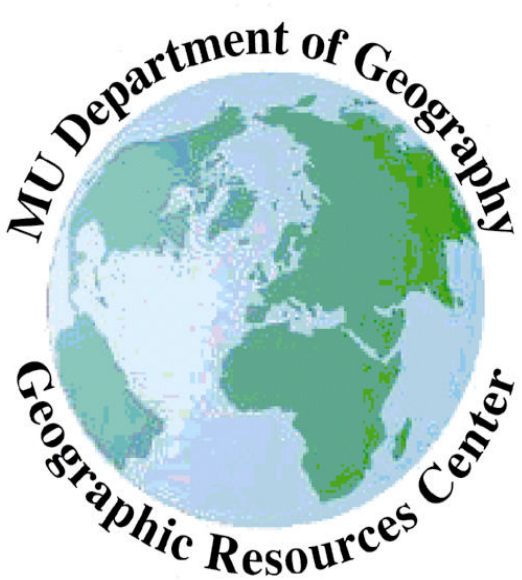


Missouri

GAP

presented by:

Tim Haithcoat

University of Missouri

Columbia

National GAP Analysis Program

U.S. Geological Survey

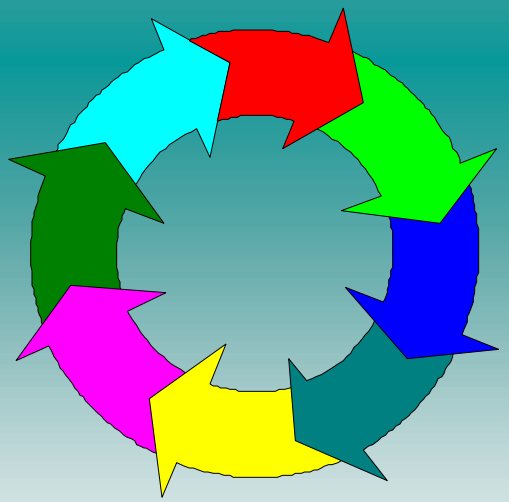
