Effect of Mapping Unit on Vertebrate Modeling Results within GAP Analysis

National GAP Analysis Program
U.S. Geological Survey
Biological Resources Division

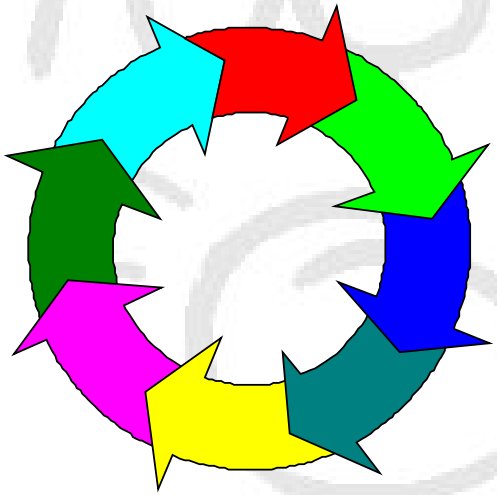
Tim Haithcoat
Department of Geography

Dr. Ron Drobney
School of Natural Resources
Missouri Co-Op Unit

http://biology.usgs.gov/state.partners/gap.html

Desirable database characteristics should be:

- Same vintage
- As detailed as necessary
- Positionally accurate
- Exactly compatible
- Internally accurate
- Readily updated
- Accessible

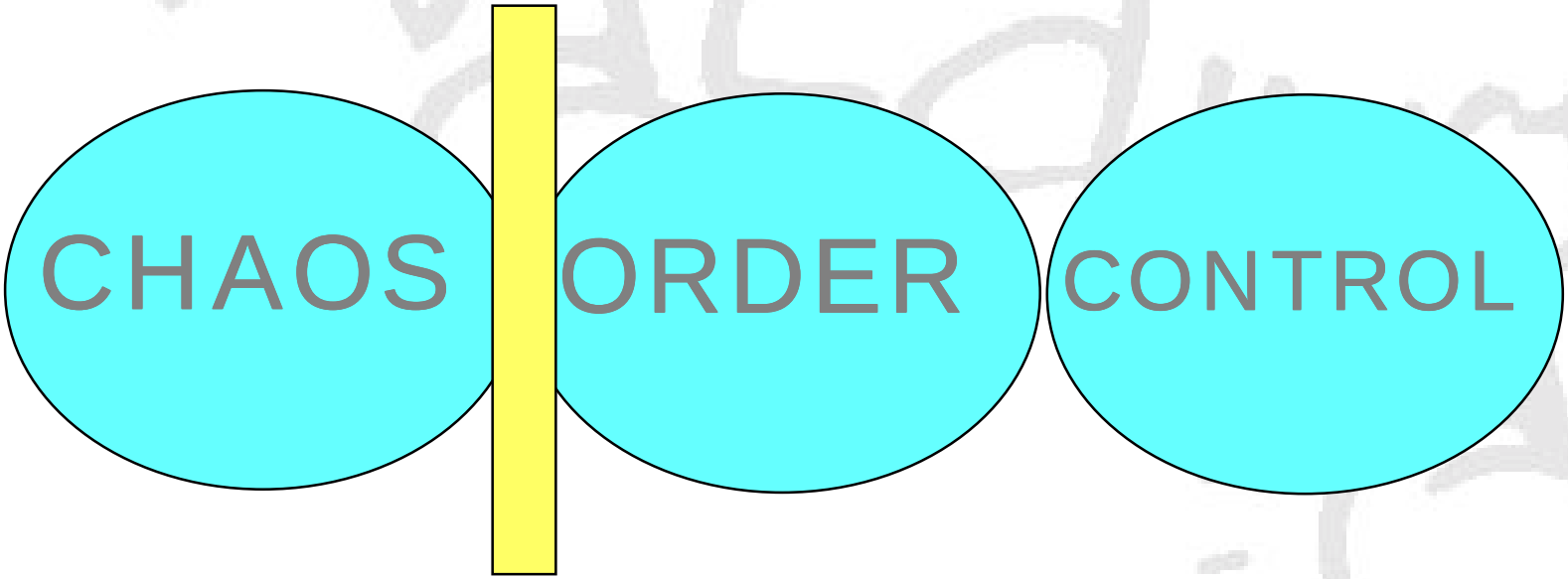


TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

- The interdependence between location and value in spatial databases gives rise to spatial dependence and heterogeneity.
- In GAP analysis, we combine data from different sources with different levels of accuracy.
- What impact does error in each data layer have on the final result?
- Reliability is a function of both cartographic & ecological factors.
- Inaccuracy is often inadvertent but may also be intentional since generalization methods are frequently applied.

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

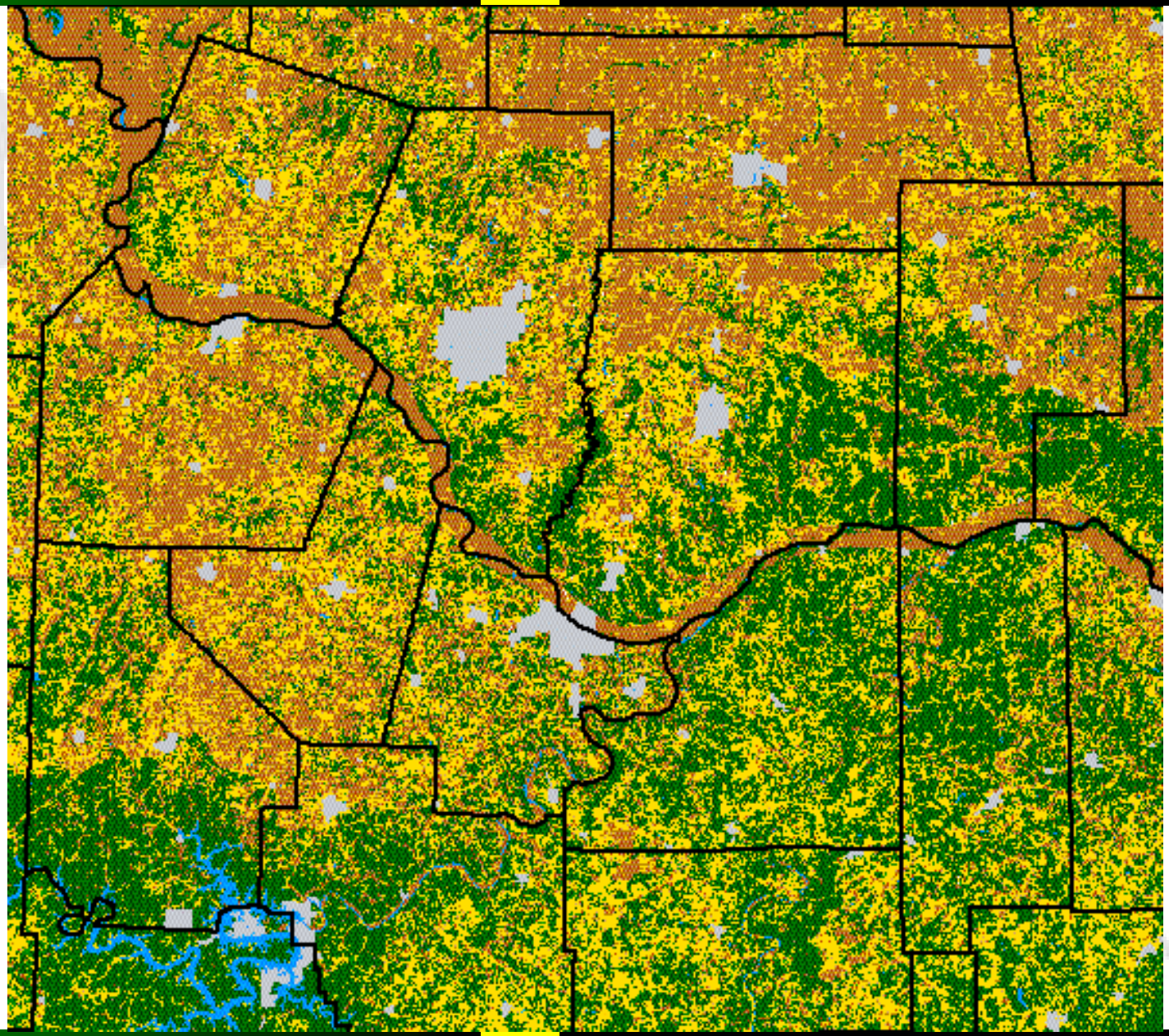
Fundamental Organizing Principle of Evolution and Nature



