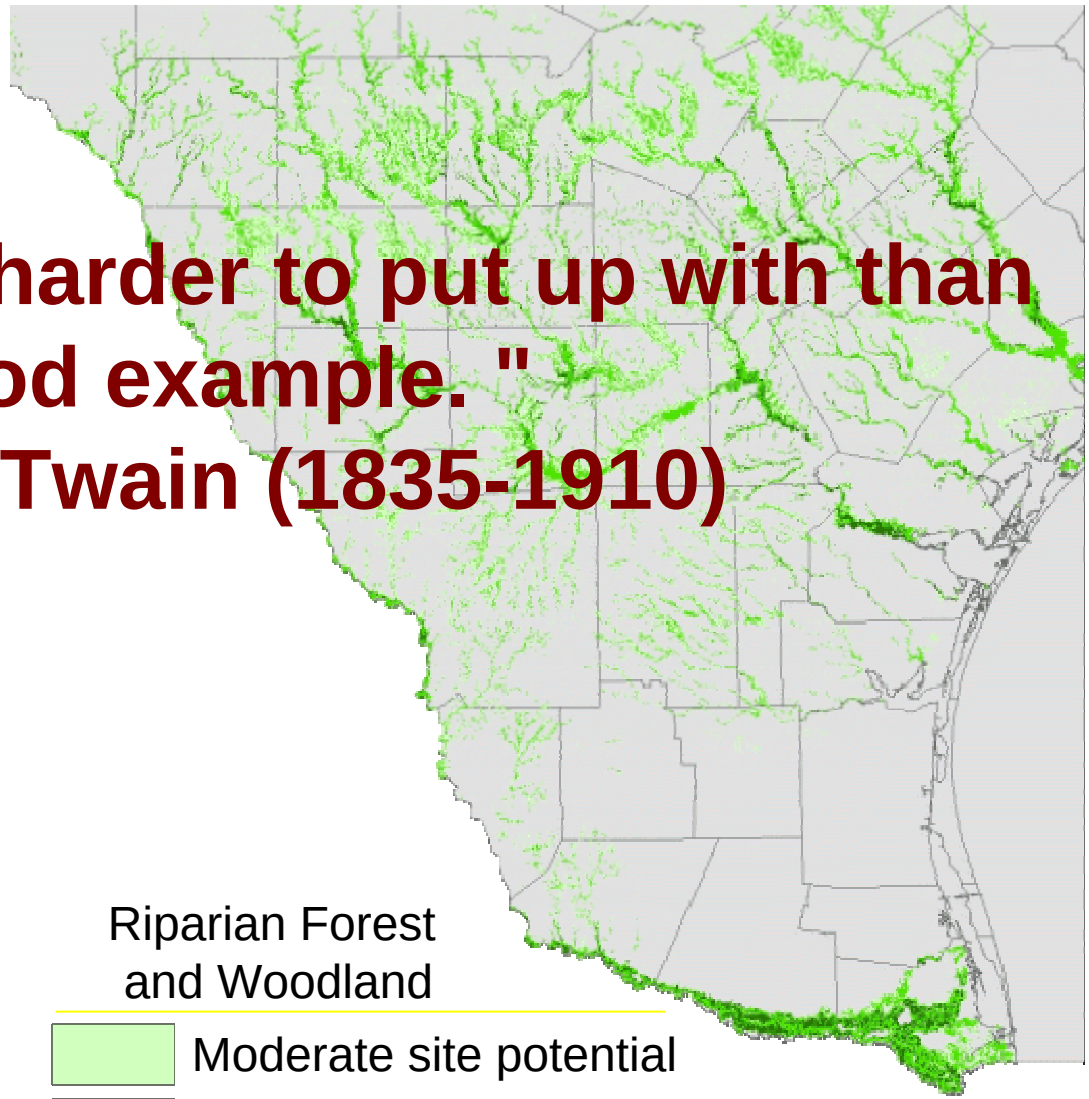
Ecological System	Land Cover	Within Floodplain	Solar Insolation	Landscape Position
Eastern Great Plains Wet Meadow, Prairie, and Marsh	Herbaceous Dominated Wetland	any	any	any
North-Central Interior Floodplain	Deciduous Forest	Y	any	any
North-Central Interior Maple-Basswood Forest	Deciduous Forest or Deciduous Woody-Herbaceous	any	lowest 2½%	lowest 2½%
North-Central Interior Oak Savanna	Deciduous Forest or Deciduous Woody-Herbaceous	N	highest 2½%	highest 2½%
North-Central Interior Shrub Swamp-Wet Meadow and Marsh	Deciduous Woody-Herbaceous	Y	any	any

Modeling Riparian Forest and Woodland in South Texas



"Few things are harder to put up with than a good example. "

- Mark Twain (1835-1910)



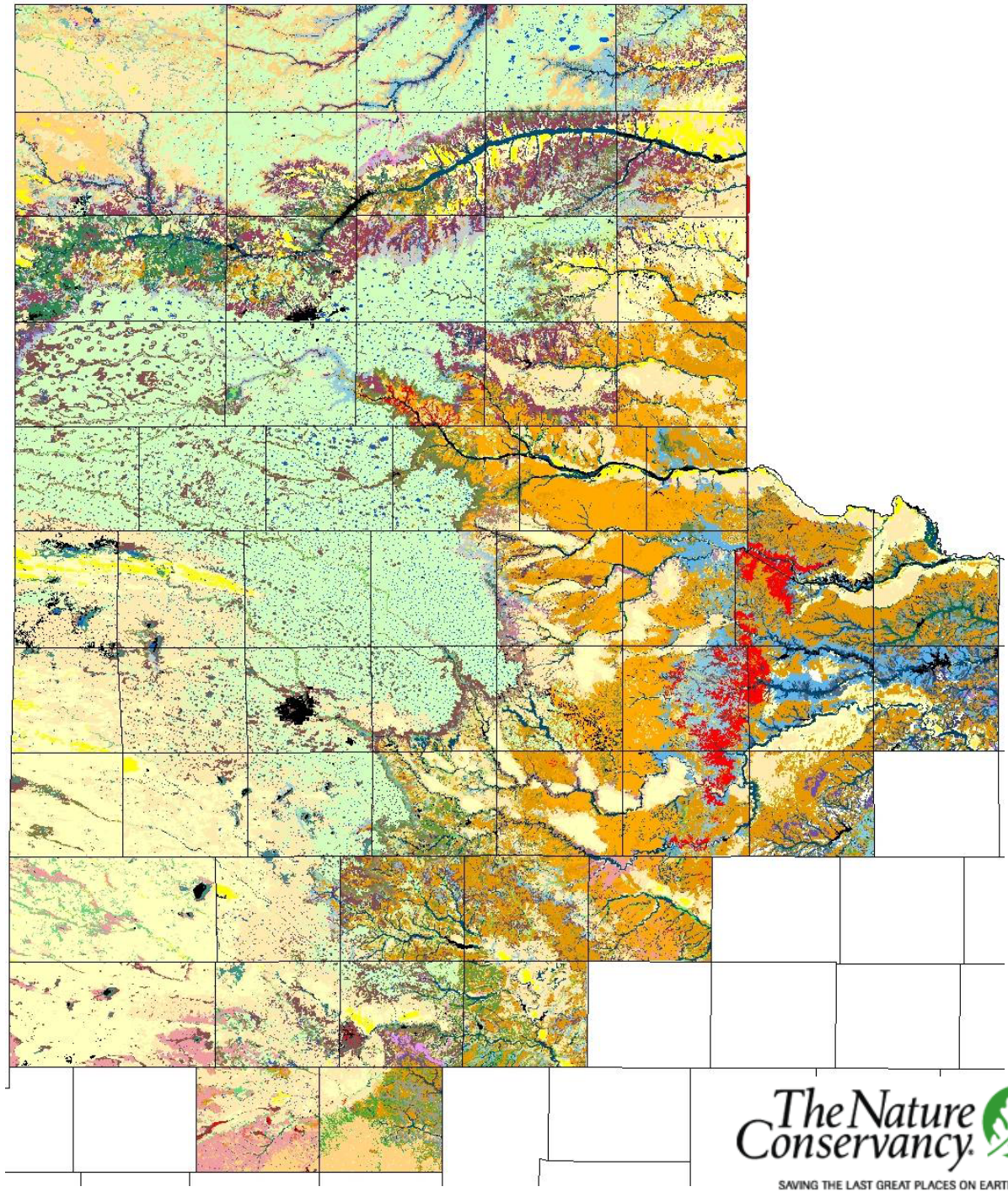
Riparian Forest and Woodland

- Moderate site potential
- High site potential
- Currently forested

The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH

Panhandle Ecological Sites



Selected Ecological Sites

- Bottomland
- Deep Hardland
- Deep Sand
- Gyp
- Loamy Prairie
- Playa
- Sandy Loam

The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH

Urban-Wildland Project Team

Austin Fire Department
Texas Forest Service
Austin OEM
City of Austin

Austin, Texas - 2003

Spatial Variable

Fuel + Slope +

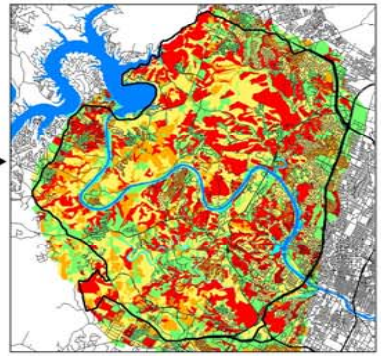
TEXAS FOREST SERVICE
The Texas A&M University System

FUELS (47%)

FUELS	RISK	VALUE
Nine	Low	40
One	Moderate	80
Two	Moderate	119
Six	High	158
Four	Extreme	197

LOW (9)
MODERATE (1)
MODERATE (2)
HIGH (6)
EXTREME (4)

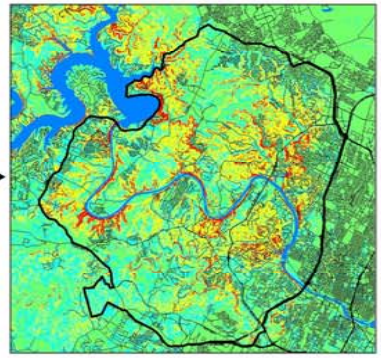
Based on Anderson Fuel Model



SLOPE (36%)

SLOPE %	RISK	VALUE
6-10%	Low	38
11-15%	Moderate	76
16-29%	High	114
30% +	Extreme	151

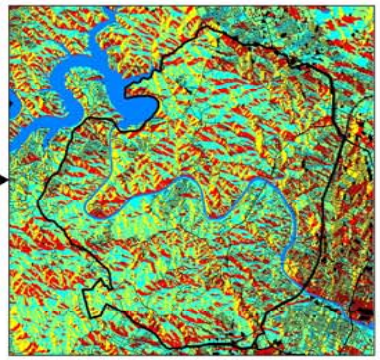
LOW
MODERATE
HIGH
EXTREME



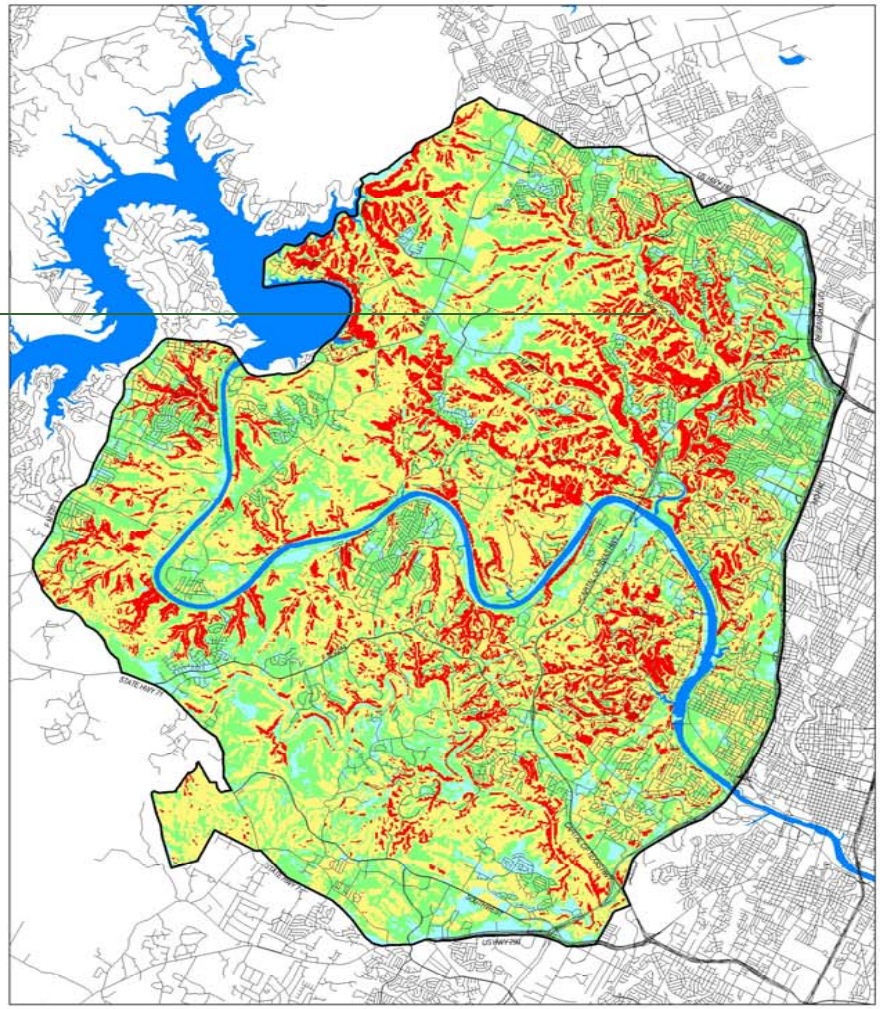
ASPECT (17%)

ASPECT	RISK	VALUE
North	Low	0
East	Moderate	18
West	High	36
South	Extreme	72

LOW
MODERATE
HIGH
EXTREME



Analysis



VALUE	RISK
0-105	Low
106-210	Moderate
211-315	High
316-420	Extreme

420 total points

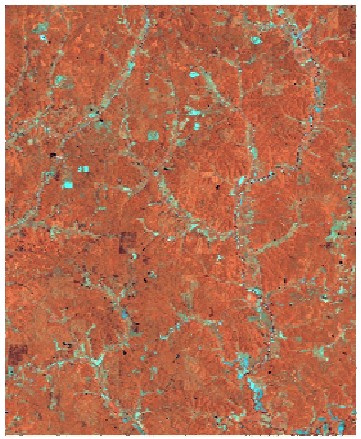
Low (0-105)
Moderate (106-210)
High (211-315)
Extreme (316-420)

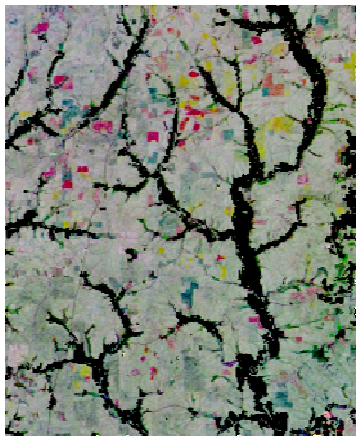
N W E S

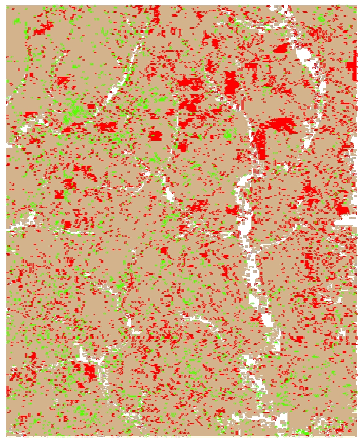
Produced by Austin Fire Dept's Fire Marshal's Office and Planning & Research Section. No reproduction allowed without written consent. January 2003(g)

Hazard maps are intended to be descriptive, NOT predictive. Please see complete report for detailed information regarding study methods.
January 2003