Biological Resources Division

A Geographic Approach to Planning for Biological Diversity

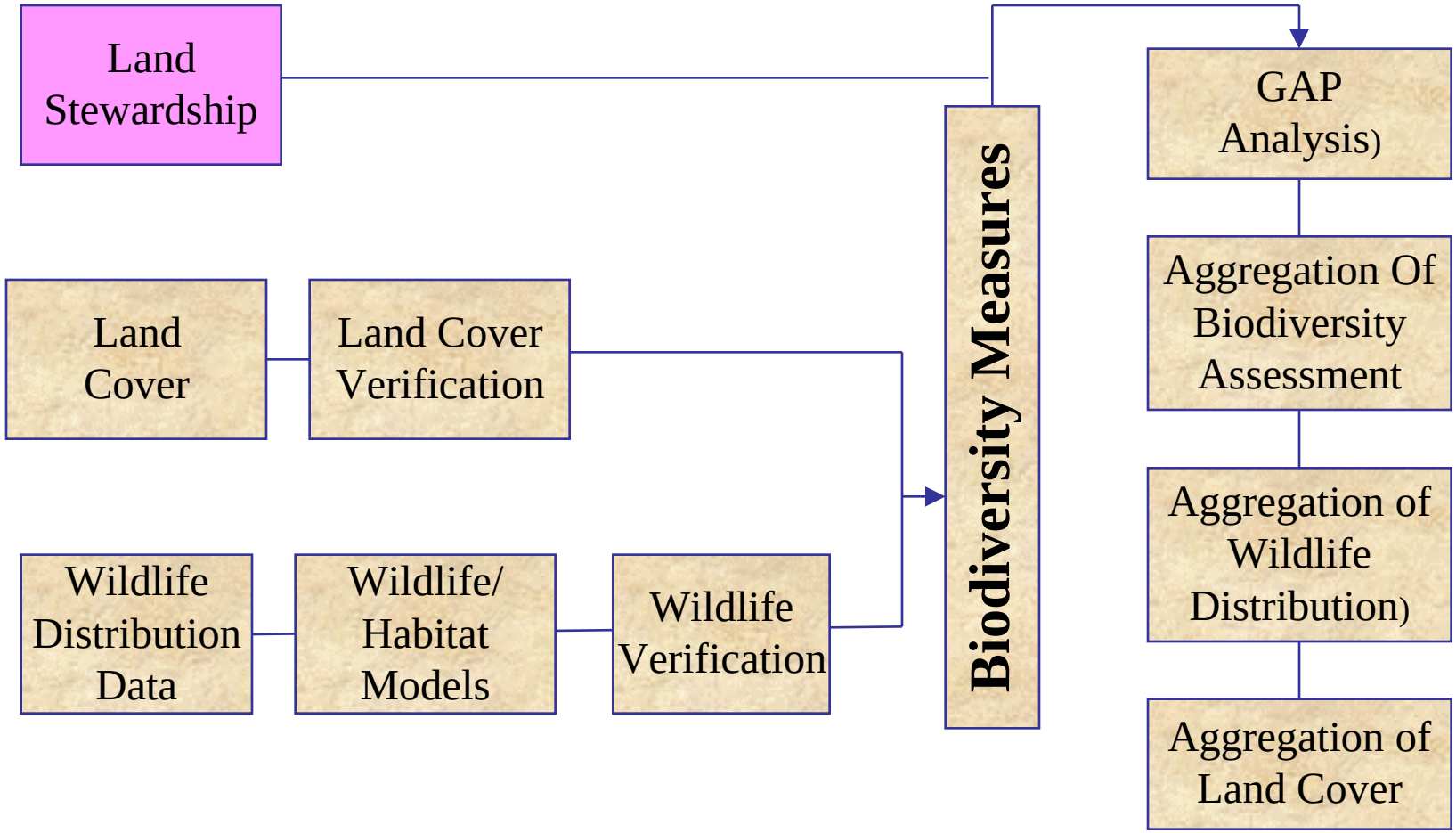
http://biology.usgs.gov/state.partners/gap.html

Desirable database characteristics should be:

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



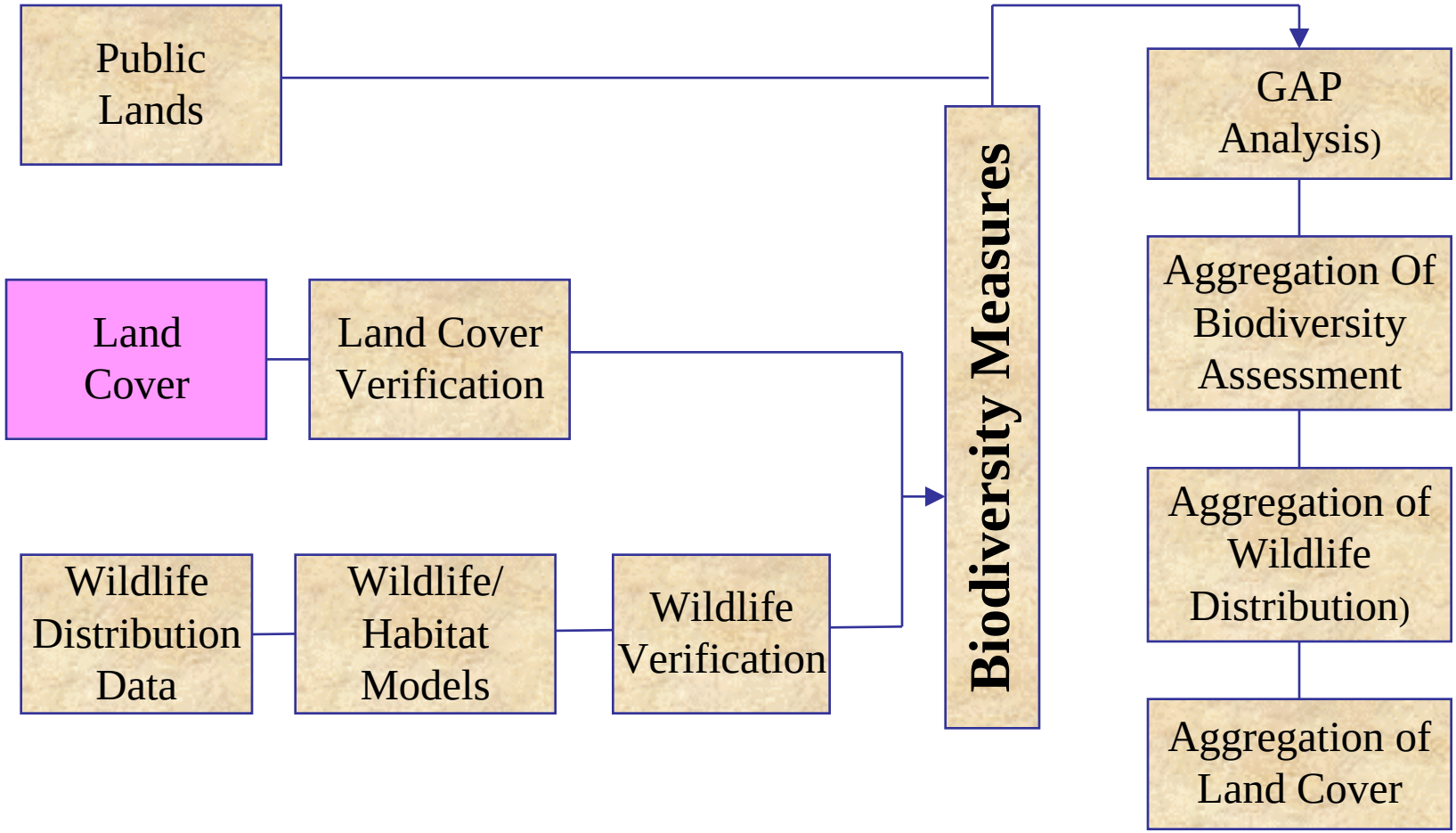
Data Resources



Stewardship Layer Statistics

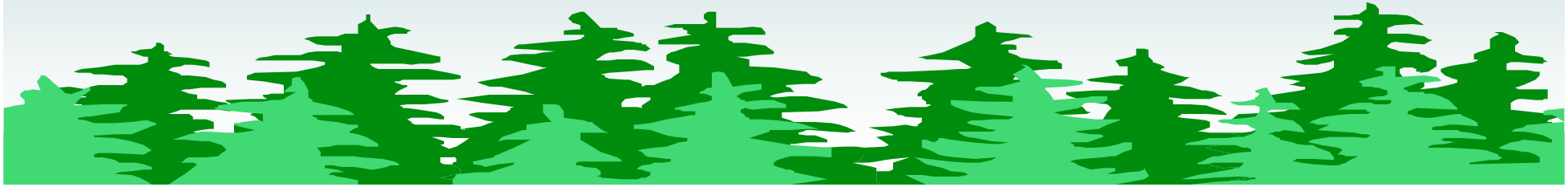
Protection Class	Hectares	% of State
1 An area having an active management plan in operation to maintain a natural state and within which natural disturbance events are allowed to proceed without interference.	52,761	0.29
2 An area generally managed for natural values, but which may receive use that degrades the quality of existing natural communities.	85,026	0.47
3 Legal mandates prevent the permanent conversion of natural habitat types to anthropogenic habitat types but which is subject to extractive uses.	1,077,289	5.97
4 Private or public lands without an existing easement or irrevocable management agreement to maintain native species and natural communities and which are managed for intensive human use.	8,590	0.05