Chaos with just enough order to give them observable patterns and probabilities

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Land Cover



TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Missouri Basic Land Cover Types Supplied to GAP Project

- Deciduous Forest
- Evergreen Forest
- Mixed Evergreen - Deciduous Forest
- Deciduous Woodland
- Mixed Evergreen - Deciduous Woodland
- Grassland
- Row & Close Grown Crops
- Urban Mask
- Open Water
- Barren / Sparsely Vegetated

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Habitat Classification & Comparison
(MoFWIS v. UNESCO)

MAMMALS	MoFWIS
Nine-banded Armadillo	Perennial Grass (Warm season) Perennial Grass (Cool season) Shrub Grass Fruiting Tree-Shrub Immature Hardwoods Mature Oak-Hickory (9" + dbh, open understory) Mature Oak-Hickory (9" + dbh, dense understory) Oak-Hickory Old Growth Mature Shortleaf Pine Shortleaf Pine Old Growth Marsh
Badger	Perennial Grass (Warm season) Perennial Grass (Cool season) Savannah (Grass-Shrub) Legumes (Tame)
Big Brown Bat	Perennial Grass (Cool season) Shrub-Grass Fruiting Tree-Shrub Eastern Red Cedar(70% + crown closure) Eastern Red Cedar(30% - 70% + crown closure) Oak-Hickory Old Growth Limestone Bluff and Cave

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

GAP Analysis
Data Layer Tracking

Ancillary Information Data Sets for Modeling

- General Soils
- Geology
- Streams - Perennial
- Streams - Intermittent
- Watersheds-Hydrologic Units
- NWI -where available (75%)
- Landform - Floodplain
- Landform - Elevation
- Landform - Complexity
- Ecotones
- Contiguous Interiors
- Stream - Cover Edges
- Min Jan Temperature Isoclines
- Max July Temperature Isoclines
- Precipitation Isoclines
- Prairies
- Caves
- Springs
- Sinkholes / Karst
- Population Density
- Road Density
- Cover aggregations

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

GAP Analysis

Techniques for Data Layer Creation

- Avoided the use of RECLASS but rather used SELECT statements with CONDITIONAL (ISNULL) to create individual grids
- Ecotones were created by EXPANDing one cover class and adding that grid to another EXPANDed cover class such that the ecotone would have a value of "2" and all other cells within the grid would have "1" or "0".
- Edges were created by SHRINKing a habitat component and then adding that resultant layer back to the original habitat component. Again, creating the "2", and "1", "0" classes.
- Interiors were created with the SHRINK command
- Minimum area requirements were created from the shrink base then a REGIONGROUP was used to group the separate regions of cells. Finally the ZONALAREA function was run to determine the area of each region for use in modeling.

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Greater Prairie Chicken

/*GPCH - Greater Prairie Chicken

/* **General Habitat:**

/* PREFER GRASSLAND TRACTS OF AT LEAST 80 ACRES. SHOULD INCLUDE HERBACEOUS VEGETATION 8-16" TALL FOR NESTING, DIVERSE STRUCTURE AND SPECIES COMPOSITION FOR BROOD HABITAT, AND DENSE STANDS OF NATIVE GRASS OR SHRUB THICKETS FOR WINTER COVER.

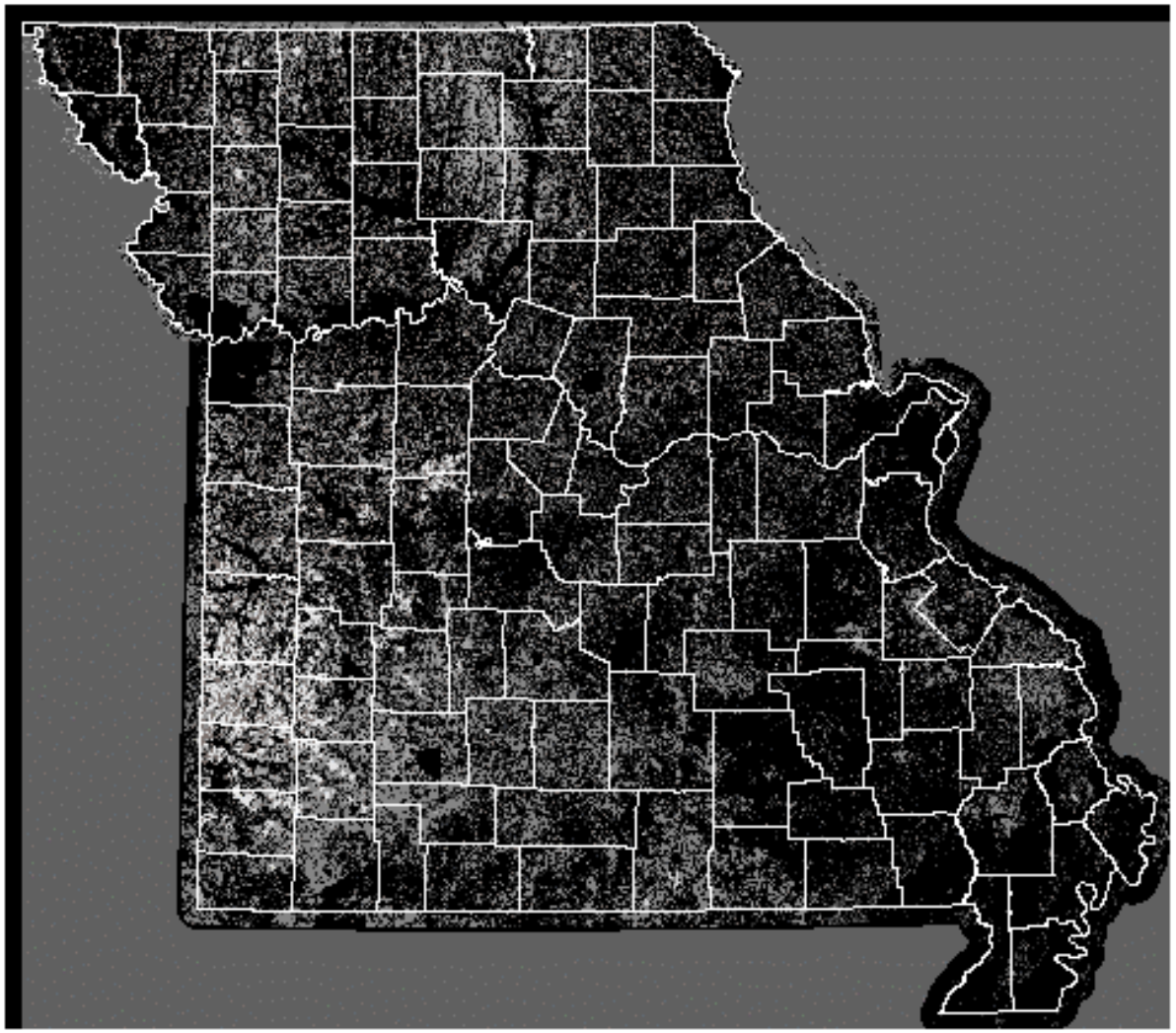
/* **Breeding Adult Niche Requirements:**