Forest Change Detection



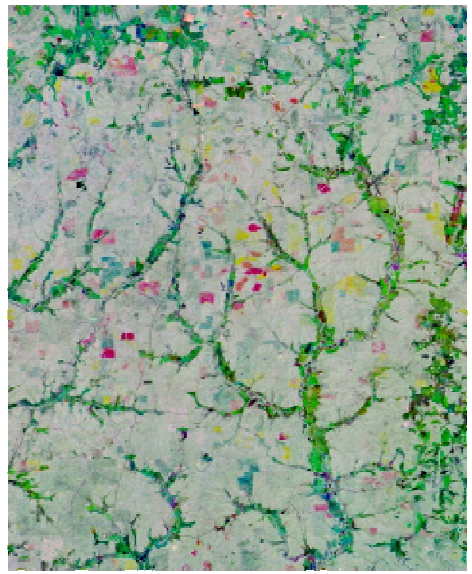




Forest Change Detection

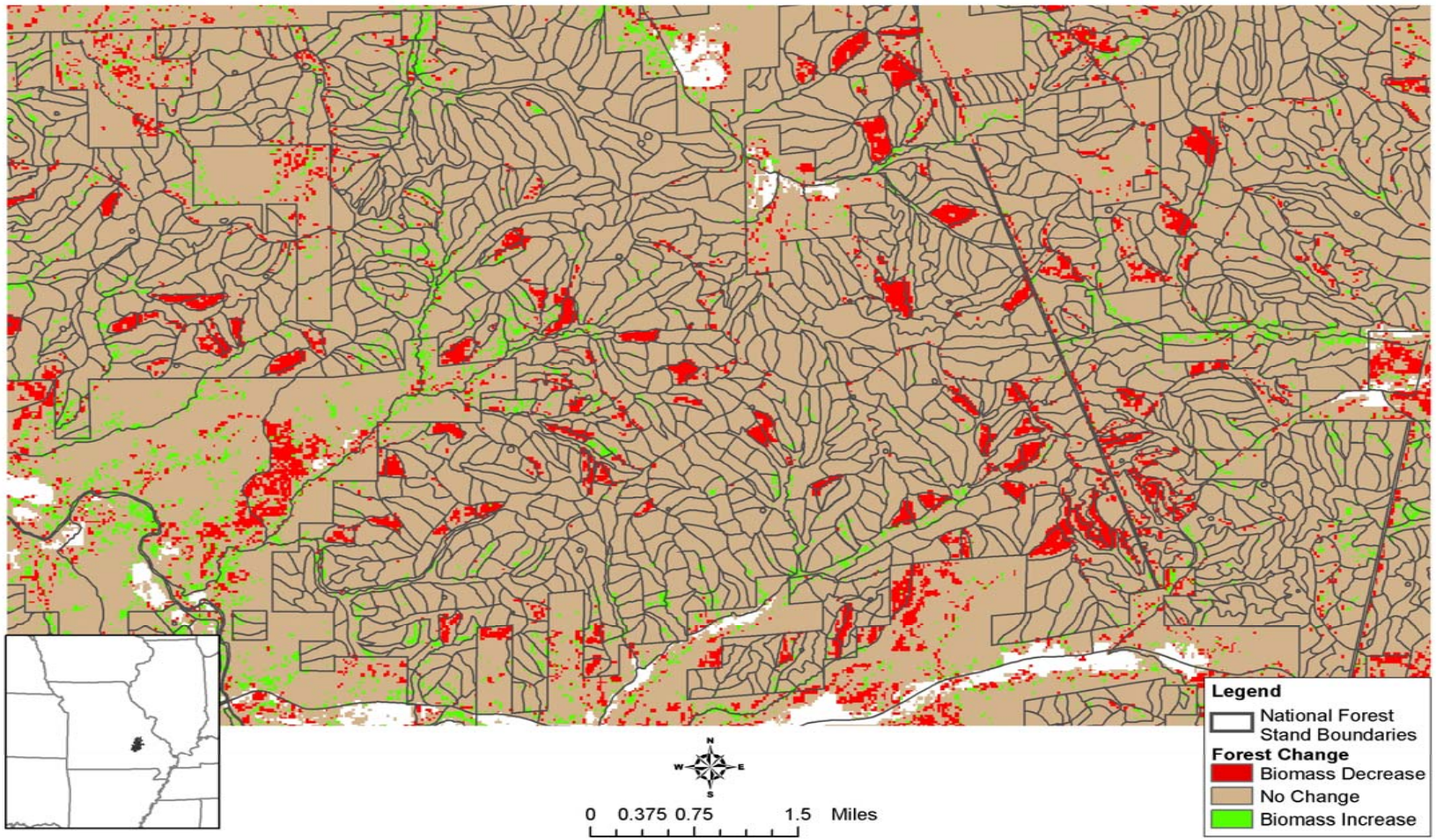
- Stacked a time sequence of Tasseled-cap wetness channels into a single image file to create a multitemporal “composite” wetness image
- Change was classified based on these data

Tasseled Cap
Wetness Composite

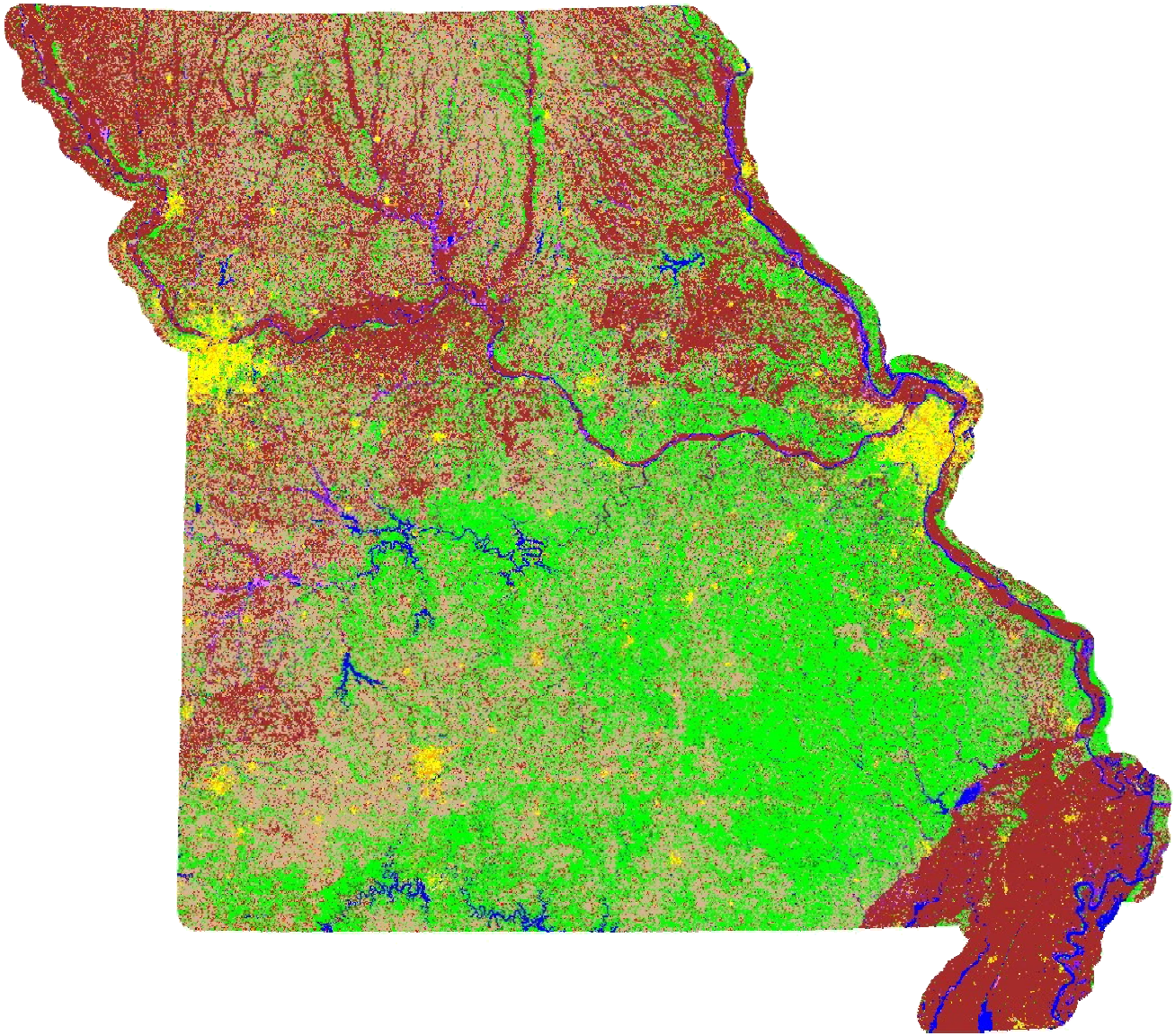


Forest Change Validation

- Stand management data intersected with change detection data



MoRAP Land Cover for Missouri: 1999 and 2005 versions



Collection and Processing of a High Volume of Field Data for Statewide Land Cover Mapping

Abstract

The Missouri Resource Assessment Partnership (MoRAP), a cooperative of natural resource agencies, mapped land cover for Missouri using Thematic Mapper (TM) satellite data. We initially derived land cover data for verification using an unsupervised, scene by scene classification. Cooperation from more than 150 field biologists from several agencies afforded us the opportunity to collect a large volume of field verification data. To take advantage, we developed a field sampling scheme based on spatial segmentation of individual TM scenes by ecological subsection that was designed to derive the maximum relevant information possible. Easy to use field forms were developed in conjunction with field personnel. Incoming data quality varied due to the diversity of individuals involved, but the spatially segmented sampling scheme, large data volume, and final expert review ensured that the biases of any individual had negligible impact on the final land cover product. In order to efficiently process the large volume of incoming data, we developed the Missouri Land Cover Ground Verification Tool – a Microsoft Visual Basic application with data management, analysis, and mapping functions that bridges Microsoft Access and ESRI's Arc/INFO software.

This is a DB used for the Kansas Land Cover – Clayton designed this effort as well (shows additional experience); we have DB manager

	Date														
2	06/18/98	Ellis	[illegible]	1	Achison	1S	13E	[illegible]	14	[illegible]	[illegible]		40	Non-native grassland (e.g. Smooth Brome or Tall Fescue)	Smooth Brome, Fenced
3	06/18/98	Ellis	2		Achison	1S	13E	26	14	250465	4423750		31	freshwater Marsh (with Bulrush & Cattali)	carex, typha, surrounded by brome unfenced, might have been put
4	06/18/98	Ellis	3	3	Achison	2S	13E	15	14	248611	4417877	41B		CRP (Conservation Reserve Program) with non-native species	Unfenced, all young smooth brome on the west side of road and te
5	06/18/98	Ellis	4	2	Achison	2S	14E	27	14	256594	4414422		33	Cattail Marsh	Typha, carex willows and cottonwood scattered about on east side
6	06/18/98	Ellis	5	4	Achison	2S	14E	28	14	256568	4414622	41A		CRP(Conservation reserve Program) with native grass	big blueslem, on west side of road, big bluestem encroaching bror
7	06/18/98	Ellis	6	4	Achison	1S	14E	26	14	260170	4424662	41B		CRP (Conservation Reserve Program) with non-native species	Smooth brome, unfenced
8	06/19/98	Ellis	7	1	Achison	1S	15E	33	14	264955	4423359	41A		CRP(Conservation reserve Program) with native grass	Little bluestem/big bluestem, lots of brome along eclges, not more
9	06/19/98	Ellis	8		Achison	1S	15E	9	14	265462	4428128		40	Non-native grassland (e.g. Smooth Brome or Tall Fescue)	grazed fenced, mildly weedy, smooth brome
10	06/19/98	Ellis	9	3	Achison	1S	16E	19	14	270776	4426265	41A		CRP(Conservation reserve Program) with native grass	Big bluestem, no fence along streambeo
11	06/19/98	Ellis	10	2	Achison	1S	16E	20	14	272924	4425661		31	Freshwater marsh (with bulrush& cattail)	Typha, ringed on south by willow-cottonwood, tree row, corn on so
12	06/19/98	Ellis	11		Achison	2S	16E	8	14	272745	4419566		40	Non-native grassland (e.g. Smooth Brome)	Brome with western wheatgass into mixed
13	06/19/98	Ellis	12		Achison	2S	16E	9	14	275141	4418025		40	Non-native grassland (e.g. tall fescue)	Tall fescue, mod weedy
14	06/19/98	Ellis	13	1	Achison	2S	16E	12	14	279251	4416352	41A		CRP(Conservation reserve Program) with native grass	Big bluestem, no fence, virtually weedless, < 3 years old
15	06/19/98	Ellis	14	1	Achison	2S	17E	6	14	282337	4420421		40	Non-native grassland (e.g. smooth brome)	Brome field
16	06/19/98	Ellis	15	4	Achison	1S	16E	23	14	279383	4425783		40	Non-native grassland (e.g. smooth brome)	Brome, fenced, ringed by tree rows
17	06/19/98	Ellis	16		Achison	1S	17E	11	14	288413	4427329		5	Ash-elm-hackberry floodplain forest	bur oak, black willow, hackberry, elm
18	06/19/98	Ellis	17	3	Achison	1S	18E	19	14	290559	4424799		17	Tallgrass prairie	Little blue, Indian grass , foxtail barley scattered within
19	06/21/98	Ellis	18	1	Achison	2S	17E	22	14	285669	4414575		40	Non-native grassland (e.g. Smooth Brome)	Smooth brome, fenced
20	06/21/98	Ellis	19	1	Achison	2S	18E	19	14	291254	4414406		31	Freshwater marsh (with bulrush& cattail)	Cared, typha,spartina, surrounded by brome
21	06/21/98	Ellis	20	3	Achison	2S	18E	20	14	291832	4415261		40	Non-native grassland (e.g. tall fescue)	Tall fescue, new fence, Indian grass and willows scattered on road
22	06/21/98	Ellis	21	2	Achison	2S	18E	7	14	291903	4418385		40	Non-native grassland (e.g. tall fescue)	Tall fescue
23	06/21/98	Ellis	22	1	Achison	2S	18E	12	14	297558	4418606	41B		CRP (Conservation Reserve Program) with non-native species	Smooth brome, unfenced
24	06/21/98	Ellis	23		Achison	2S	18E	2	14	297603	4420080		30	Low or wet prairie (with prairie cordgrass and sedges)	Carex, spartina, black willow, little bluestem
25	06/21/98	Ellis	24		Achison	1S	18E	23	14	298480	4425175		11	Cottonwood floodplain woodland	Black willow, cottonwood, elm, Indiangrass
26	06/21/98	Ellis	25	1	Achison	1S	19E	13	14	300822	4426320		40	Non-native grassland (e.g. tall fescue)	Tall fescue, mod weedy, fenced, grazed
27	06/21/98	Ellis	26		Achison	1S	19E	9	14	304111	4426907		6	Cottonwood Floodplain forest	Cottonwood, elm Bur oak, red oak om hillside
28	06/21/98	Ellis	27	2	Achison	1S	19E	16	14	304114	4425940	41B		CRP (Conservation Reserve Program) with non-native species	Smooth brome, unfenced, terrdced
29	06/21/98	Ellis	28		Achison	1S	19E	28	14	304046	4423060		6	Cottonwood Floodplain forest	Black willow, cottonwood, elm,
30	06/23/98	Ellis	29	4	Achison	3S	21E	17	14	321277	4407212	41B		CRP (Conservation Reserve Program) with non-native species	No Fence, smooth brome
31	06/23/98	Ellis	30	2	Achison	3S	21E	5	14	321305	4409380		17	Tallgrass prairie	Fenced, big blue, Indiangrass, little blue, smooth brome on east s
32	06/23/98	Ellis	31	3	Achison	2S		29	14	311950	4414254		6	Cottonwood Floodplain forest	Cottonwood, bur oak, elm, white oak, little bluestem in understory
33	06/23/98	Ellis	32	3	Achison	2S	19E	28	14	303054	4414197		40	Non-native grassland (e.g. tall fescue)	Fenced, tall fescue, weedy surrounded by sorn crops
34	06/23/98	Ellis	33	4	Achison	2S	18E	32	14	293346	4412511	41A		CRP(Conservation reserve Program) with native grass	Big blue, little blue, Indian grass, brome encrodched, deiriage near
35	06/23/98	Ellis	34	3	Achison	3S	18E	16	14	293224	4407162	41B		CRP (Conservation Reserve Program) with non-native species	Smooth brome, no fence on east side of road
36	06/23/98	Ellis	35		Achison	3S	18E	33	14	294069	4403085		6	Cottonwood Floodplain forest	Cottonwood, Black willow, Bur oak, elm
37	06/23/98	Ellis	36	3	Achison	4S	18E	11	14	296340	4398657		31	Freshwater marsh (with bulrush& cattail)	In waterwdy between crops, when on south corn on east and north
38	06/23/98	Ellis	37	3	Achison	3S	18E	33	14	296132	4396349		40	Non-native grassland (e.g. tall fescue)	Tall fescue
39	06/23/98	Ellis	38		Achison	4S	19E	19	14	300058	4394373	40		Freshwater marsh (with bulrush& cattail)	Modeeately weed pasture, fenced, tall fesoue seland, brome, prun
40	06/23/98	Ellis	39	1	Achison	4S	19E	10	14	305911	4398747		17	Tallgrass prairie	Little bluestem scattered, willow trees carex on roadside, eragrost
41	06/23/98	Ellis	40	1	Achison	3S	19E	35	14	307579	4401116		31	Freshwater marsh (with bulrush& cattail)	Foxtail,cattail, bulrush
42	06/23/98	Ellis	41		Achison	3S	20E	32	14	311000	4401033		33	Cattail Marsh	Lots of cattals and bulrush
43	06/23/98	Ellis	42	3	Achison	4S	21E	5	14	320399	4400607		40	Non-native grassland (e.g. Smooth Brome)	Smooth brome, fenced, cows inside
44	06/23/98	Ellis	43	4	Achison	4S	21E	29	14	321006	4393852	41B		CRP (Conservation Reserve Program) with non-native species	Unfenced, smooth brome
45	06/25/98	Ellis	44	1	Achison	5S	21E	31	14	318805	4382131		1	Maple - basswood forest	Maple, basswood, elm maple, hickory, Paw-paw
46	06/25/98	Ellis	45	4	Achison	5S	21E	19	14	320225	4384753		7	Mixed oak floodplain forest	Chiquapin sycamure, Elm, redbud, cottonwood, on west side of ro
47	06/25/98	Ellis	46	1	Achison	5S	21E	3	14	323477	4389776		6	Cottonwood Floodplain forest	Cottonwood, sycamore, redbud, black willow
48	06/25/98	Ellis	47	3	Achison	6S	21E	19	14	317688	4376500		7	Mixed oak floodplain forest	Chinkapin, bur, basswood, blackjack oak, paw paw along Missour
49	06/25/98	Ellis	48		Achison	6S	21E	19	14	318913	4375878		40	Non-native grassland (e.g. tall fescue)	Tall fescue
50	06/25/98	Ellis	49	1	Achison	6S	20E	16	14	312349	4376627	41A		CRP(Conservation reserve Program) with native grass	Little blue, CRP mix, fenced mildly weedy
51	06/25/98	Ellis	50		Achison	5S	19E	26	14	306617	4384978		40	Non-native grassland (e.g. Smooth Brome)	Smooth brome, fenced, probably hayed
52	06/25/98	Ellis	51A	2	Achison	5S	19E	8	14	300856	4390159		17	Tallgrass prairie	Little blue, purple prairie coneflower, scattered trees
53	06/25/98	Ellis	51B	3	Achison	5S	19E	12	14	307326	4389345		8	Bur oak floodplain woodland	Bur oak, willow. elm, redbud, little bluestem
54	06/25/98	Ellis	53		Achison	3S	19E	31	14	301121	4402270		40	Non-native grassland (e.g. tall fescue)	Tall fescue, purple prairie coneflower, thistle and brome on perimet
55	06/30/98	Ellis	54	3	Achison	6S	18E	4	14	292484	4382180		40	Non-native grassland (e.g. Smooth Brome)	Smooth brome, fenced on south side of road. North side of road in
56	06/30/98	Ellis	55		Achison	5S	18E	31	14	289385	4382518	41A		CRP(Conservation reserve Program) with native grass	Big bluestem mix
57	06/30/98	Ellis	55B	4	Achison	4S	17E	27	14	286473	4394444	41B		CRP (Conservation Reserve Program) with non-native species	Smooth brome on west side of road, on SE side worst, worst I hav
58	06/30/98	Ellis	56		Achison	4S	17E	10	14	286655	4399899		31	freshwater Marsh (with Bulrush & Cattali)	Typha Carex, wine waterway surriunded by corn
59	06/30/98	Ellis			Achison				14						
60	06/30/98	Ellis			Achison				14						

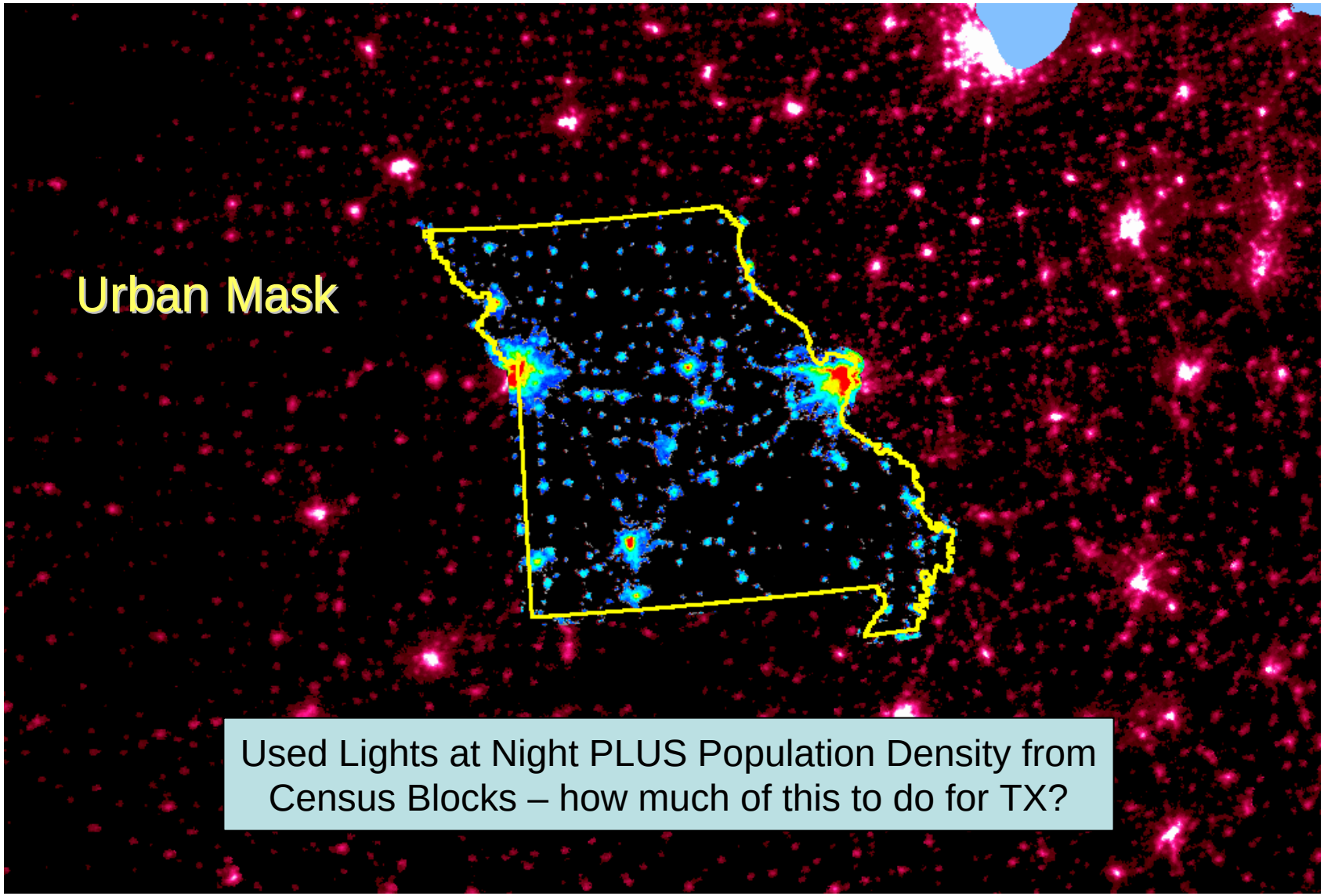
Achison | Beloit | Blue Rapids | Butler | Chanute | Clay Center | Coffeyville | Concordia | Council Grove | Dodge City | El Dorado | Emporia | Ga

gap field.wb3 QuickCell NUM CAPS SCRL READY

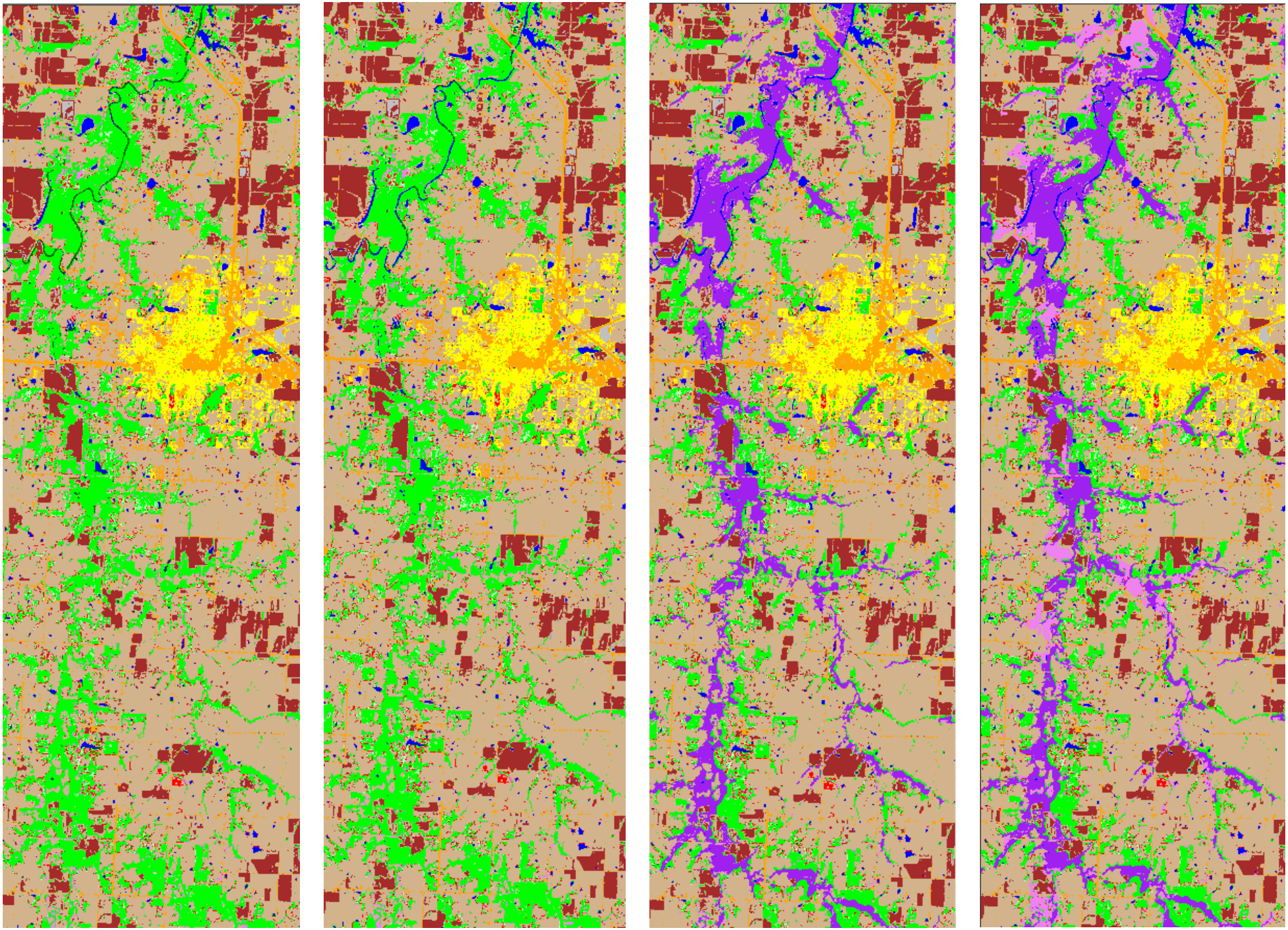
2005 Missouri Landcover Mapping

- Image stratification used to aid information class assignment in urban areas
- Cluster-busting to help alleviate confusion
- Modeling to extract additional classes

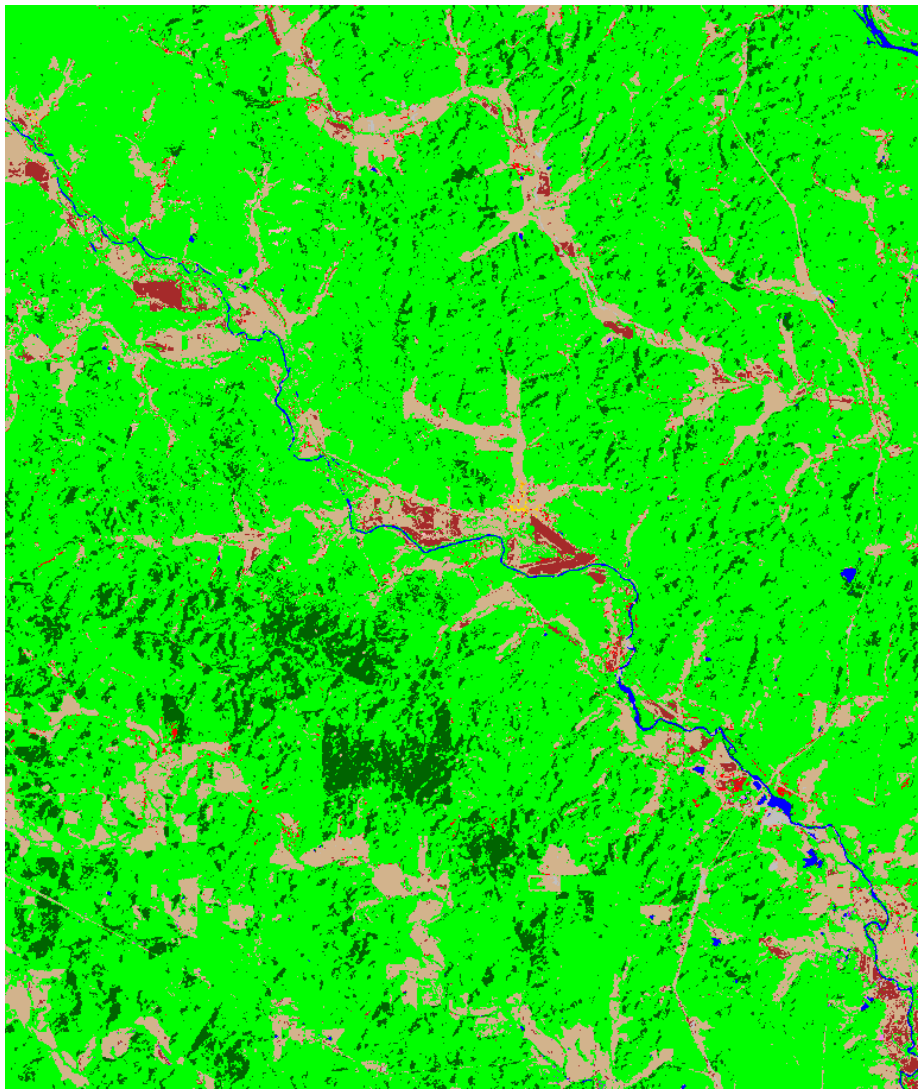
Stratification Data Layer



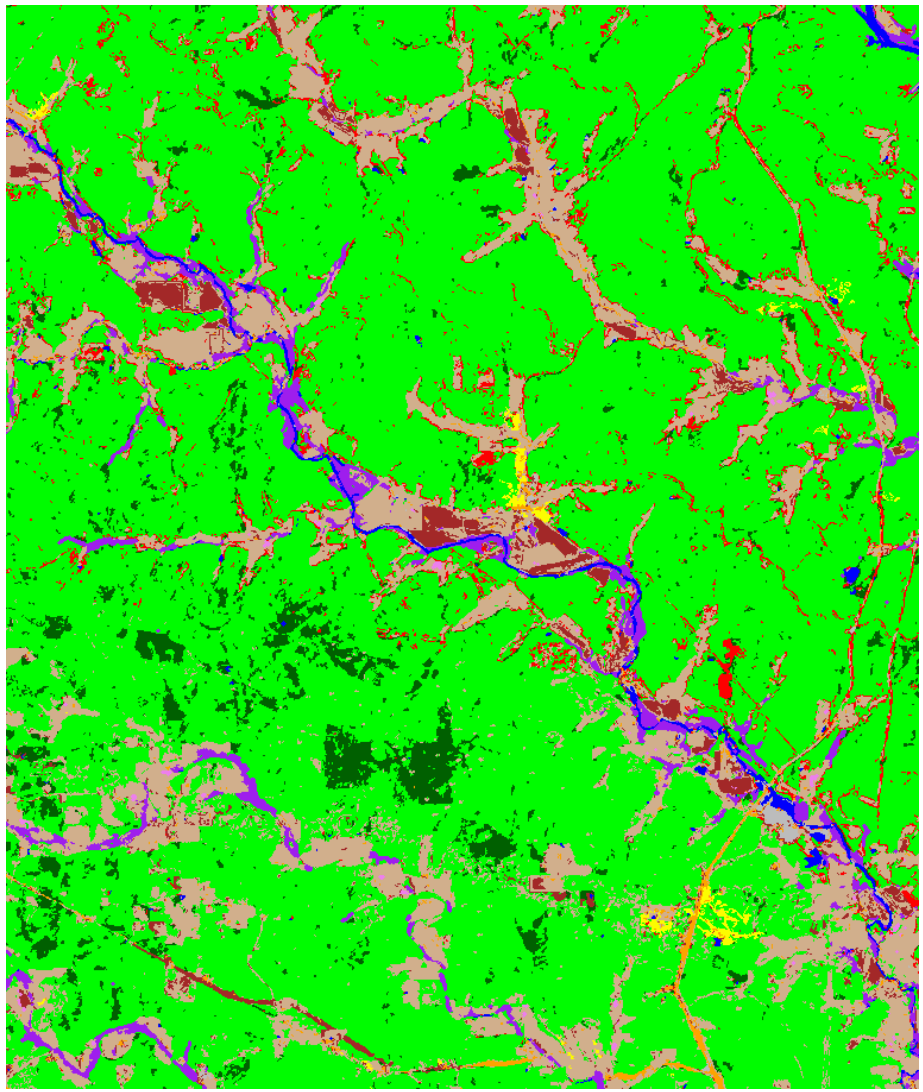
Used Lights at Night PLUS Population Density from Census Blocks – how much of this to do for TX?