/* Natural Features: hills, ridges
/* Crop fields/grassland ecotone
/* Habitat size dependent on size of continuous grassland
/* Stable prairie/grassland successional stage
/* Subclimax grassland successional stage
/* Climax grassland successional stage
/* Agricultural crops: soybeans,small grains, clover,hay,legumes
/* IN MO STUDY, 56% OF NESTS IN MOSAIC HABITAT WERE ON TRACTS > 160 HA. USUALLY NEST WITHIN .5 MILES OF BOOMING GROUND NEST SUCCESS IN AGRICULTURAL COVER WAS LOWER THAN NEST SUCCESS IN NATIVE PRAIRIE OR MIXED GRASS PASTURES. NEST SUCCESS DECLINED WITH INCREASED WOODY COVER. PRESENCE OF ANY WOODY COVER HAD NEGATIVE EFFECT ON NEST SUCCESS. NATIVE PRAIRIE TRACTS >65 HA MAY BE MORE EFFECTIVE IN ATTRACTING NESTING HENS THAN SMALLER TRACTS NEED 39-84% GRASSLAND IN HOME RANGE
/* Natural Divisions - no
/* Breeding core - wintering core
/* Missouri quad percentages 1.7%
/* very rare

gpch-g = grass-73 + g2-1x-19 + eco-g-ag-73 + prair-nf-91 + hprairie-64 + af-28 + upland-82b

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Resulting Missouri Predicted Distribution



TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

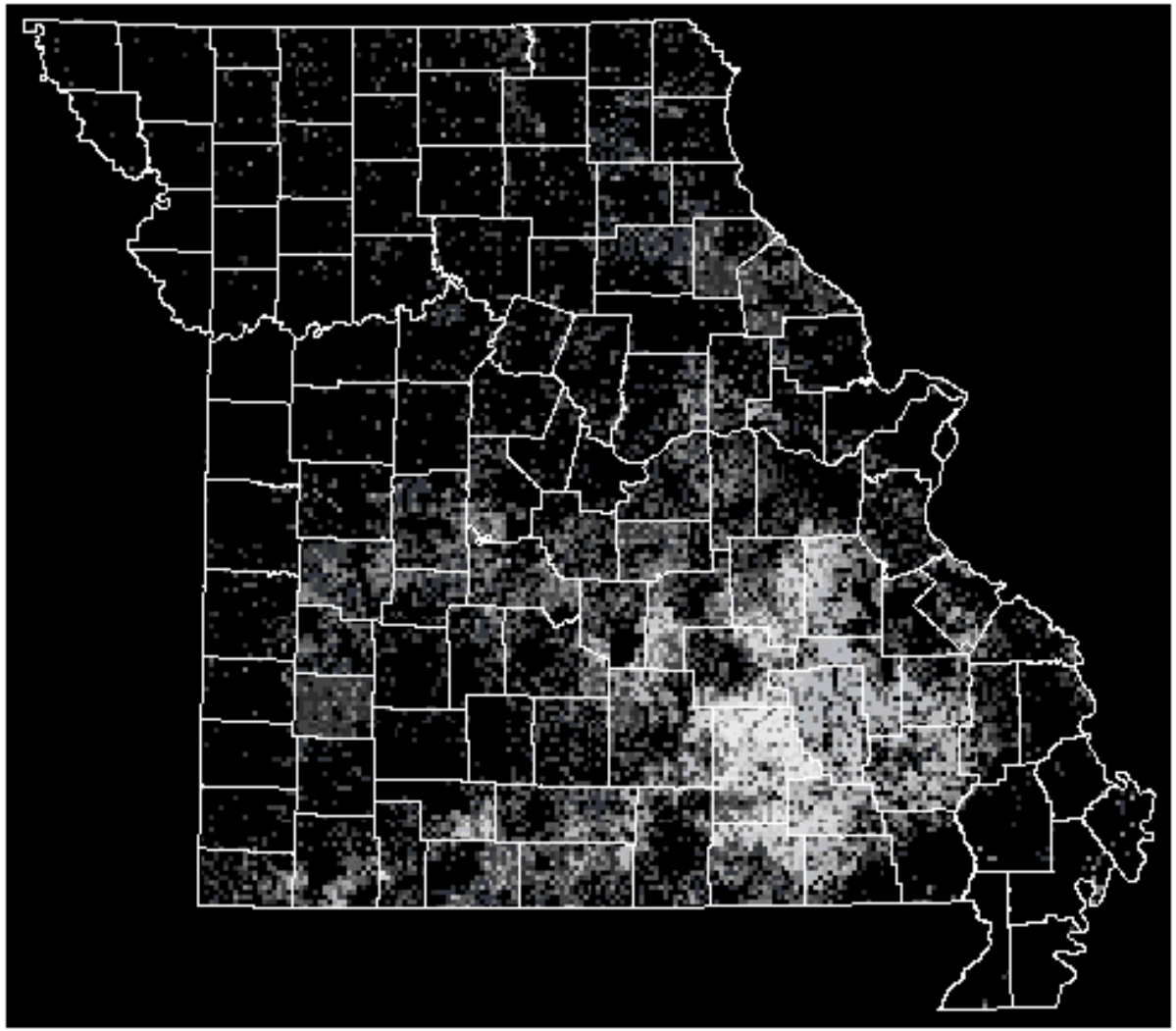
Black Bear

/* **Black Bear**
/* INHABIT FORESTS WITH SNAGS, DENSE THICKETS AND BRUSH PILES.
/* **Breeding Adult Niche Requirements:**
/* Elevation specified in comments
/* Inland Wetlands: swamp
/* Natural Features: caves, dry
/* Slope specified in comments
/* Abandoned field successional stage
/* Distance to water specified in comments
/* Diseased/decaying trees or plants specified in comments
/* Cavities in dead/dying trees
/* Subcanopy closure specified in comments
/* Downed logs, Snags, Stumps
/* Other niche requirements specified in comments
/* IN RADIOTELEMETRY STUDY, FEMALES WERE GENERALLY FOUND AT MID TO
/* HIGH ELEVATIONS IN SUMMER AND LOWER ELEVATIONS IN FALL. SUITABLE
/* HABITAT CONSISTS OF LARGE REMOTE FORESTED TRACTS OF MAST-BEARING
/* TREES AND SHRUBS.IN AR, USED POLETIMBER HARDWOODS AND MIXED
/* HARDWOOD-PINE STANDS. IN AR, WERE FOUND LESS OFTEN IN SITES MORE
/* THAN 600 M FROM STREAMS: PATCHES OF DENSE UNDERSTORY ARE
/* IMPORTANT. IN AR, WERE FOUND LESS OFTEN IN AREAS WITHIN 240 M OF ROADS.

bbear-g = upland-82b + cave-09 + swamp-82 + dec-f-82 +
af6-1x-19 + mix-f-73 + pop-d-10-0g + rd-d-10-0g2

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Resulting Missouri Predicted Distribution