Improved forest cover mapping due to elimination of topographic shadowing effect



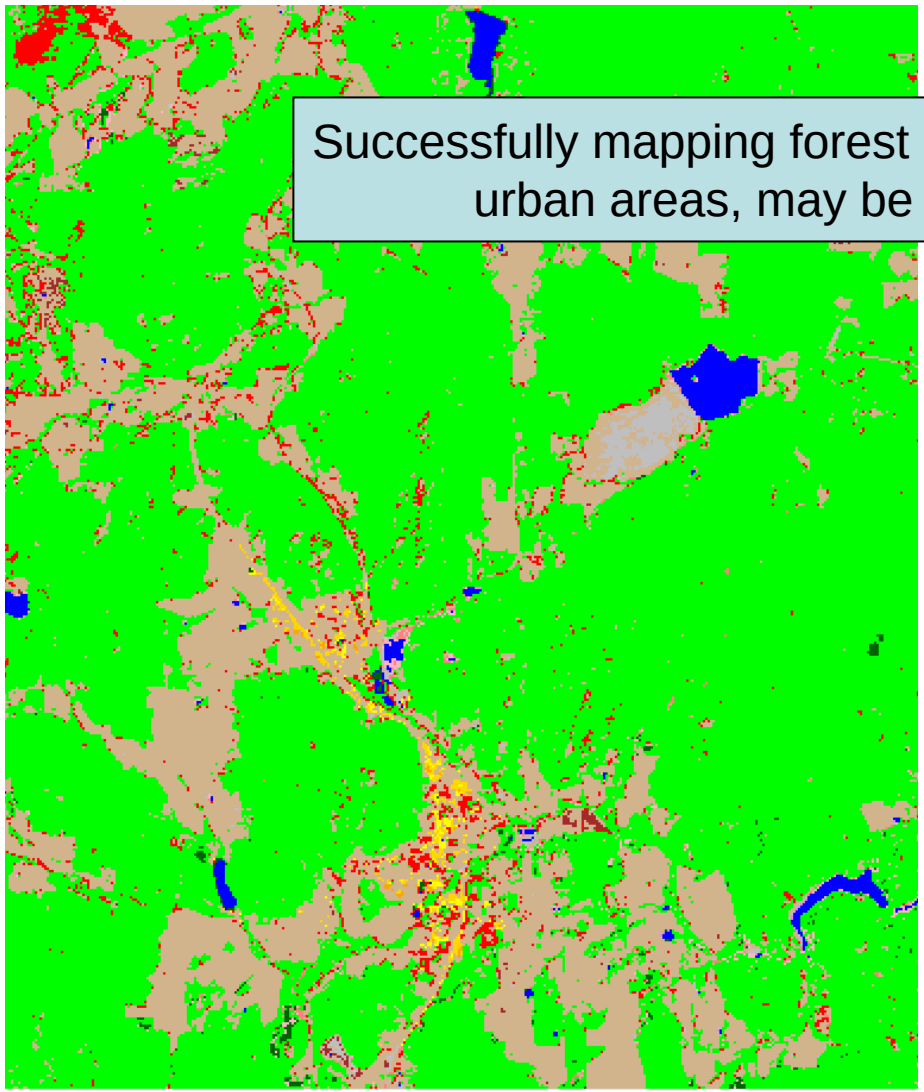
1992 MoRAP LULC



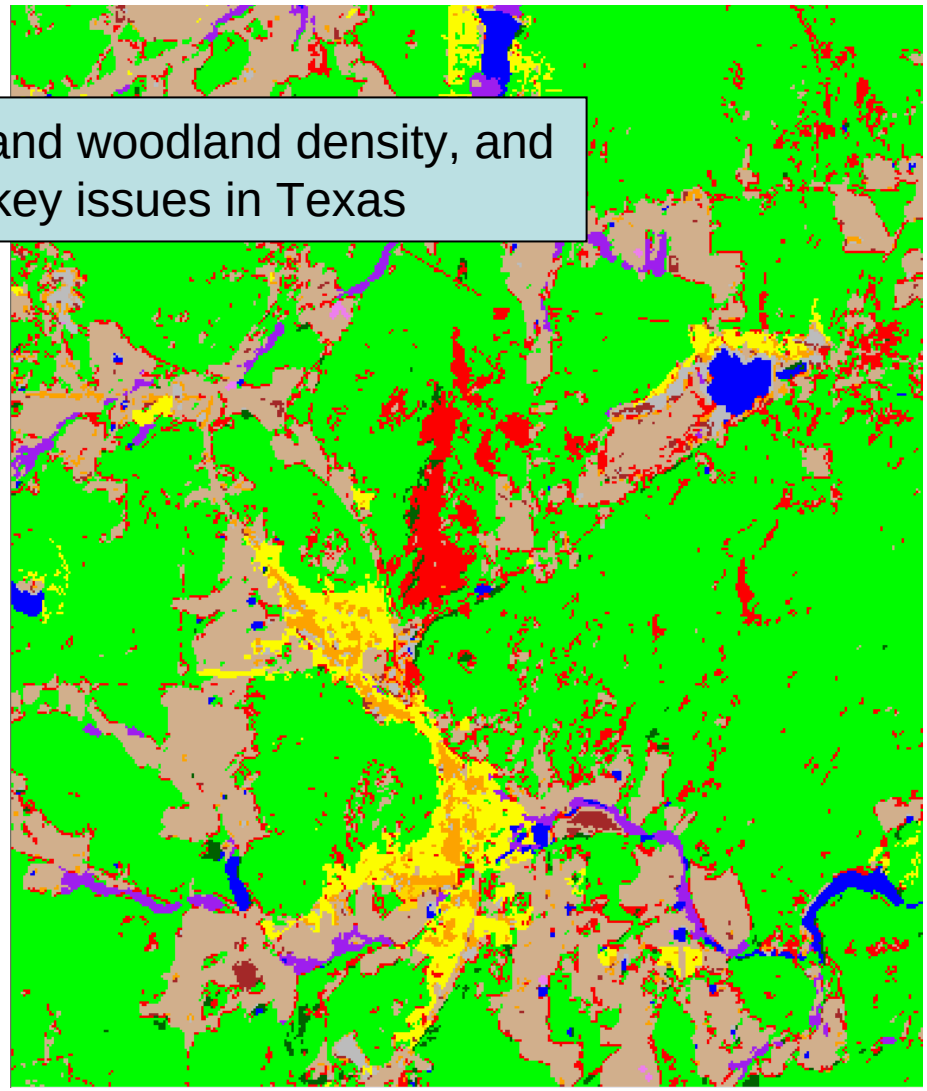
2005 MoRAP LULC

Improved urban land cover and forest density mapping

Successfully mapping forest and woodland density, and urban areas, may be key issues in Texas



1992 MoRAP LULC

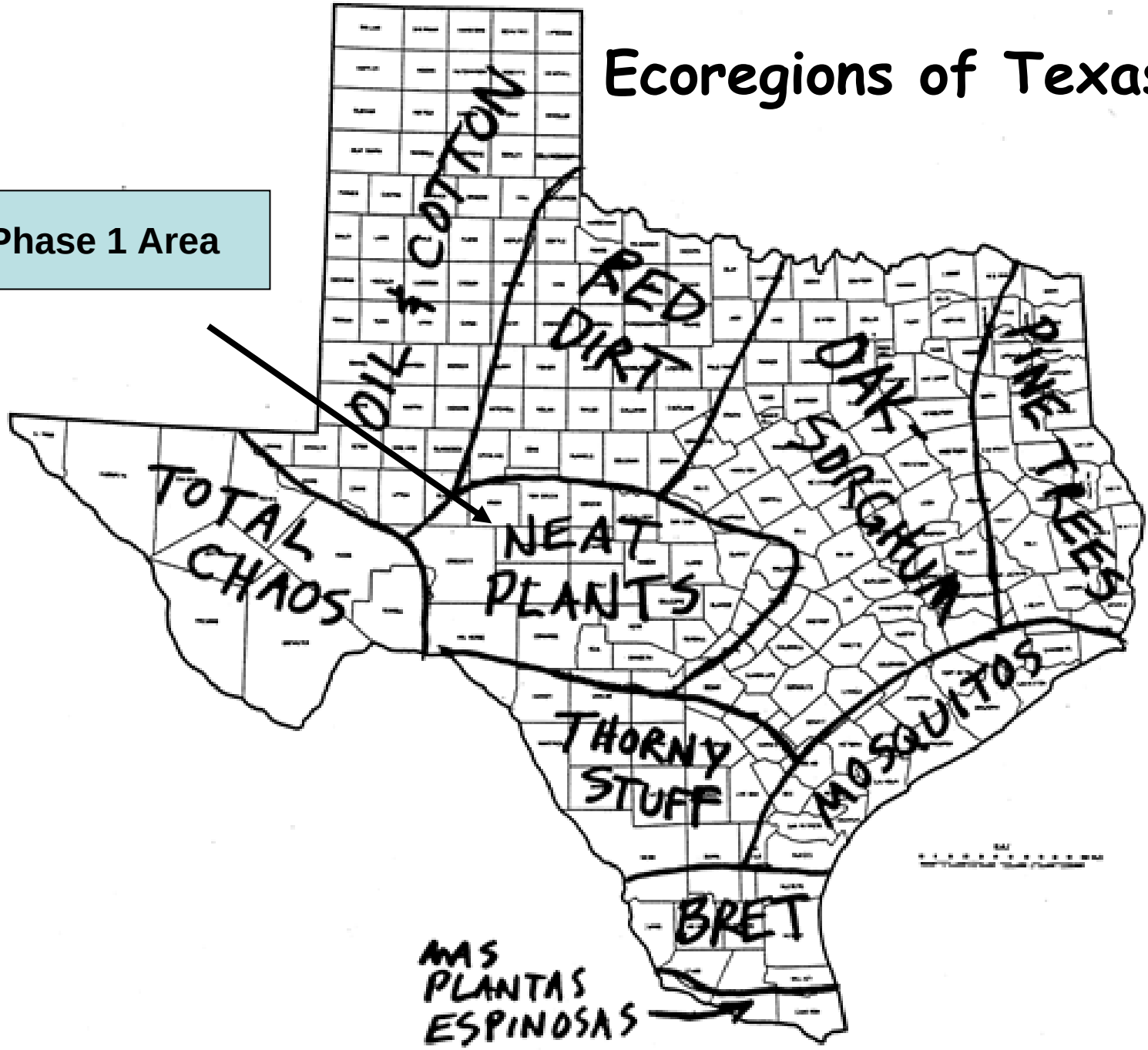


2005 MoRAP LULC

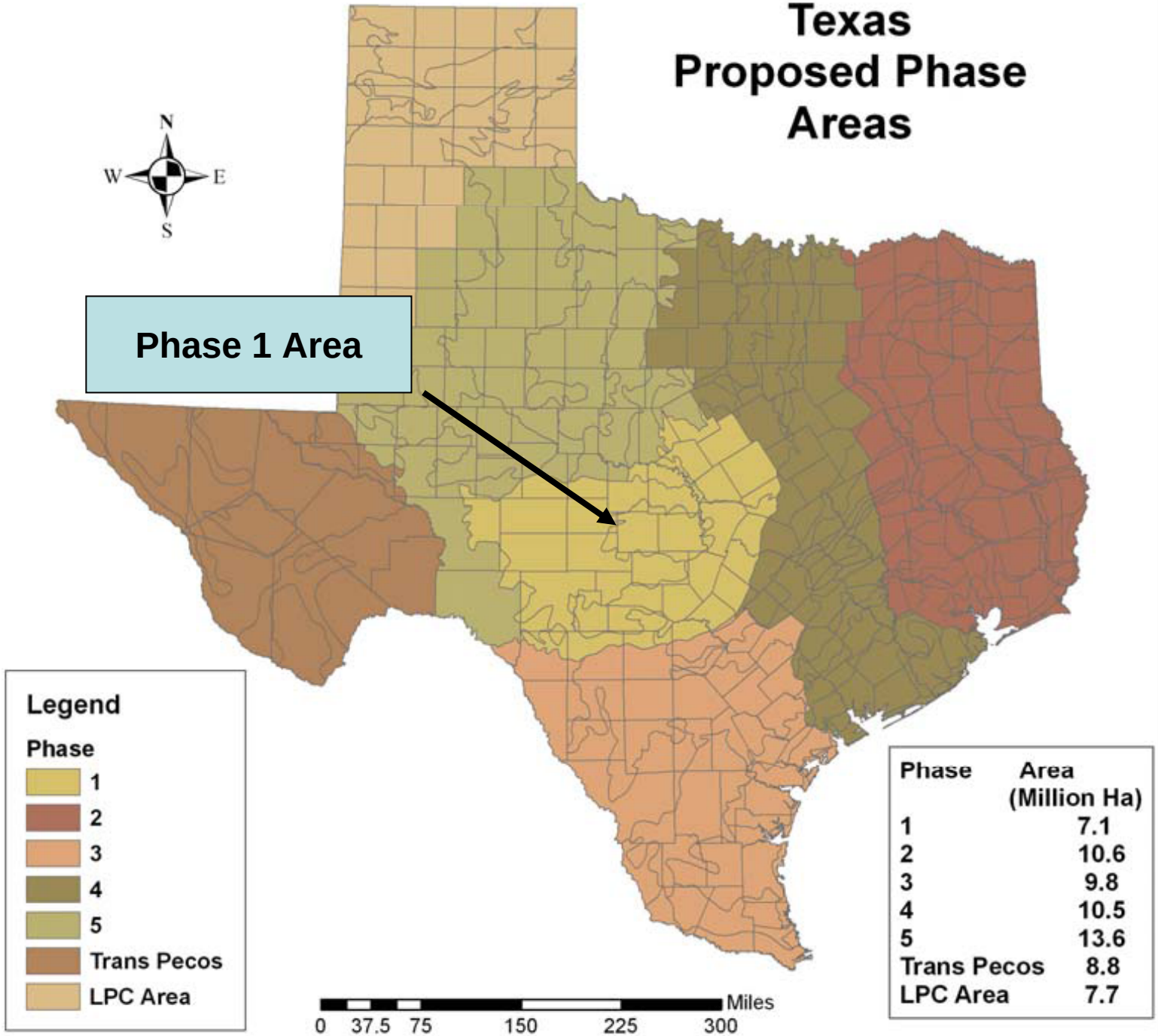
Shelby Metcalf, former basketball coach at Texas A&M, recounting what he told a player who received four F's and one D: "Son, looks to me like you're spending too much time on one subject."

Ecoregions of Texas

Phase 1 Area



Texas Proposed Phase Areas



Phase	Area (Million Ha)
1	7.1
2	10.6
3	9.8
4	10.5
5	13.6
Trans Pecos	8.8
LPC Area	7.7

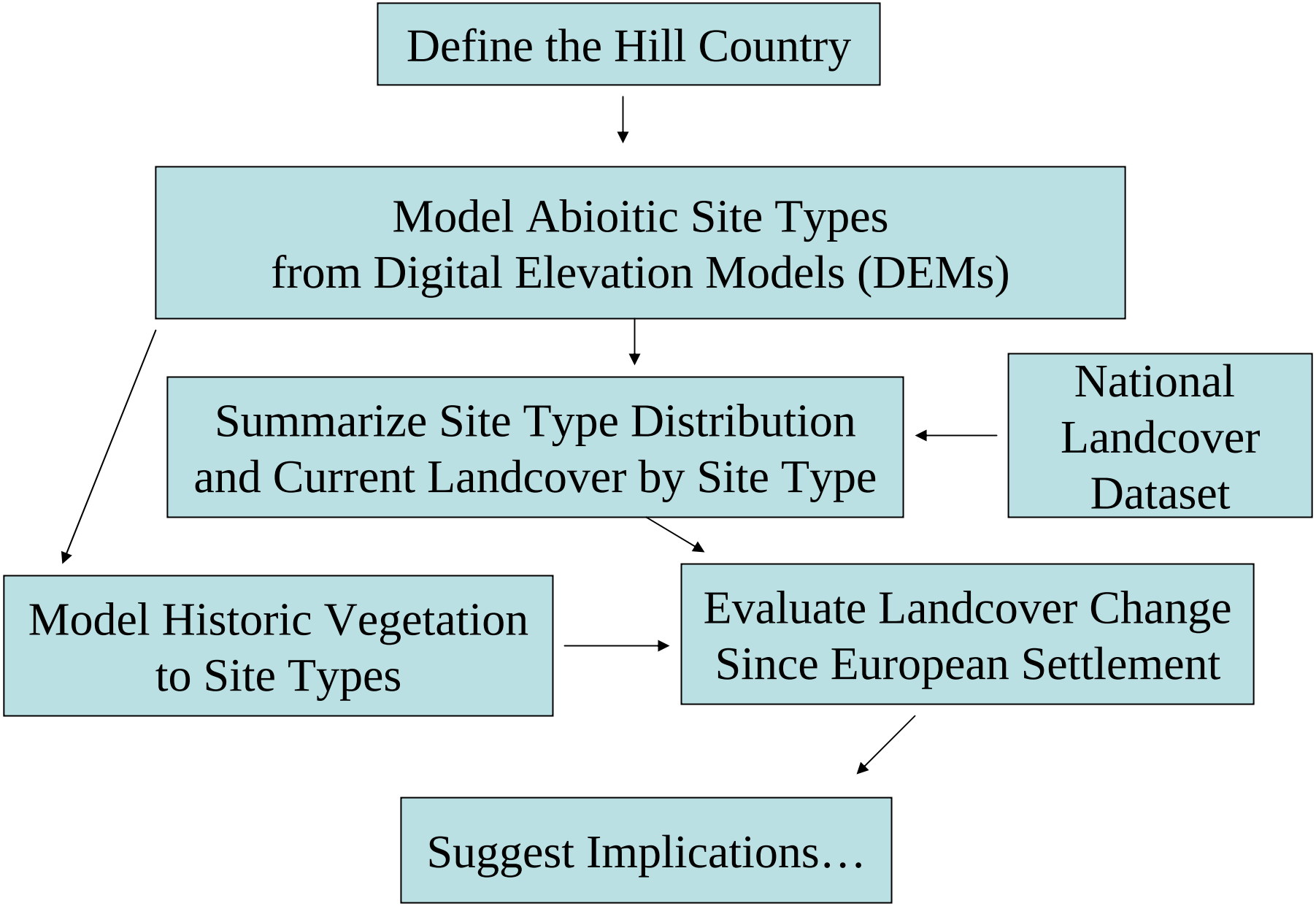
The Distribution of Ashe Juniper Forests in the Hill Country in Relation to Abiotic Site Type