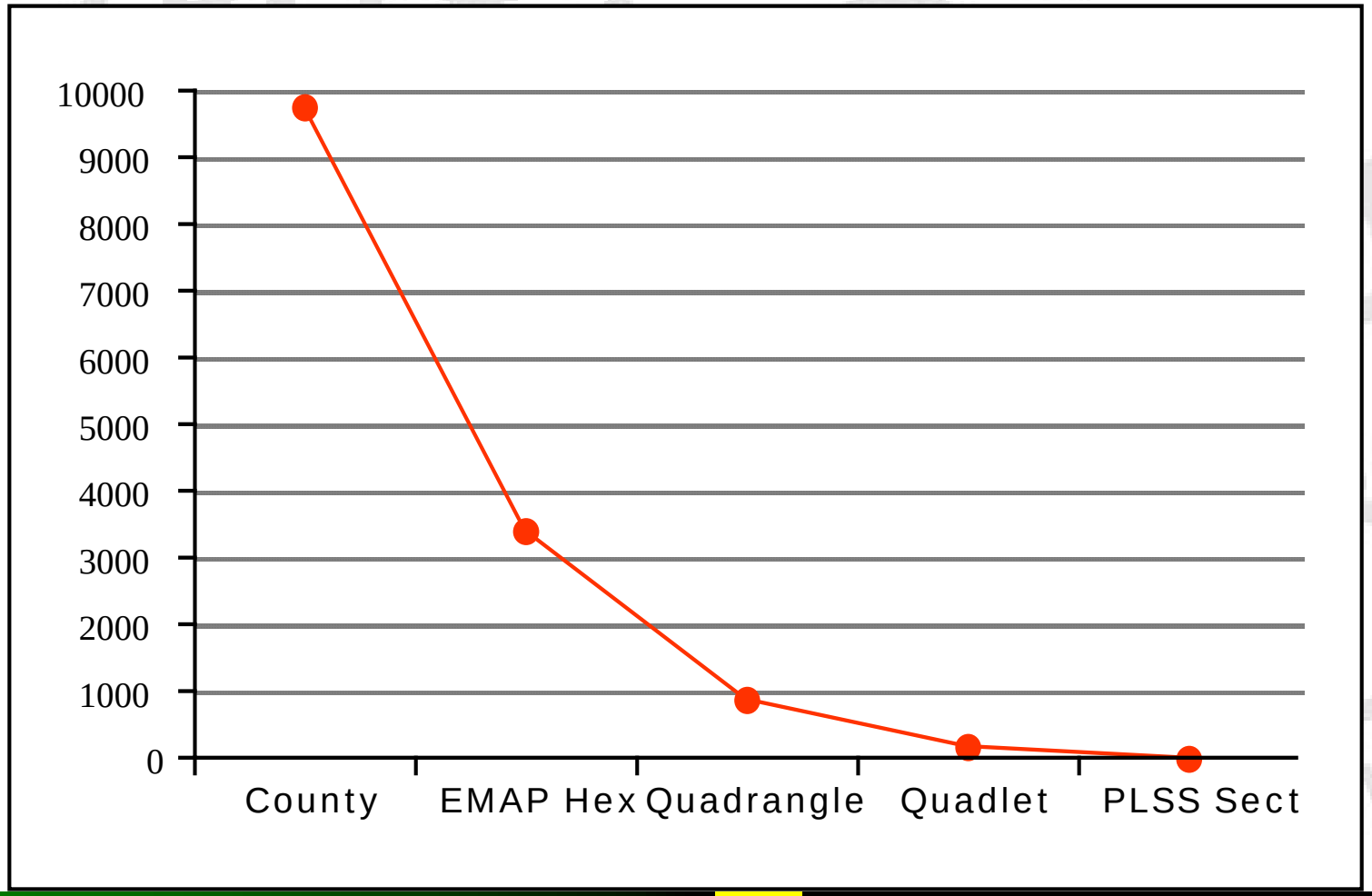
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Suppose two maps, each with percent correctly classified of .90 are overlaid…

- Studies have shown that the accuracy of the resulting map is little better than .9 x .9 = .81
- When many maps are overlaid the accuracy of the resulting composite can be very poor.
- **However, we are more interested in the accuracy of the composite suitability index** than in the overlaid attributes themselves.

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Number of Sample Points per Geographic Unit



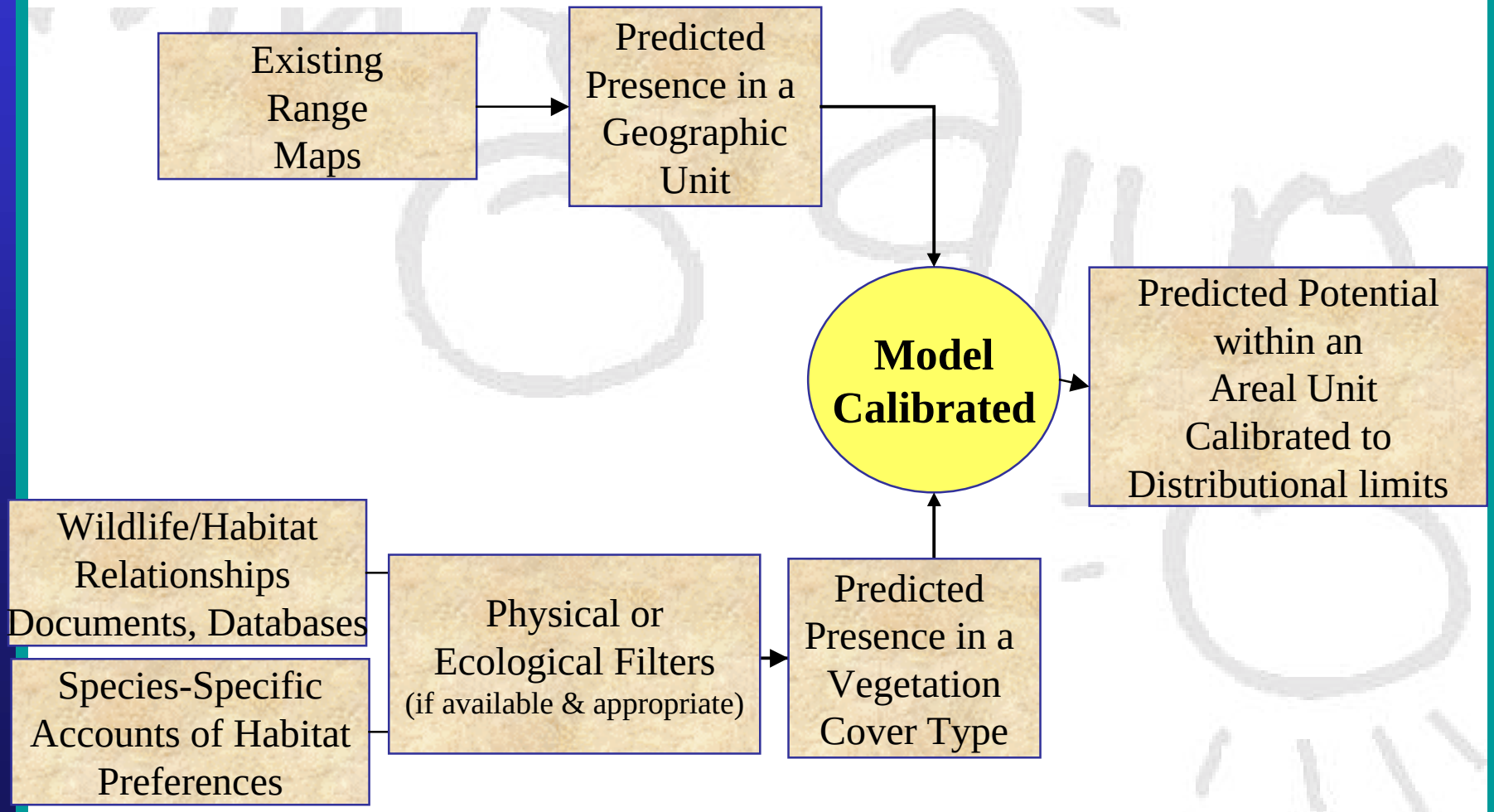
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Construction of Predicted Species Index Point Database

- The point database was created using the GENERATE command for a regular 400 meter grid across the entire state.
- The point file was overlayed using the IDENTITY command to the geographies of interest in GAP analysis (County, EMAP hexagons, 7.5 min Quadrangles, 1/6 Quadlet, and Public Land Survey System - sections)
- The final species richness database was created using LATTICESPOT to obtain for each species modeled its index value at each point on the 400 meter grid.