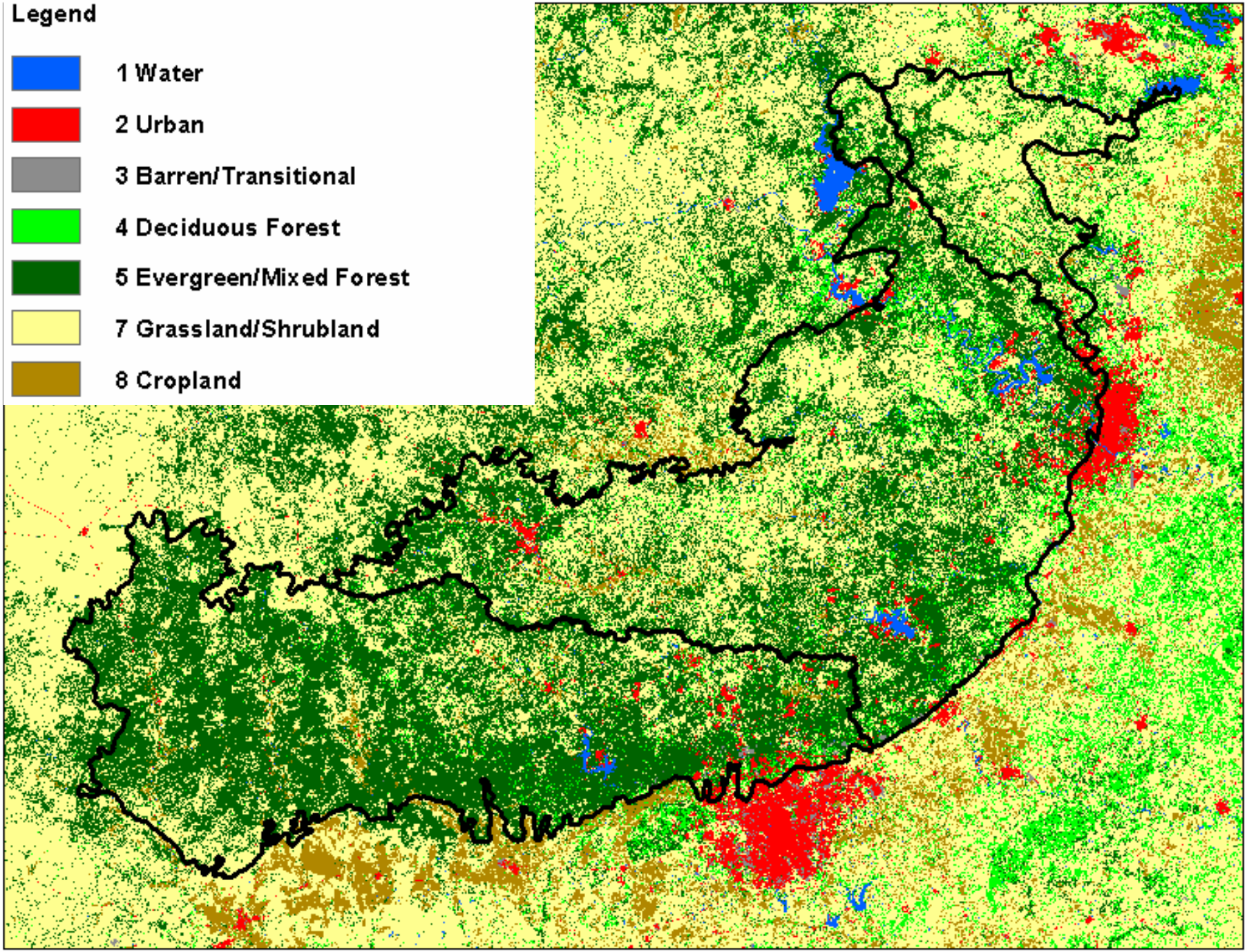
David D. Diamond and C. Diane True

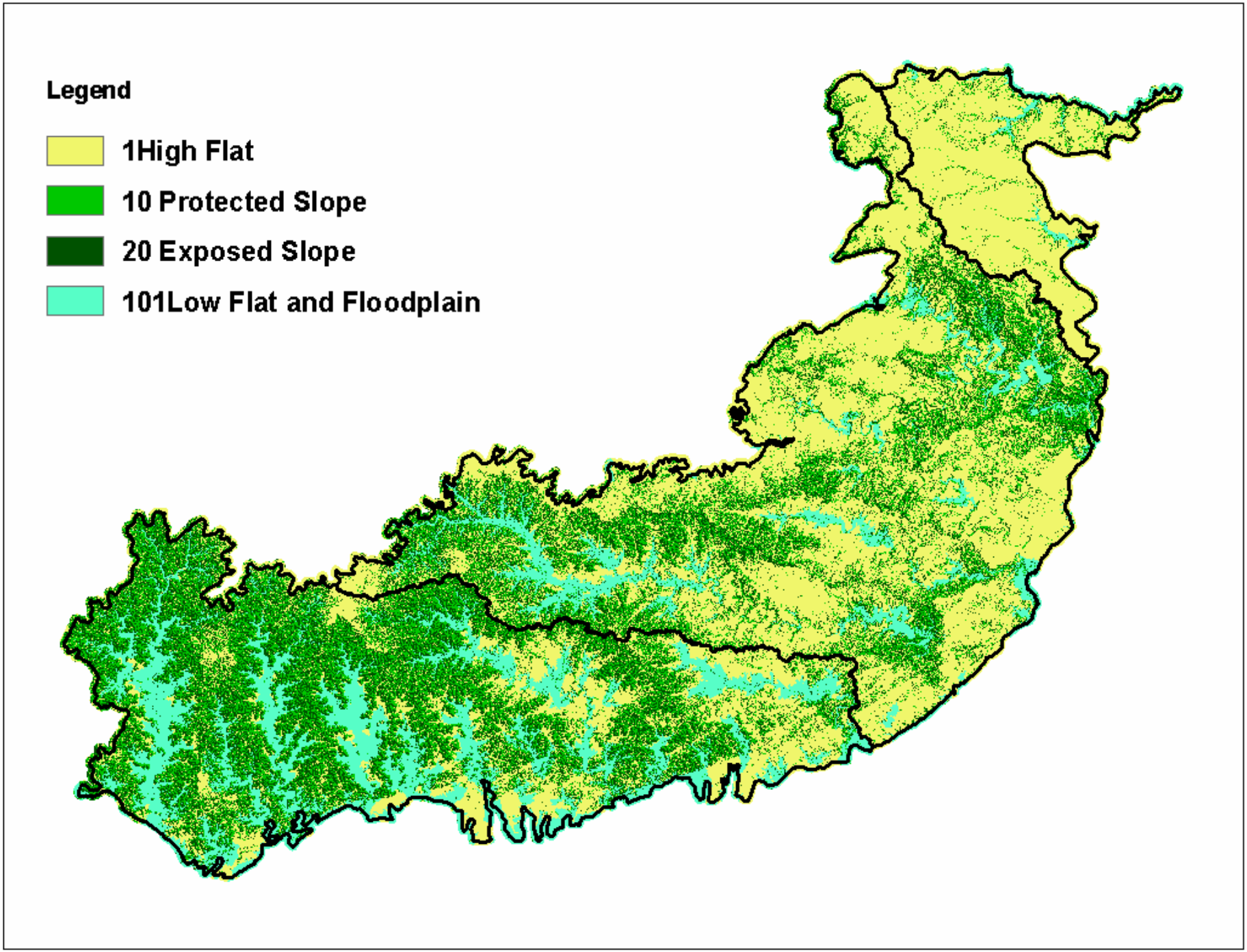
Missouri Resource Assessment Partnership

http://www.cerc.usgs.gov/morap

SWAN, April 2004


Define the Hill Country
Model Abioitic Site Types
from Digital Elevation Models (DEMs)
Summarize Site Type Distribution
and Current Landcover by Site Type
National
Landcover
Dataset
Model Historic Vegetation
to Site Types
Evaluate Landcover Change
Since European Settlement
Suggest Implications…


Legend
1 Water
2 Urban
3 Barren/Transitional
4 Deciduous Forest
5 Evergreen/Mixed Forest
7 Grassland/Shrubland
8 Cropland

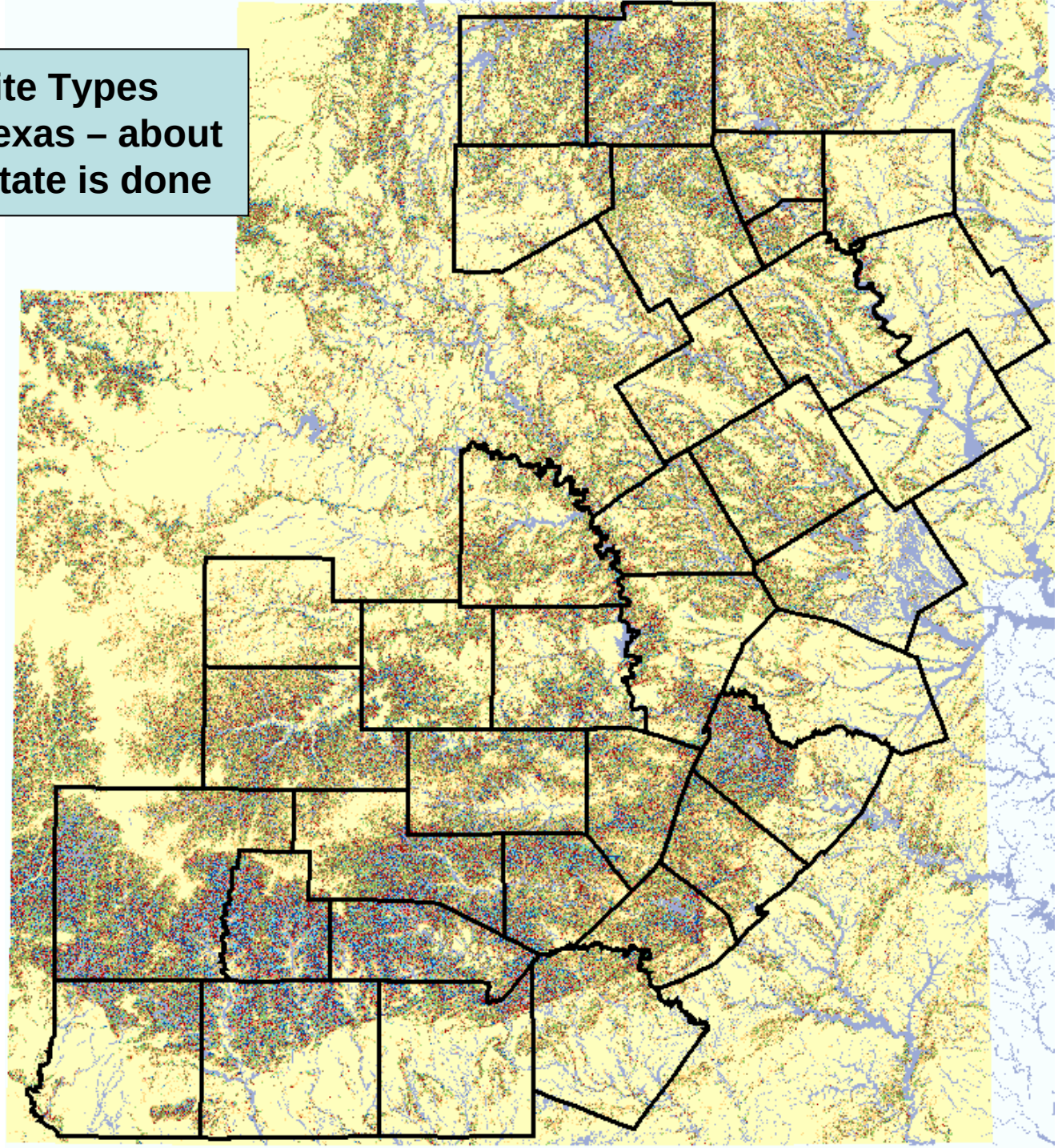

Legend
1High Flat
10 Protected Slope
20 Exposed Slope
101Low Flat and Floodplain

Golden-cheeked Warbler Habitat Quality Modeling

October 13, 2006

Hosted by: Texas Parks & Wildlife Department,
Craig Farquhar
Meeting Facilitator: David D. Diamond,
Missouri Resource Assessment Partnership
University of Missouri
ddiamond@missouri.edu

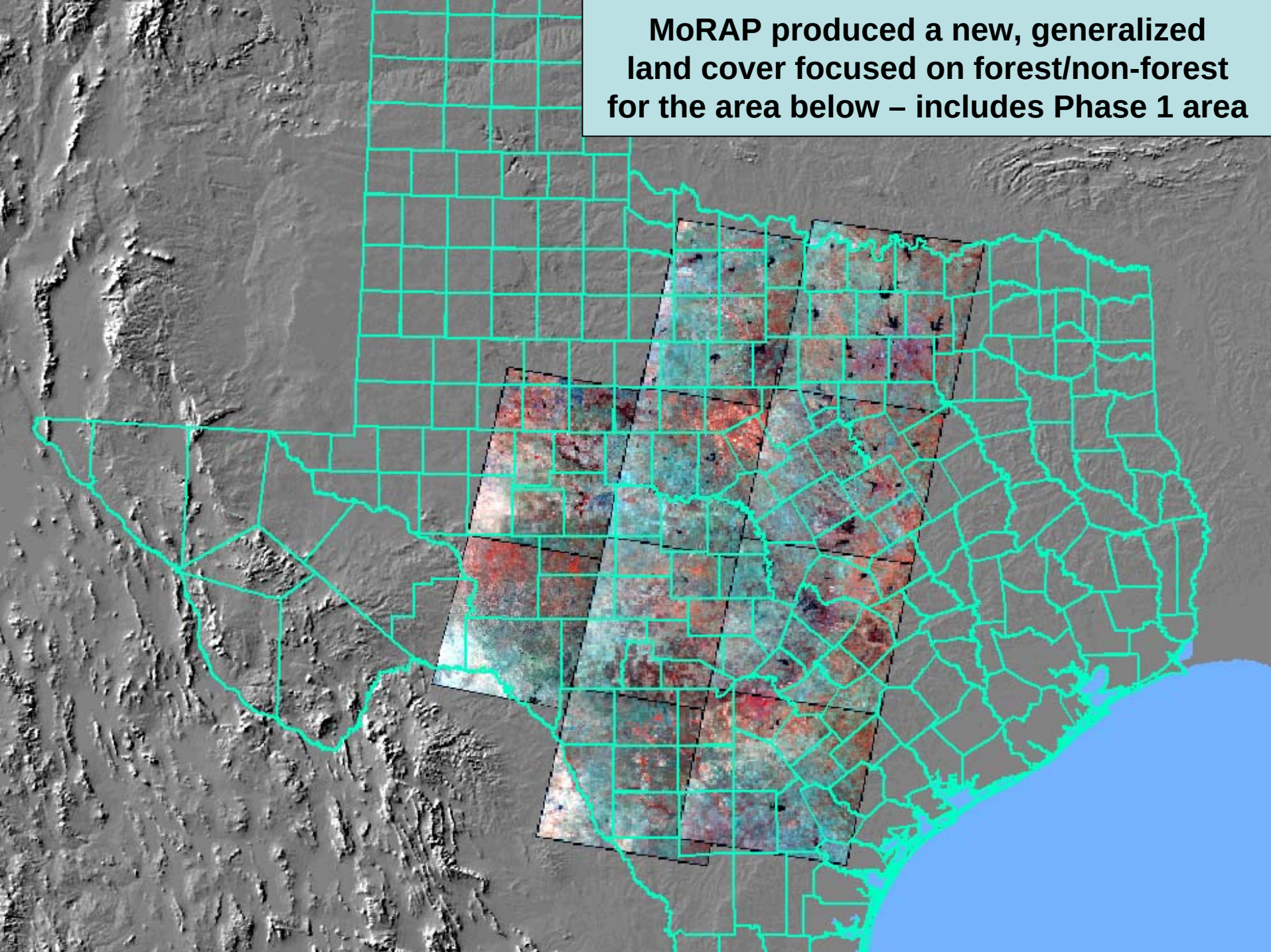
Abiotic Site Types for Central Texas – about 1/3rd of the state is done