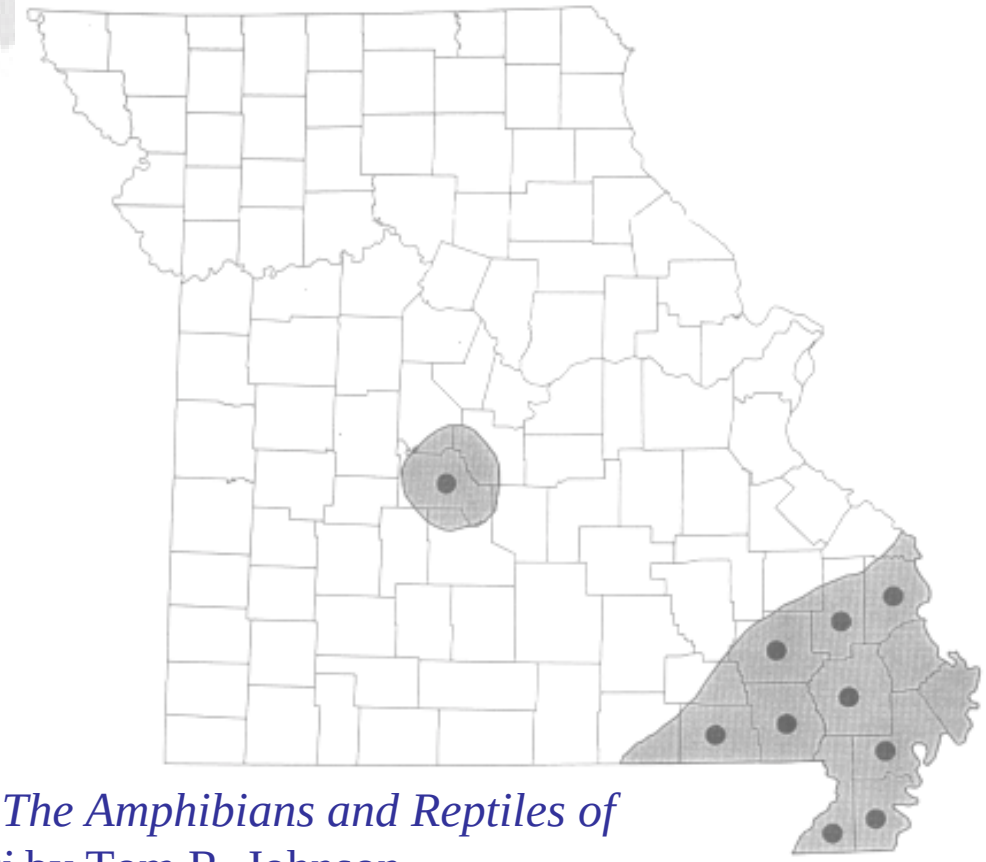
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Schematic diagram showing steps in the development of a generalized predicted vertebrate, amphibian, reptile, bird, or mammal distribution map for Missouri Gap Analysis.



TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Distribution of Green Tree Frog (*Hyla cinerea*) in Missouri



Source: *The Amphibians and Reptiles of Missouri* by Tom R. Johnson

Each dot represents a known county record.

The shaded area is presumed range.

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

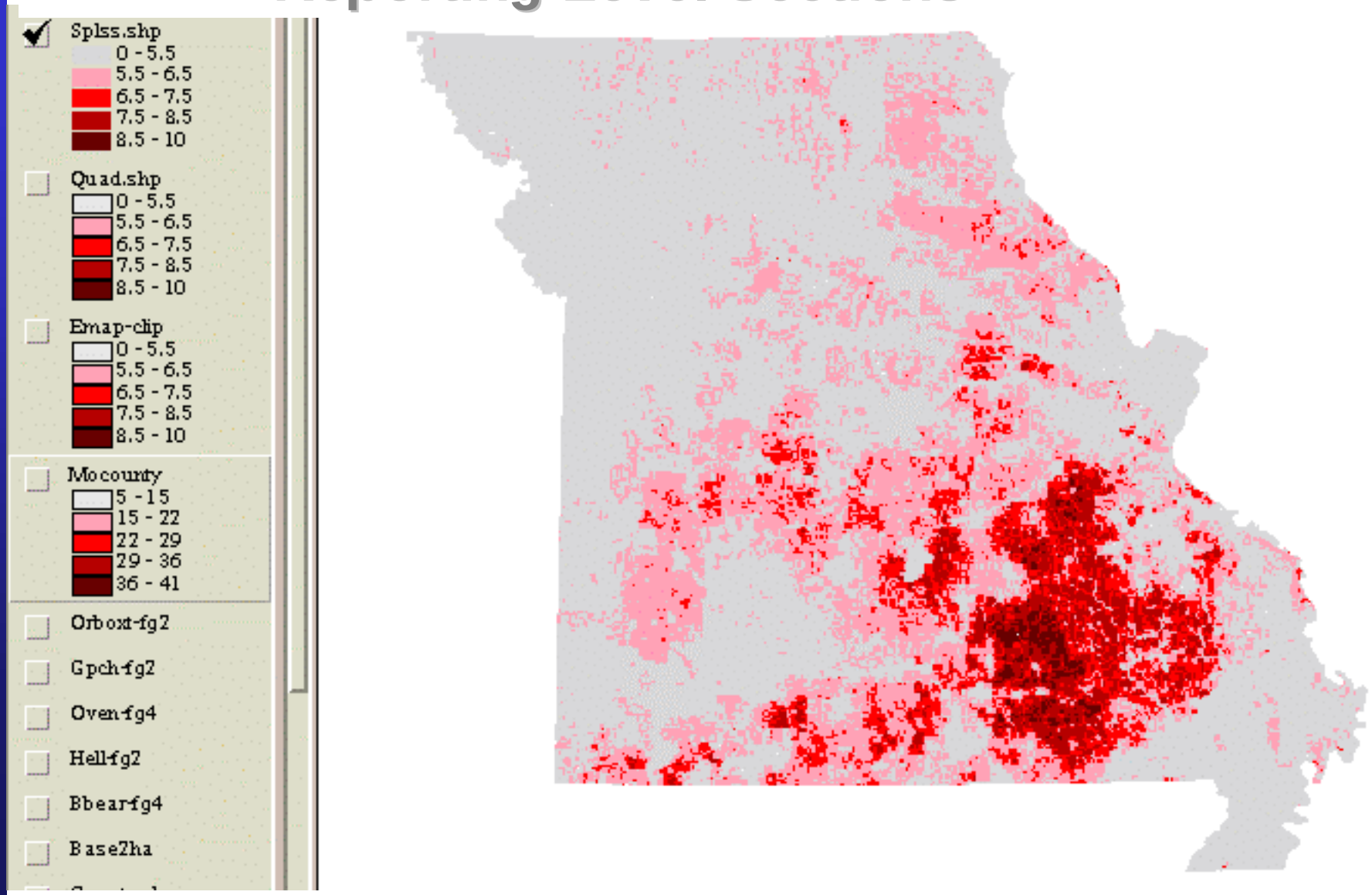
Calibration and Incrementation of Habitat Scores

The FREQUENCY command was then run on each geography of interest and an average index by species was calculated for that geography which can then be mapped using the link created in the IDENTITY step.

NewIndex = (((OldIndex / SD) - (CalIndex / SD)) * 2) + 8

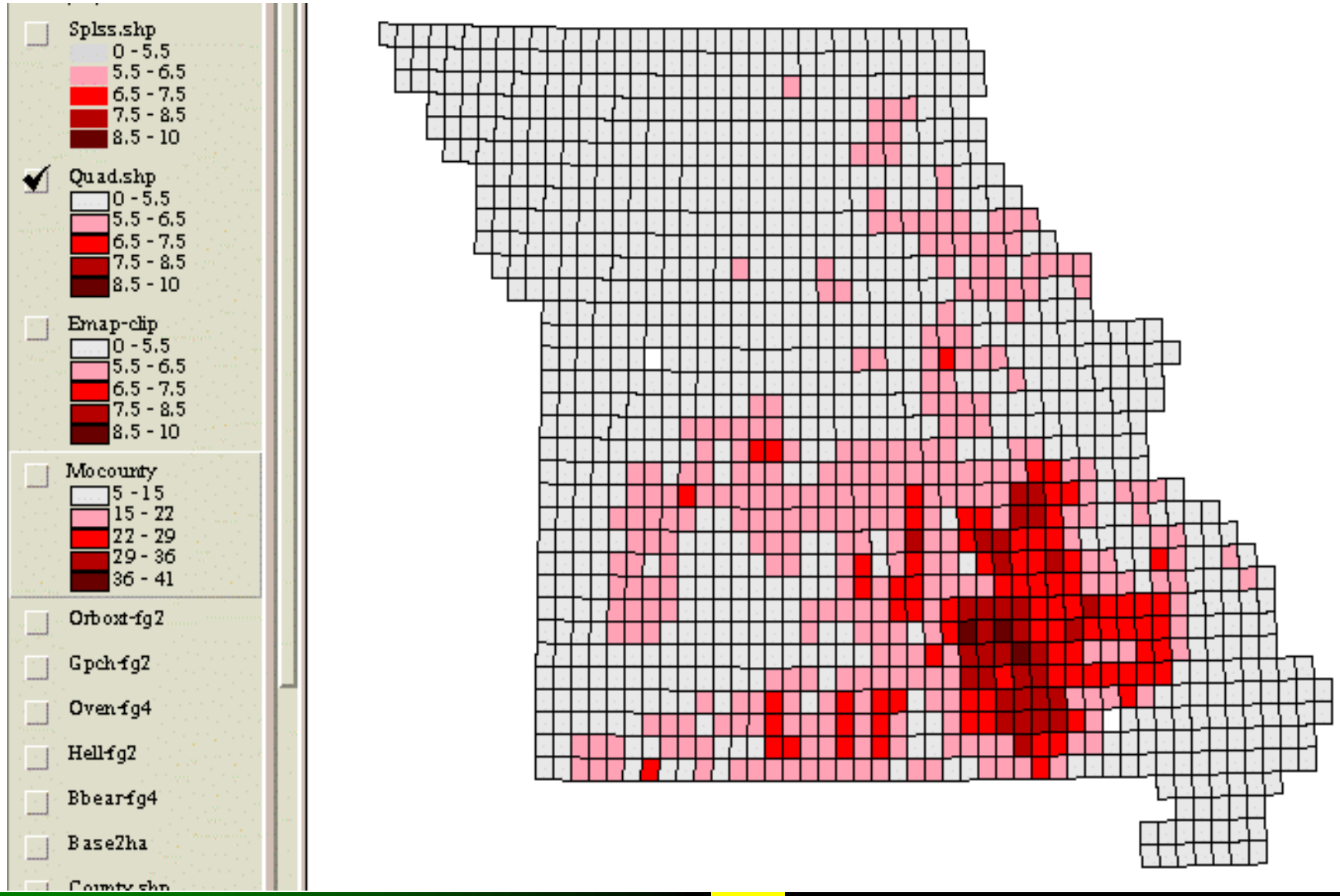
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Reporting Level Sections



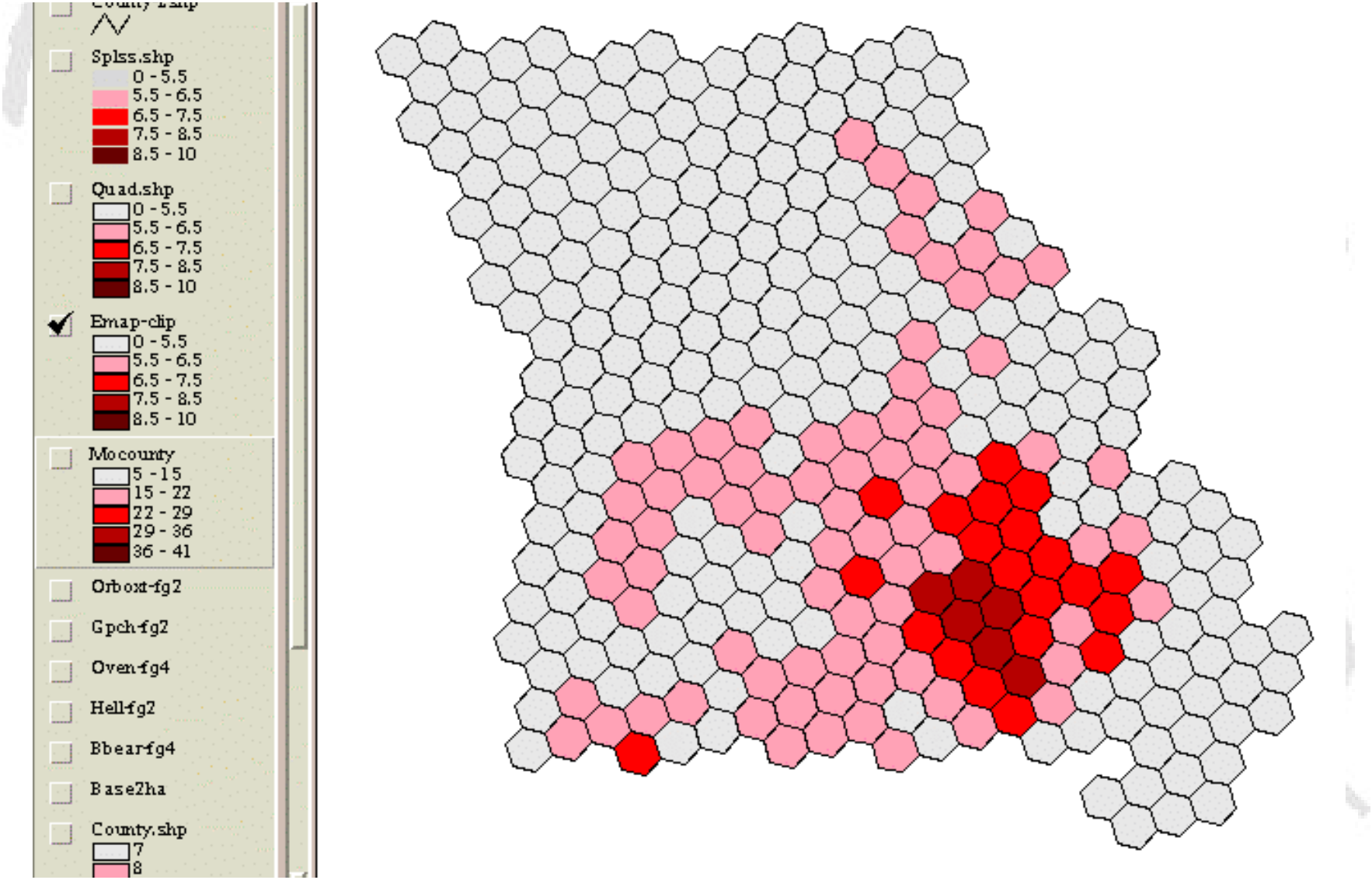
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Reporting Level Quadrangles