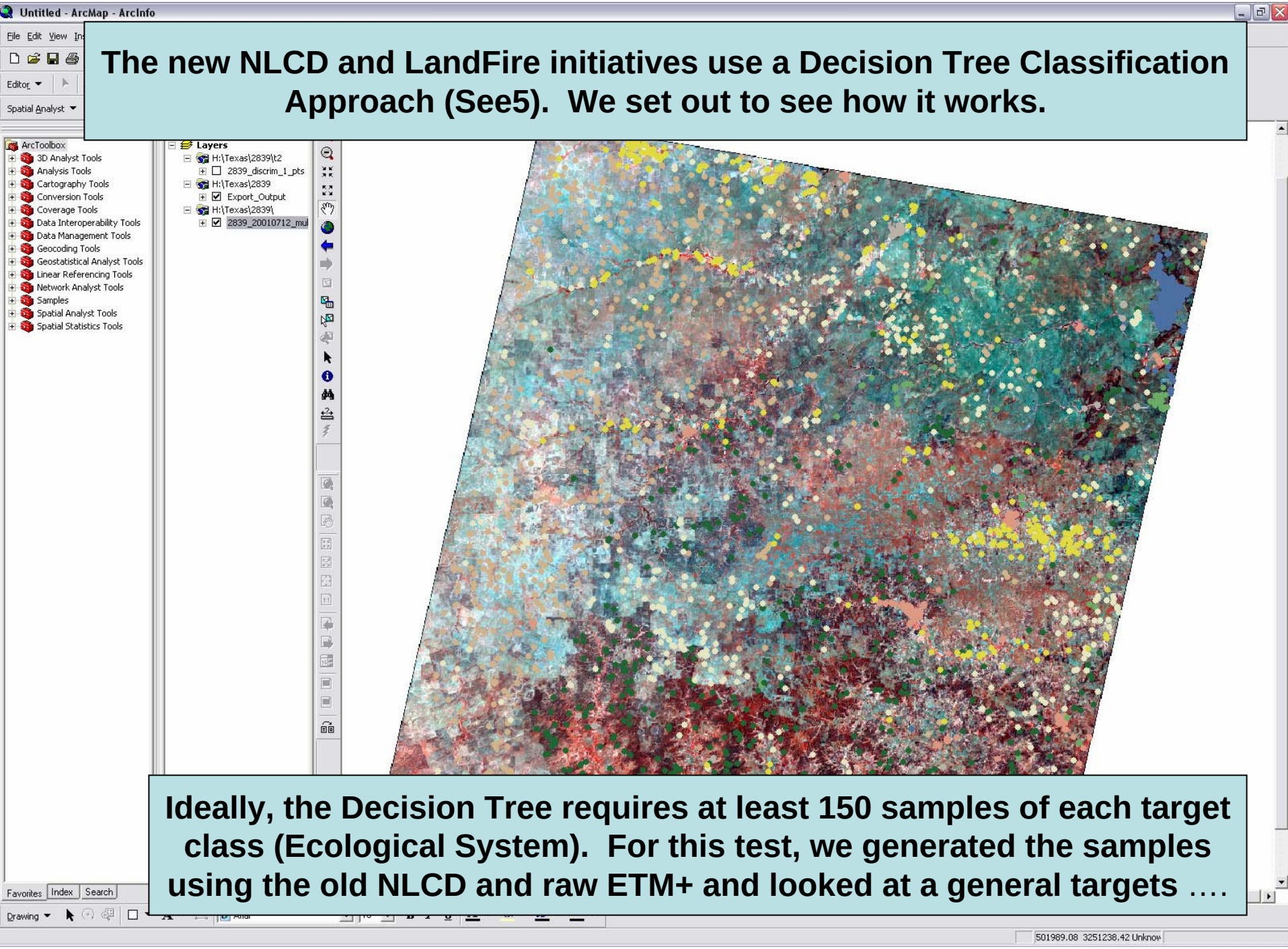
I have assigned generalized, uniform names to most SSURGO polygons by interpreting the eFOTG

R081CY574TX	Shallow PE 44+	Edwards Plateau Shallow Live Oak Savanna	mid and tall grasses with oak mottes; goes to juniper shrubland type might be too shallow to develop much of a taller woodland	says this one is mainly on slopes of stair step topography interspersed with very shallow or other types	
R081XY340TX	STEEP REDLAND PE 31-44	Edwards Plateau Canyon Mixed Woodland			not in the database
R082AY374TX	Schist 31-44	Llano Uplift Live Oak Savanna	midgrass live oak savanna; persimmon, whitebrush, catclaw listed as invaders	gentle uplands	
R082XY364TX	DEEP SAND PE 31-44	Llano Uplift Sandy Oak Savanna	post oak/blackjack with tall grasses; does not say what it goes to maybe white brush/oak?	rolling uplands 1-5%	
R082XY365TX	GRANITE GRAVEL PE 31-44	Llano Uplift Post Oak Savanna	open tallgrass post oak blackjack savanna; mesquite and whitebrush invade and ash juniper is listed too, which is a little odd but..	undulating uplands	

MoRAP produced a new, generalized land cover focused on forest/non-forest for the area below – includes Phase 1 area



The new NLCD and LandFire initiatives use a Decision Tree Classification Approach (See5). We set out to see how it works.



Ideally, the Decision Tree requires at least 150 samples of each target class (Ecological System). For this test, we generated the samples using the old NLCD and raw ETM+ and looked at a general targets ….

2839_discrim_1_pd.data - WordPad

File Edit View Insert Format Help

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```

30 ‘bands’ were used: three dates X (6 Original ETM+ bands + 3 Tasseled-Cap bands + NDVI)

```
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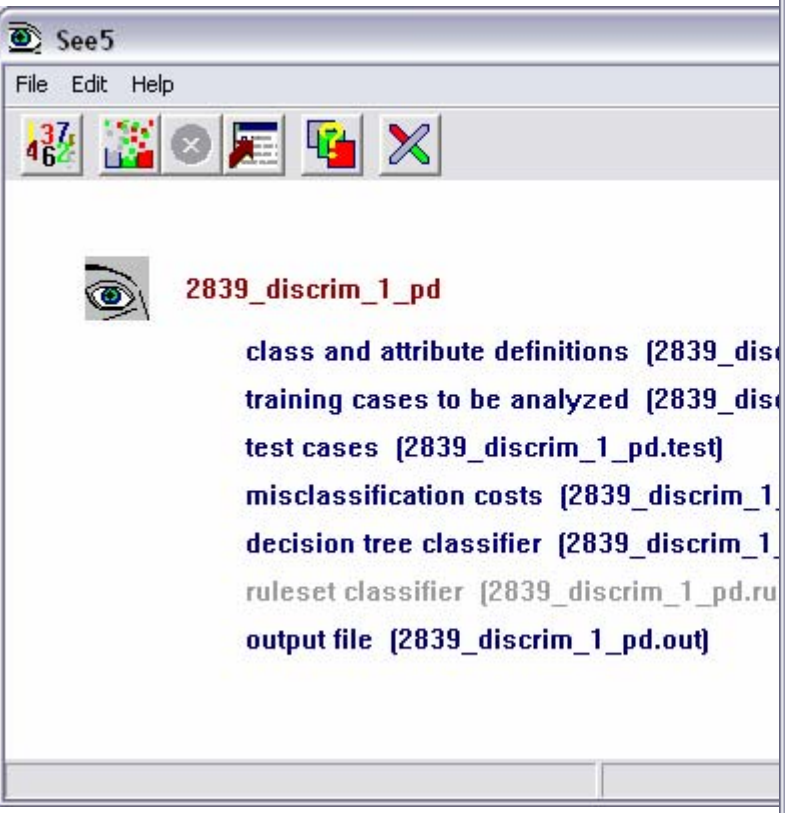
```

For Help, press F1 NUM

The Decision Tree must be developed for each scene



Results for 2839_discrim_1_pd

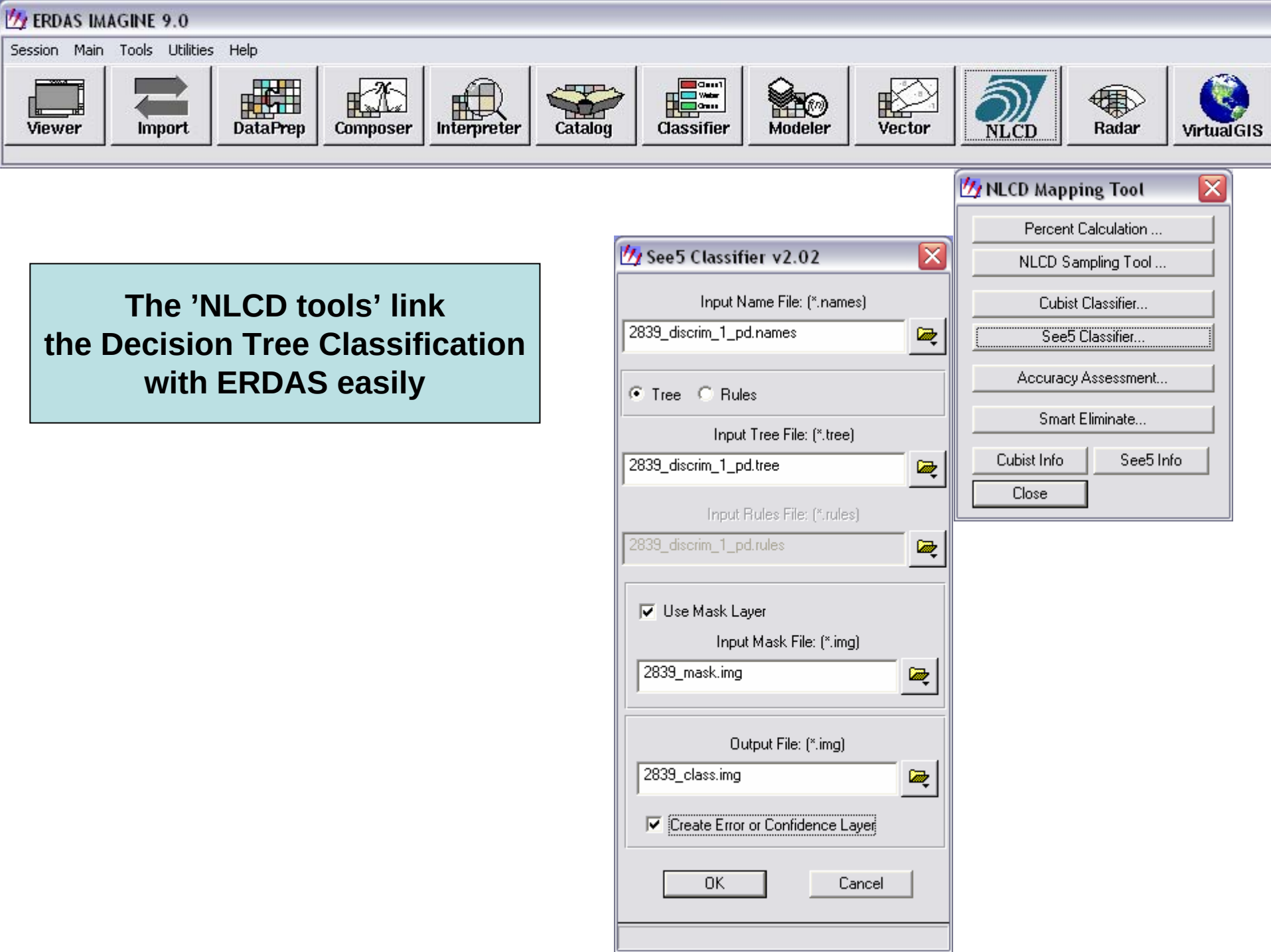
File Edit

```
Decision tree:

band14 <= 42 (45.5):
:...band02 <= 58 (65): 11 (448)
:   band02 >= 72 (65): 31 (11)
band14 >= 50 (45.5):
:...band03 <= 39 (39.5):
    :...band28 <= 170 (170.5):
    :   :...band15 >= 139 (138.5):
    :   :   :...band05 <= 51 (54): 42 (3)
    :   :   :   band05 >= 57 (54):
    :   :   :   :...band10 >= 176 (170): 82 (21/1)
    :   :   :       band10 <= 164 (170):
    :   :   :       :...band02 <= 38 (39.5): 82 (4)
    :   :   :           band02 >= 41 (39.5): 51 (8)
    :   :   band15 <= 135 (138.5):
    :   :   :...band31 >= 1 (0.5): 22 (8/1)
    :   :       band31 <= 0 (0.5):
    :   :       :...band09 >= 122 (121.5): 42 (214)
    :   :           band09 <= 121 (121.5):
    :   :           :...band17 <= 72 (74): 41 (7)
    :   :               band17 >= 76 (74):
    :   :               :...band03 <= 38 (38.5): 42 (17)
    :   :                   band03 >= 39 (38.5):
    :   :                   :...band01 <= 53 (53.5): 42 (2)
    :   :                       band01 >= 54 (53.5): 51 (3)
    :   band28 >= 171 (170.5):
    :   :...band05 <= 43 (44.5):
    :       :...band31 <= 0 (0.5): 42 (57/2)
    :       :   band31 >= 1 (0.5):
    :       :   :...band31 <= 1 (2.5): 41 (8)
    :       :       band31 >= 6 (2.5): 22 (3/1)
    :       band05 >= 46 (44.5):
    :       :...band12 >= 69 (68.5):
    :           :...band31 >= 3 (1.5): 22 (2)
    :           :   band31 <= 0 (1.5):
    :           :   :...band24 <= 83 (90): 42 (10/2)
    :           :       band24 >= 95 (90): 82 (5)
    :           band12 <= 68 (68.5):
    :           :...band15 <= 98 (102.5):
    :               :...band01 >= 50 (49.5): 41 (306/1)
    :               :   band01 <= 49 (49.5):
    :               :   :...band24 <= 68 (70.5): 42 (3)
    :               :       band24 >= 73 (70.5): 41 (15)
    :               band15 >= 103 (102.5):
    :               :...band31 >= 1 (0.5): 41 (13)
    :                   band31 <= 0 (0.5):
    :                   :...band03 <= 32 (32.5): 42 (5)
    :                       band03 >= 34 (32.5):
    :                       :...band14 <= 77 (78.5): 41 (9/1)
```

Pixel by pixel ‘confidence’ is also provided

The 'NLCD tools' link the Decision Tree Classification with ERDAS easily



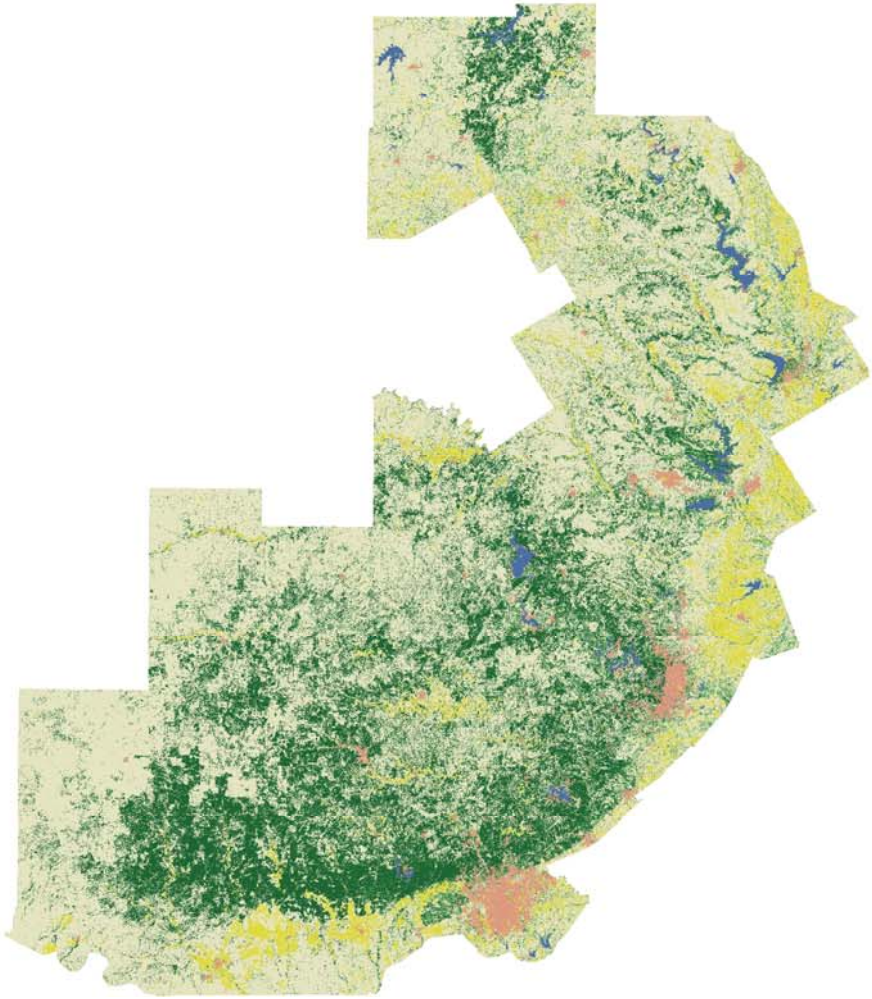
Field Trip: October 9 - 15

Impressions from October Field Trip

- Decision Tree approach works if driven by appropriate ground data
- Cropland and Urban Land were over-classified, possibly because of poor sampling from the original NLCD
- Forest types are not well separated by the NLCD or, therefore, by the current effort
- Mesquite-dominated communities do not show up well

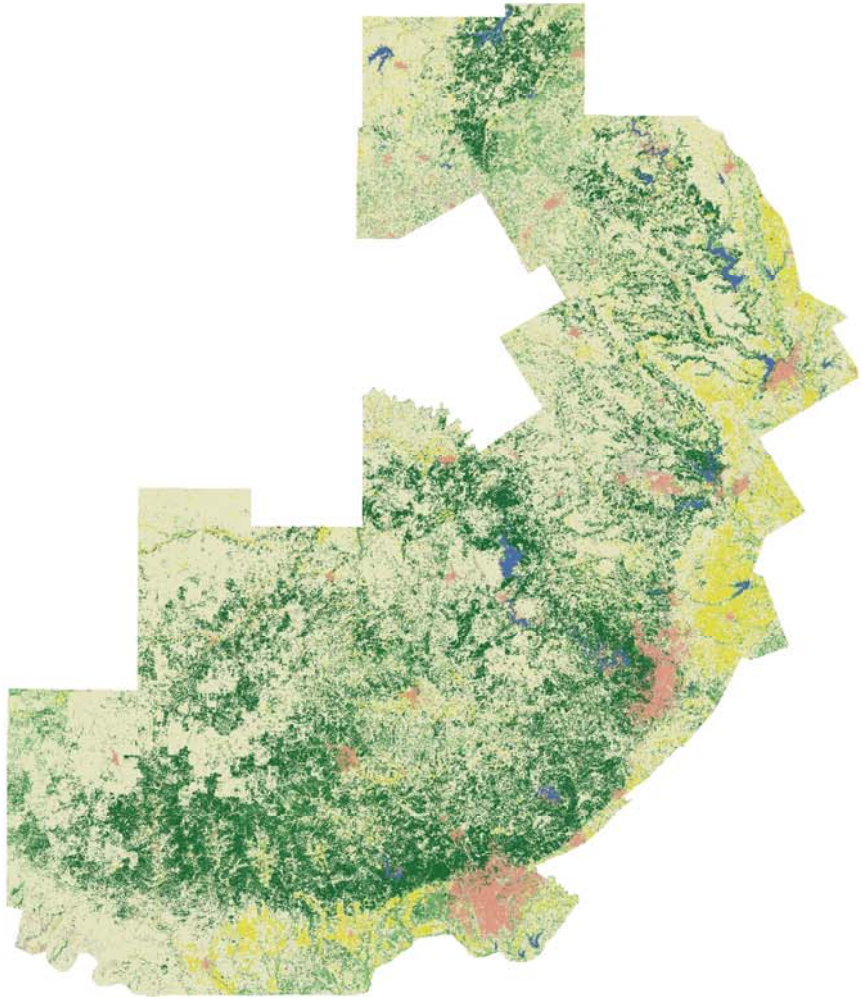
Key Point: the Decision Tree approach will work IF the sample data are correct

National Landcover Dataset



2,504,482 ha total forest area

MoRAP Landcover Dataset



2,556,805 ha total forest area

Mapping Ecological Systems: Selection of a Method

- Direct classification by including reflectance data from imagery together with environmental variables
- Indirect modeling by overlaying land cover results from classification of reflectance data with environmental data (soils and abiotic site types)

Likely Methodology & Reasoning

- Use satellite imagery for initial classification of land cover, and model/map target ecological systems using abiotic data ‘after classification’
  - Collection of appropriate ground data for direct classification would mean targeting at least 150 samples of each land cover type on each soil type or abiotic site type – a difficult logistical problem
- We may be able to develop a ‘mask’ for major land cover types and then classify directly using reflectance & abiotic data in Decision Trees
- A combination of methods may be needed to map target ecological systems

Ecological Systems Modeling Decision Rule Key

Ecological System	Land Cover	Within Floodplain	Solar Insolation	Landscape Position
Eastern Great Plains Wet Meadow, Prairie, and Marsh	Herbaceous Dominated Wetland	any	any	any
North-Central Interior Floodplain	Deciduous Forest	Y	any	any
North-Central Interior Maple-Basswood Forest	Deciduous Forest or Deciduous Woody-Herbaceous	any	lowest 2½%	lowest 2½%
North-Central Interior Oak Savanna	Deciduous Forest or Deciduous Woody-Herbaceous	N	highest 2½%	highest 2½%
North-Central Interior Shrub Swamp-Wet Meadow and Marsh	Deciduous Woody-Herbaceous	Y	any	any

Familiarity NatureServe's Ecological Systems Classification and with Texas Vegetation

Diamond et al. wrote the first TNC classification for TX and participated in the latest revisions for the Edwards Plateau (2006)

Edwards Plateau and Lampasas Cut-Plain Worksheet

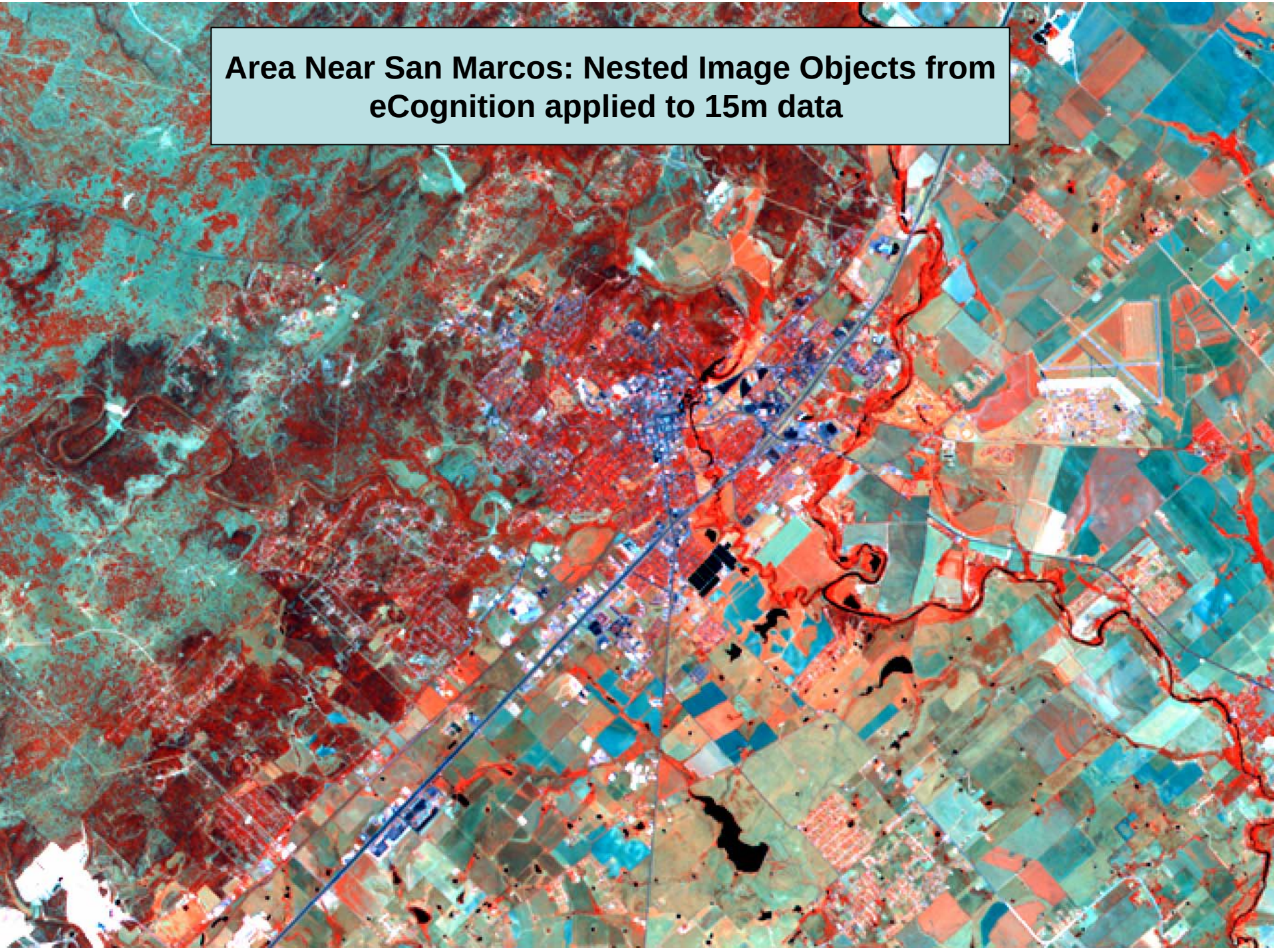
	West Plateau (Dry) (generally Ecoregion 30d, Griffith et al.. 2005)	Llano Uplift	East & South Plateau (Wet)	Lampasas Cut-Plain	
Abiotic Habitat Types	**list systems**	**list systems**	**list systems**	**list systems**	**Diamond Comments**
Typical Soft-bedded Limestone Uplands, including gentle slopes	CES303.660 Edwards Plateau Limestone Savanna and Woodland; CES303.041 Edwards Plateau Limestone Shrubland	na	CES303.660 Edwards Plateau Limestone Savanna and Woodland	CES303.660 Edwards Plateau Limestone Savanna and Woodland	diff in veg in west plateau due to mgmt or 'succession' - do successional communities get to be 'systems' all over the USA?

Note: This document is a good start on identifying what to model/map for the Edwards Plateau & how to go about it

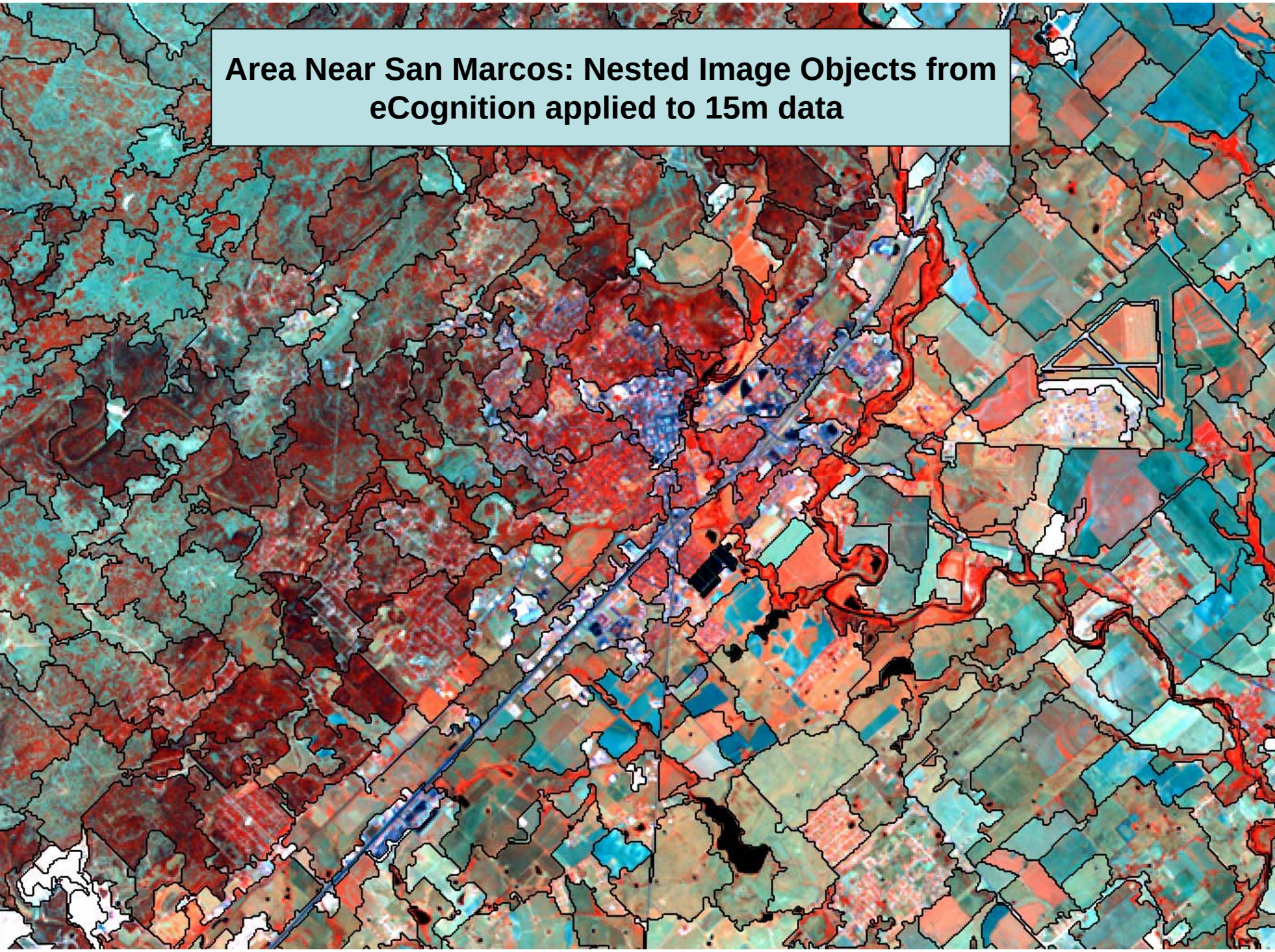
Dealing with Large File Size: A Possible Solution

- As the pixel size of the imagery decreases, the file size increases
  - Going from 30m to 15m (TM-Pan merge) increases file size by a factor of four
  - Going from 30m to 10m (TM-SPOT merge) increases file size by a factor of nine
- Processing time increases as the size of the input file increases (30 bands for one scene occupies about 30 gigabytes)
- Software limitations may also be an issue
- File sizes should be kept as small as possible and still achieve desired results
- Possible solution: process 30m resolution data, and achieve mmu requirements from eCognition applied to 15m data

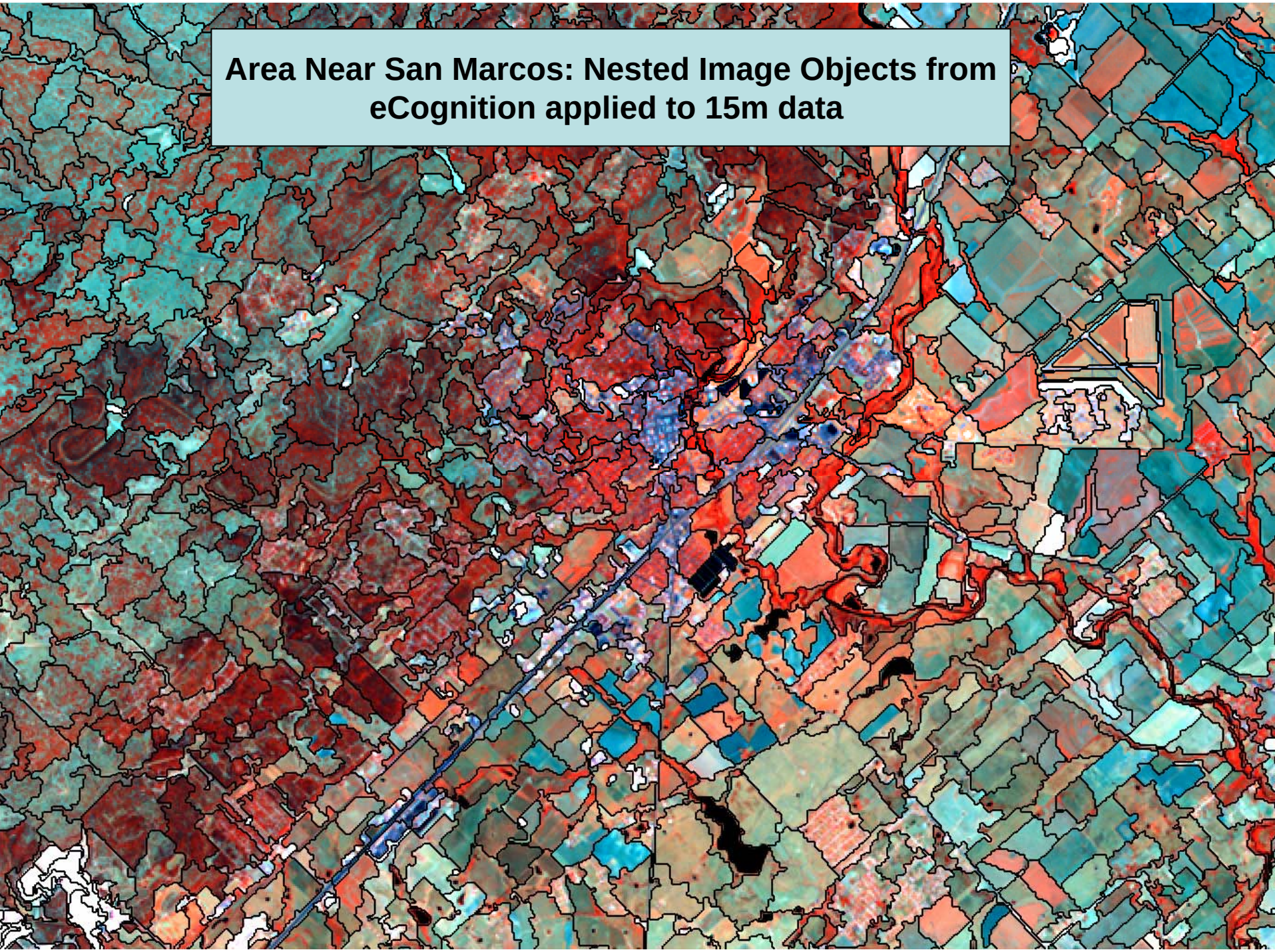
Area Near San Marcos: Nested Image Objects from eCognition applied to 15m data