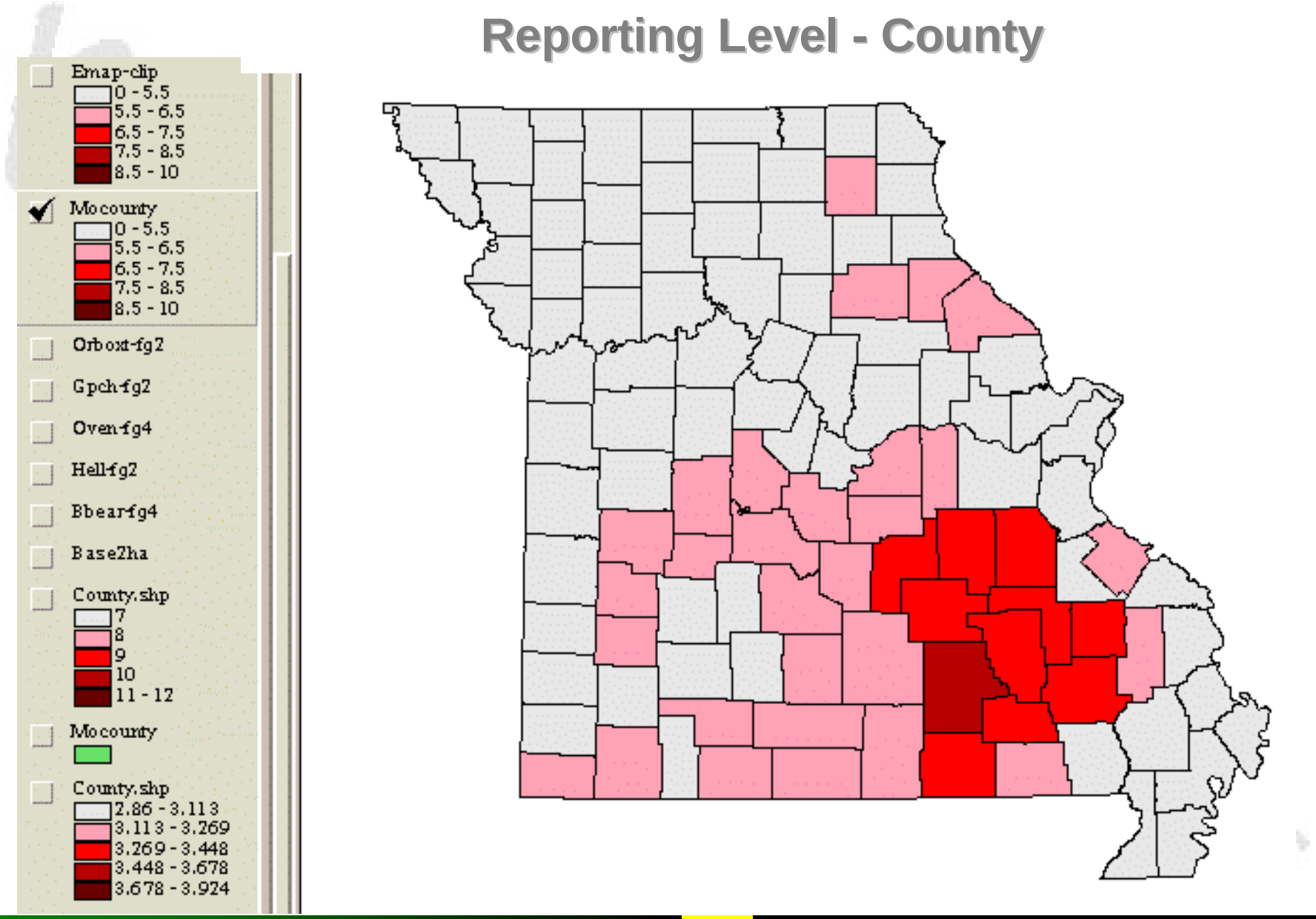
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Reporting Level EMAP Hexagons



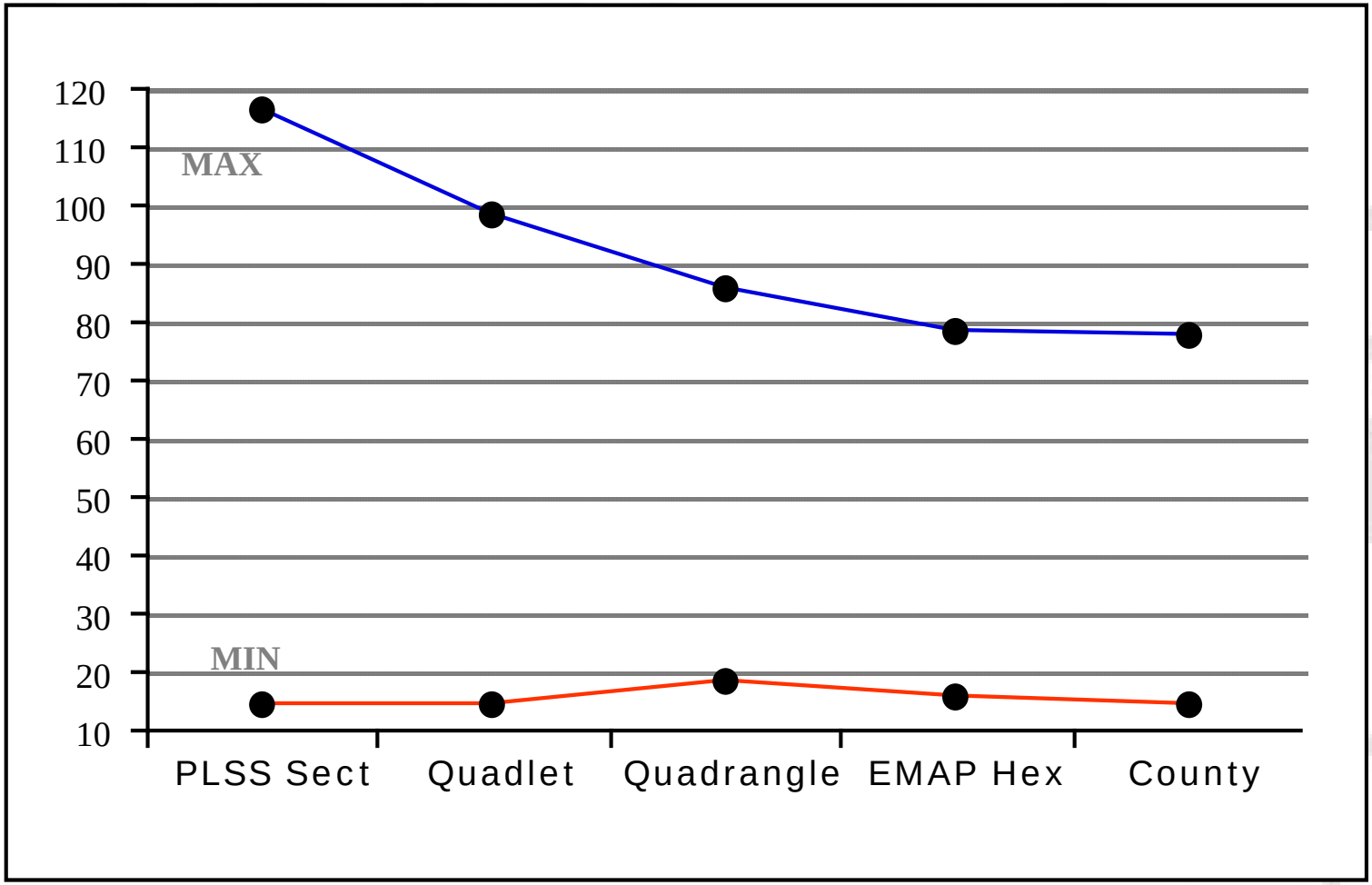
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Reporting Level - County