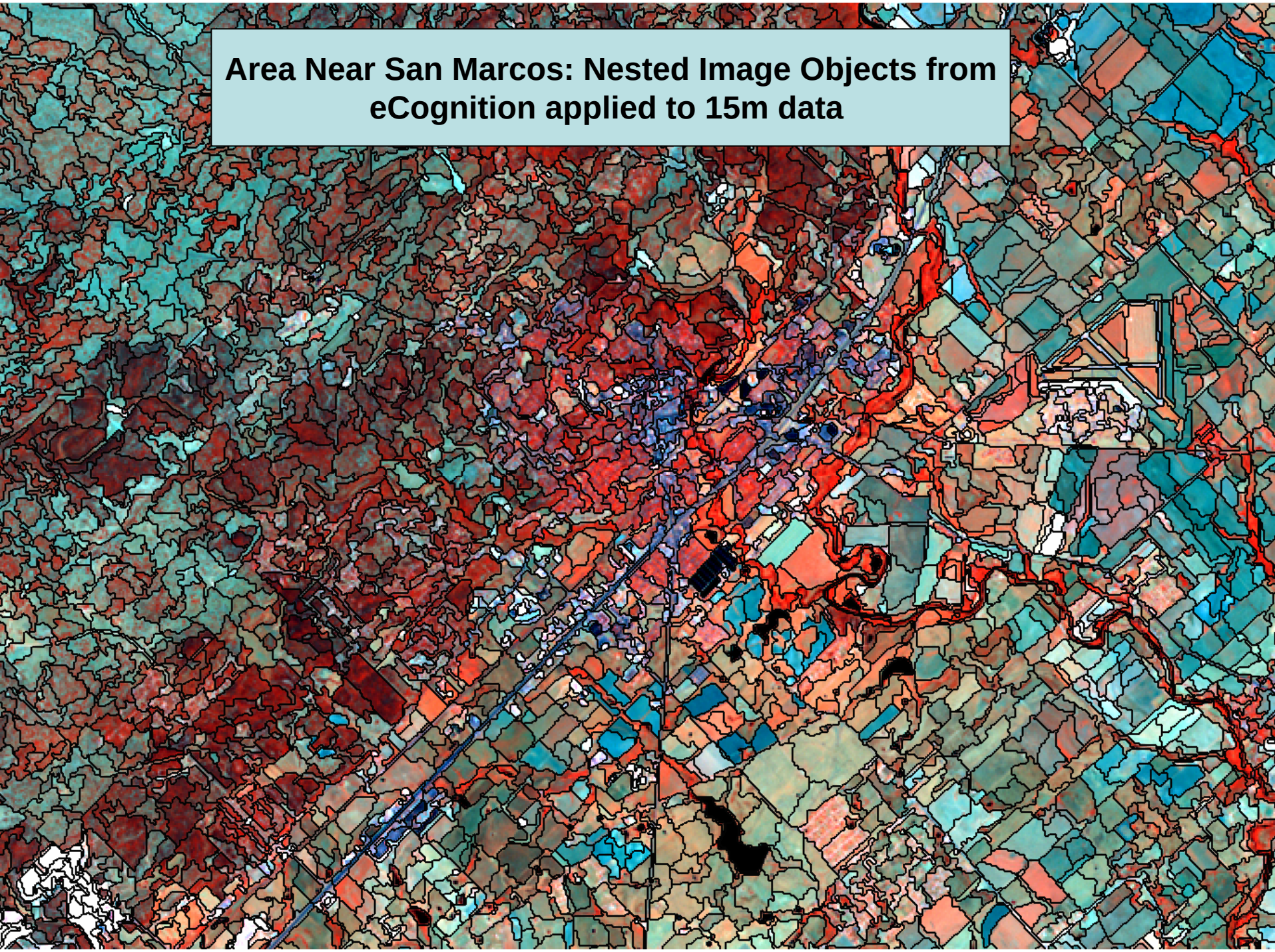
Area Near San Marcos: Nested Image Objects from eCognition applied to 15m data



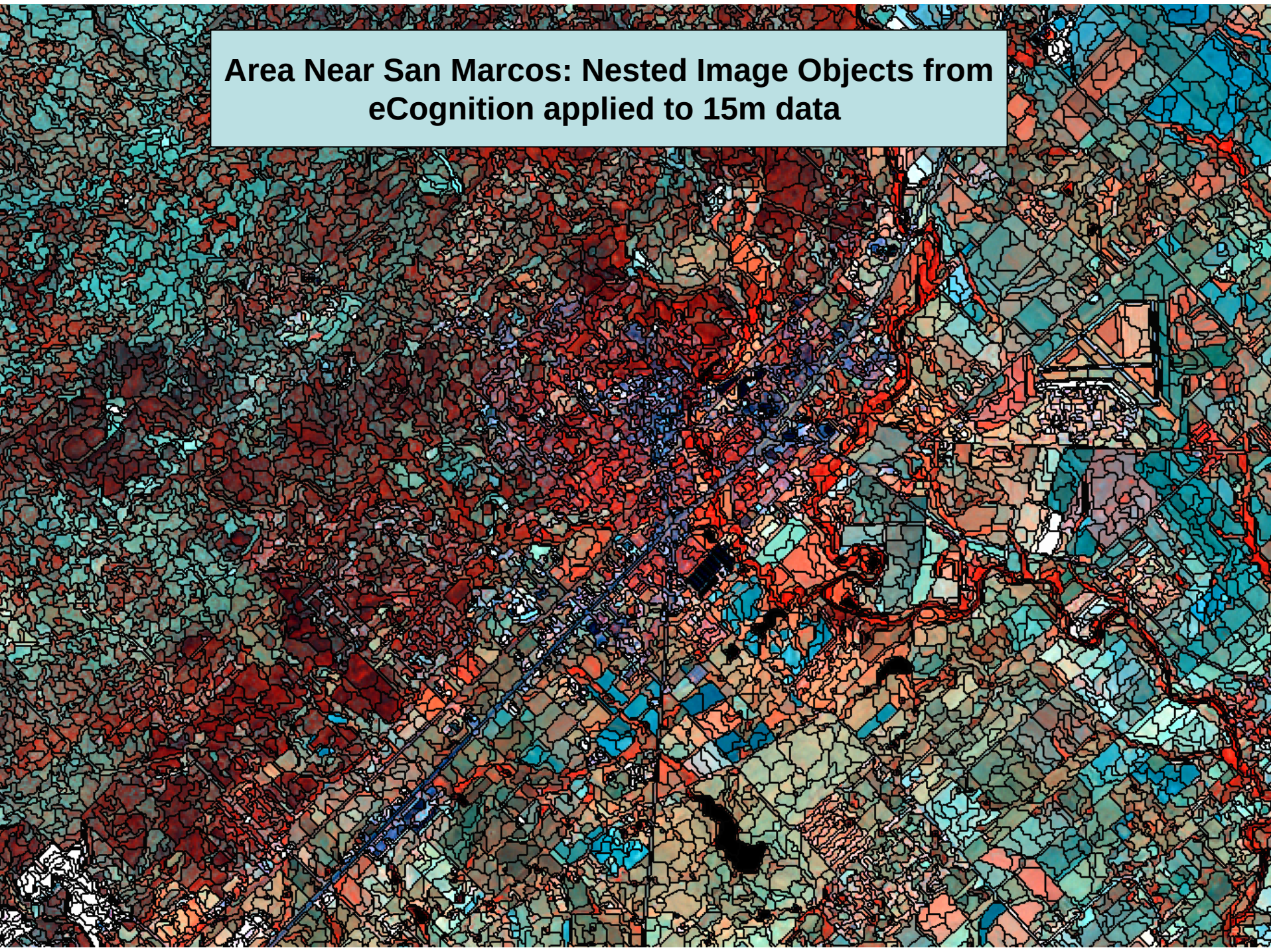
Area Near San Marcos: Nested Image Objects from eCognition applied to 15m data



Area Near San Marcos: Nested Image Objects from eCognition applied to 15m data



Area Near San Marcos: Nested Image Objects from eCognition applied to 15m data



MoRAP Operations

- Within the University of Missouri
- Ten FT staff plus student workers
  - Terrestrial ecologist/director (11 years with MoRAP; Ph.D.)
  - Aquatic ecologist/assistant director (10 years with MoRAP; Ph.D.)
  - GIS: 4 staff
  - Remote Sensing: 2 staff (one Ph.D.)
  - Database Manager (8 years with MoRAP)
  - Administrative Assistant
  - Student workers start on “simple” tasks
- Weekly staff meetings; annual staff and program reviews
- QC procedures are project-specific; we have met EPA & other standards
- Team approach with clear delegation of responsibilities
- 100% soft funded – must do good work and serve the needs of funding partners

PARTNERS

Mark Twain National Forest

Environmental Protection Agency

Missouri Department Of Conservation

University of Missouri and Missouri Cooperative Fish and Wildlife Research Unit

Missouri Department Of Transportation

Missouri National Guard

James River Basin Partnership

National Park Service and Ozark National Scenic Riverways

Natural Resources Conservation Service

US Army Corps of Engineers

United States Fish and Wildlife Service

Missouri Department of Natural Resources

American Bird Conservancy

Columbia Environmental Research Center

Staff Qualifications

- Diamond: >30 publications on Texas vegetation and ecology; >15 additional publications on use of RS/GIS for ecological planning & management; management of many large projects; 11 years at MoRAP
- Blodgett: 6 years at MoRAP; project leader for landcover of Missouri, landcover of Kansas; many other RS projects; Ph.D.
- True: 10 years at MoRAP, project leader on abiotic site type modeling and many other projects; direct experience in TX with remote sensing and GIS
- Bottom line: MoRAP has a qualified, established staff with experience relevant to this project; this project will use expertise but will not pay 100% for the time of the most highly qualified staff

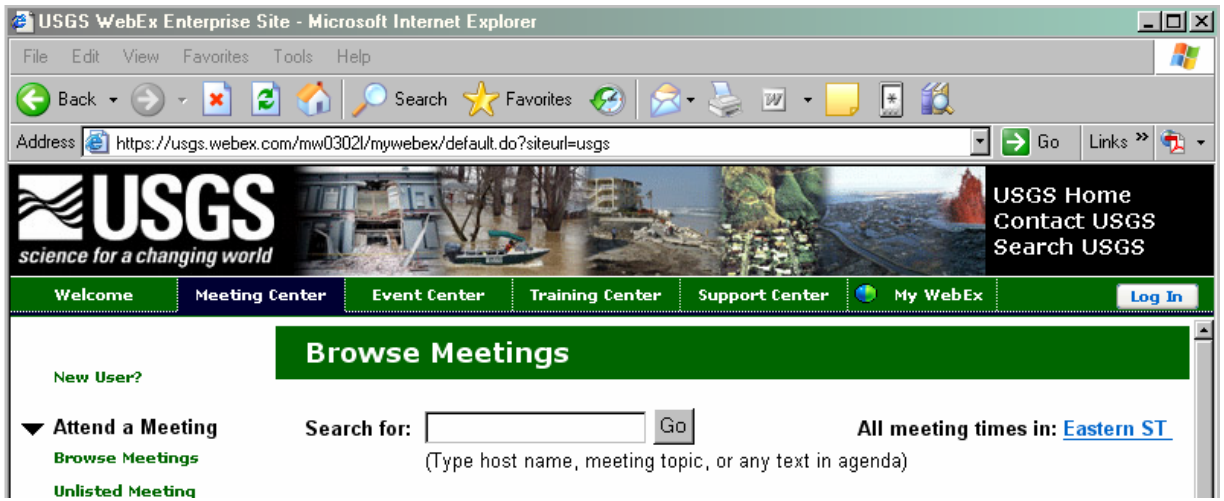
Infrastructure

- Hardware:
  - Minimum three high-end PC workstations (min. dual 3 GHz processors; min 4 MB RAM) available to be dedicated 100% to the project; minimum 10 additional workstations shared
  - at least four high-end laptops available
  - Minimum 15 terabytes available for this project; any amount needed
- Software
  - At least five floating seats of ERDAS Imagine
  - 10 floating ArcGIS 9.2 seats; 4 single-use on the laptops
  - SDE and SQL networked
  - See5, NLCD Tools
  - Two seats of eCognition Software
- Plotters, printers, office space, etc. are available
- Bottom line: infrastructure is no problem and expenses are shared among projects; we'll buy whatever we need without going over the budget

Existing Data

- All SSURGO soils for TX, including new coding for most polygons by general ecological system
- All 30m DEMs & most available 10m DEMs
- BEG surface geology (15’ quads; Geologic Atlas of Texas)
- All roads, political boundaries, etc
- Older land cover (including TPWD, NLCD, and coverages we’ve done using new data)
- Abiotic Site Types modeled for a large area of Texas (about a third)
- SSURGO soils interpreted and in place for more than half of TX
- 2004, 2005 NAIP photos for the state, some of the 2006 with more on the way
- Three-date coverage for ETM+ or TM for about half of TX; many other images (about 100 total on hand)
- Bottom line: data are in place as ready to go – this is no problem

WebEx: Participants download free software to ‘attend’ the meeting



-All participants see host computer screen

-Verbal communication via conference call

-Response time is essentially instant

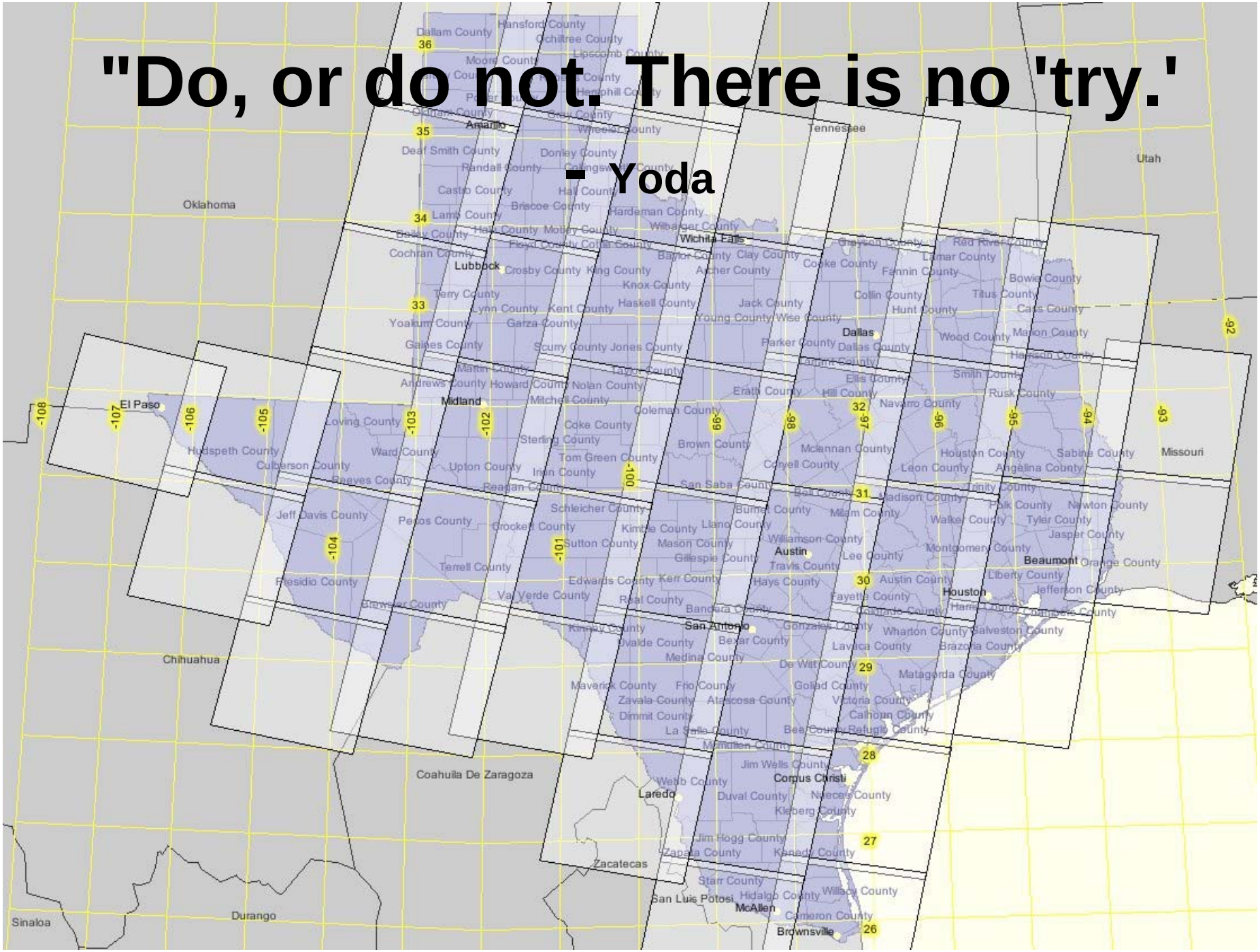
- We have used this many times, and tested it using RS classified data for TX (Lee Elliott and Bill Carr)

Why Select MoRAP?

- Infrastructure in place (hardware, software, staff)
- Significant work already done – ready to move forward
- Demonstrated Experience & Ability
  - Land cover mapping over large areas
  - Abiotic Site Type modeling over large areas
  - Ecological Systems classification for Texas
- Demonstrated links with Partners:
  - Pat Comer, Judy Teague, Milo Pyne, NatureServe
  - Lee Elliott, TNC
  - Karen Kilgore, Clay Bales, TFS
  - Dave Cleland, Dan Crittenden, Dr. Z, LandFire
  - Kevin Gergley, Gap Analysis, USGS
  - George Peacock, NRCS
- The desire and ability to do an excellent job: select MoRAP if we can provide the best quality product for the money

"Do, or do not. There is no 'try.'

- Yoda



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