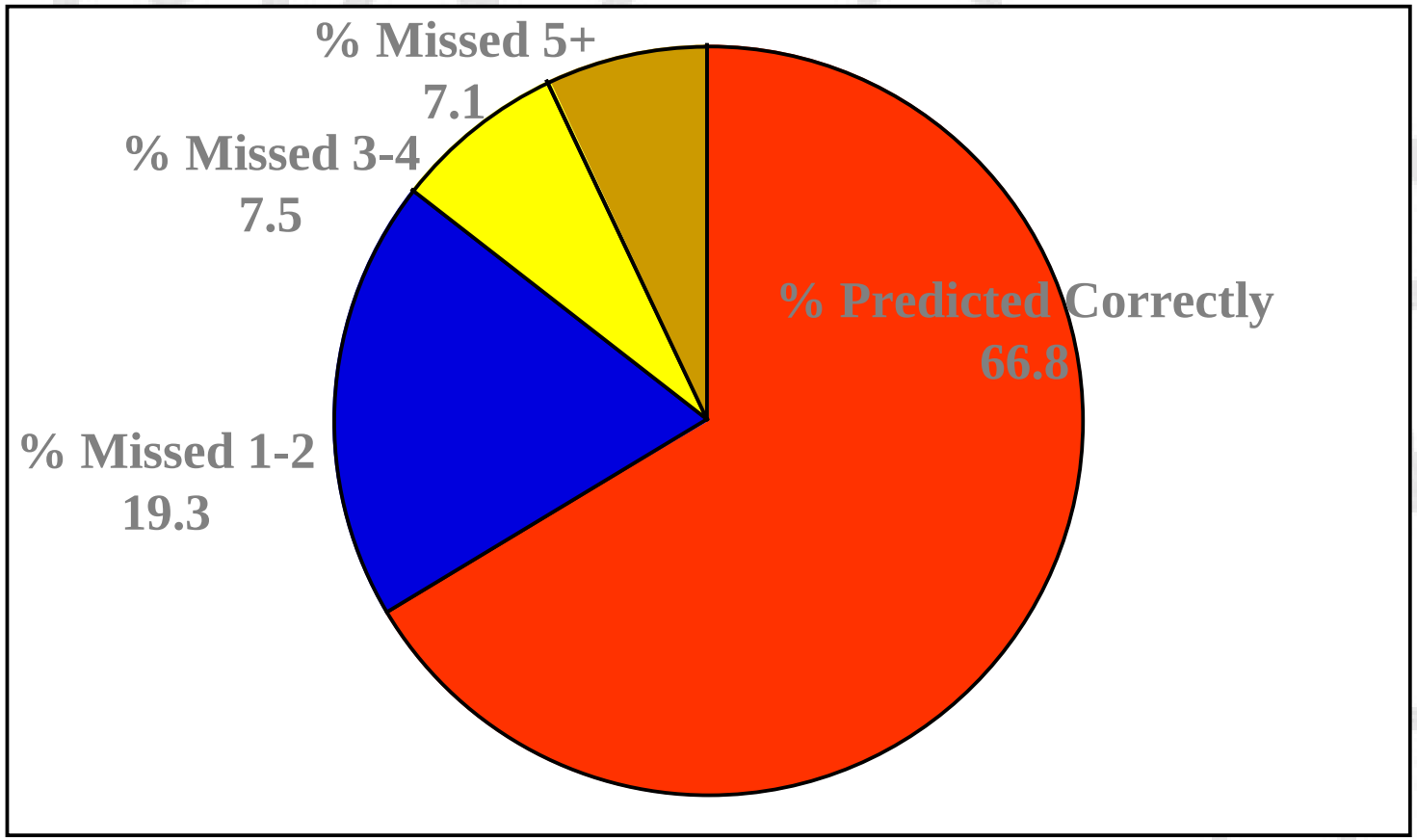
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Avian Richness - Minimum and Maximum by Geographic Unit



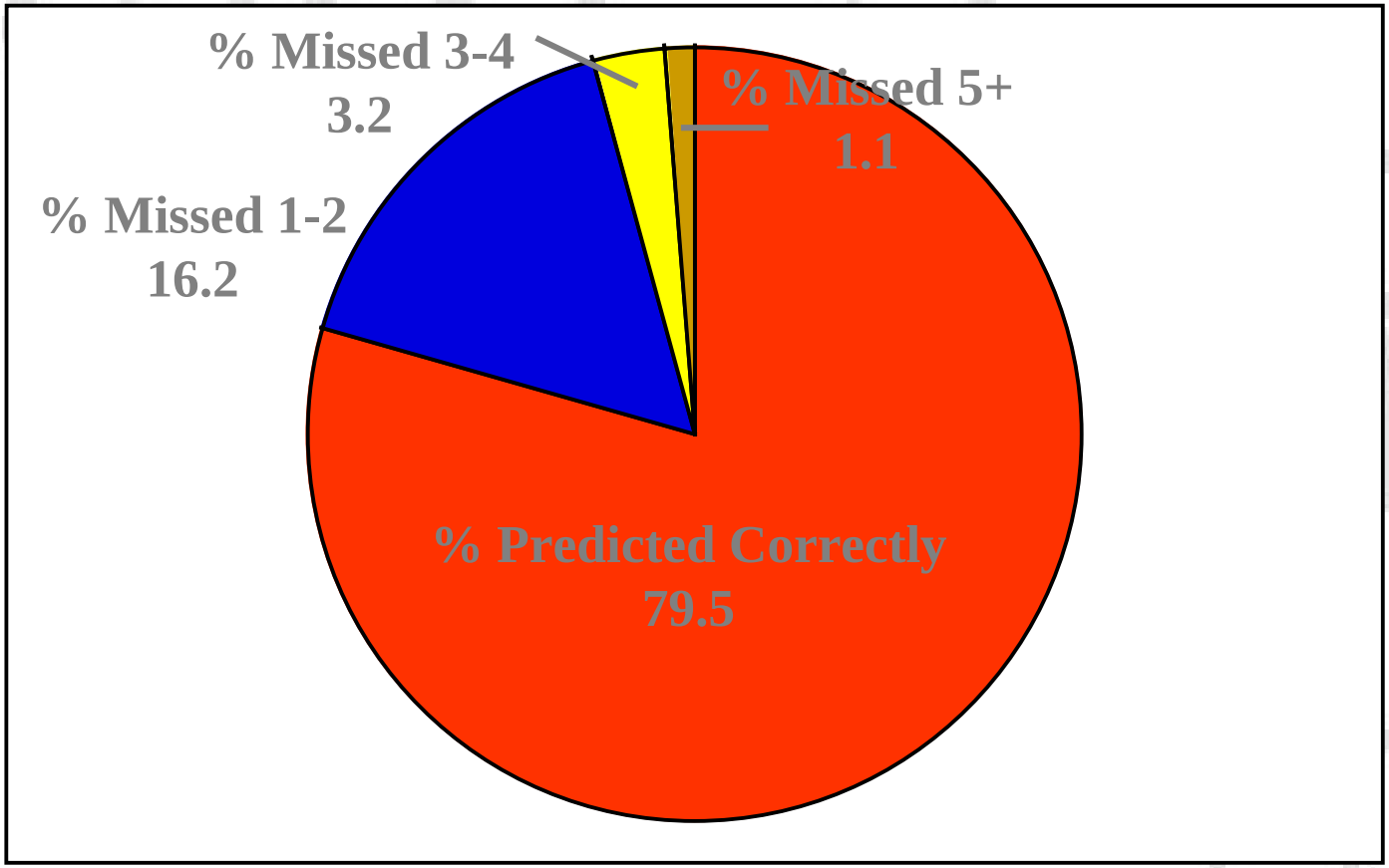
TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Avian County Listing based Accuracy Assessment

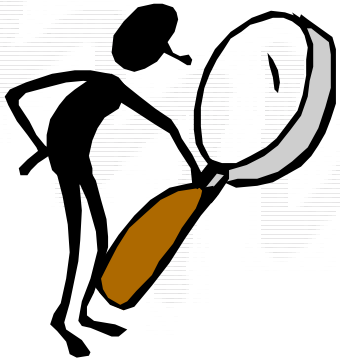


TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Avian Breeding Bird Atlas based Accuracy Assessment



TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI



Things to think about:

1) Spatial level appropriate to assess - vs- spatial level appropriate to survival of species
2) Landscape context of species needs
3) Species modeling - continuums provide flexibility
4) Fuzzy nature of nature is compounded by the fuzzy nature of mapping

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI

Things to think about:

5) One method fitting all is insane
6) No single map scale will suffice for all species
7) Richness calculation based on multi-scaler integration of potential suitability indices
8) Scaling relationship is dependent on species specific habitat / landscape parameters
9) Outcomes depend on models, data and scale of assessment

TIM HAITHCOAT & RON DROBNEY
UNIVERSITY OF MISSOURI