Data Resources

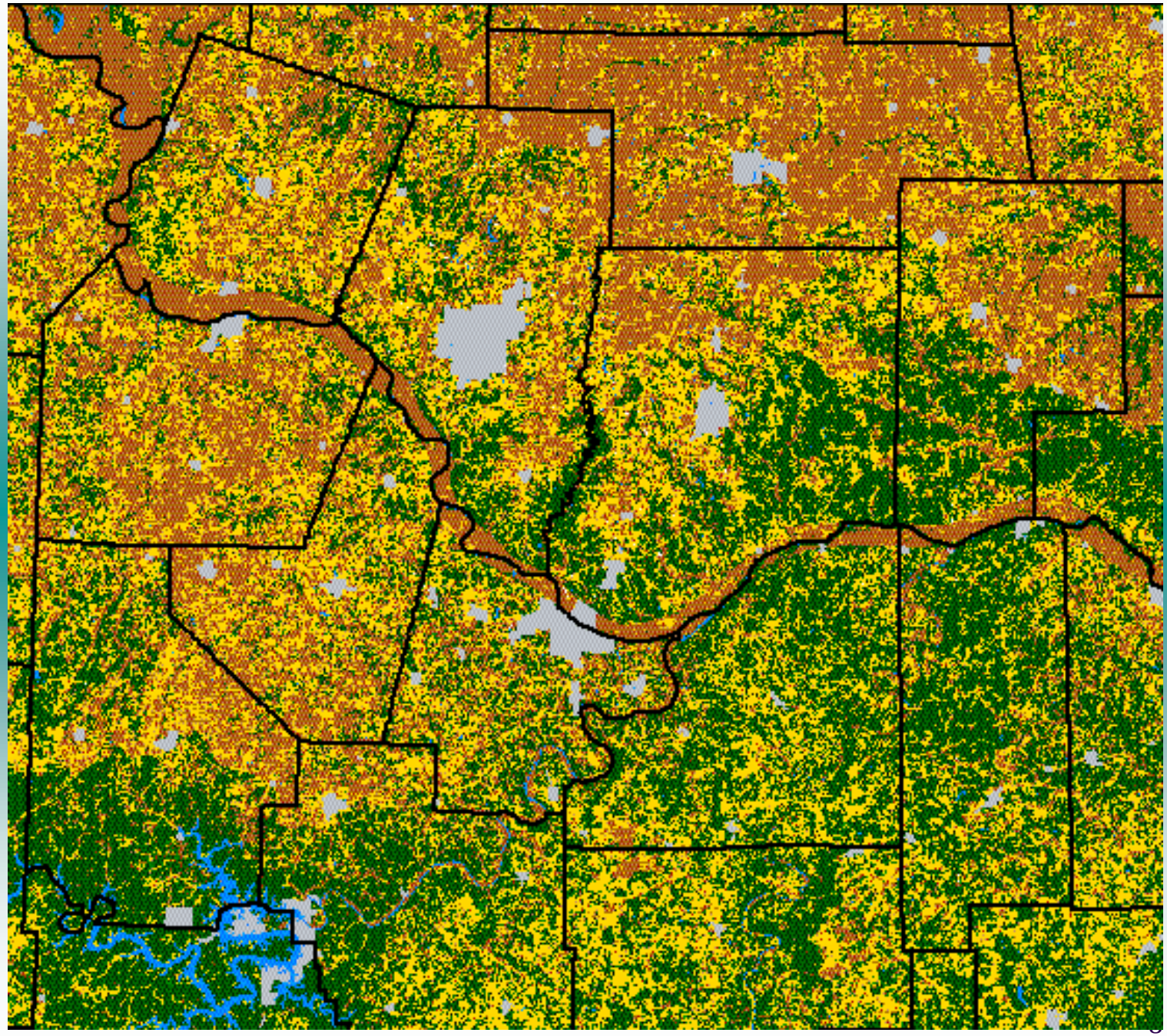


Missouri Basic Land Cover Types Supplied to GAP Project

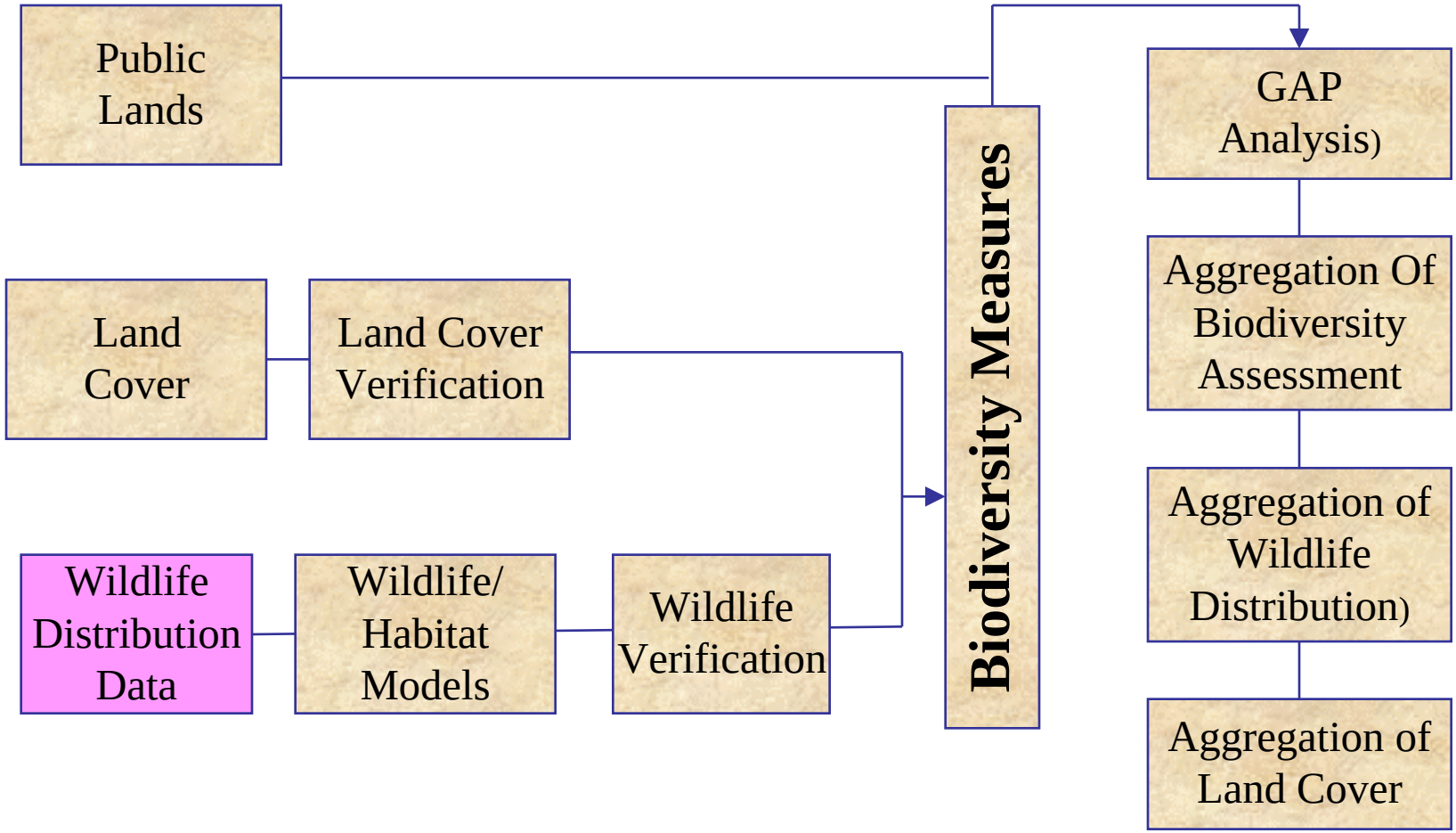
- Deciduous Forest
- Evergreen Forest
- Mixed Evergreen - Deciduous Forest
- Deciduous Woodland
- Mixed Evergreen - Deciduous Woodland
- Deciduous Shrubland
- Evergreen Shrubland
- Grassland
- Row & Close Grown Crops
- Urban Mask
- Open Water
- Barren / Sparsely vegetated



Land Cover



Data Resources



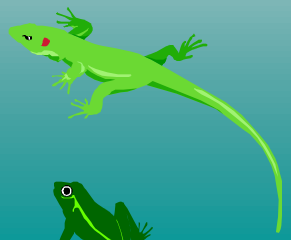
Wildlife Distribution Data Bases

- Heritage database
- Breeding bird surveys
- Winter bird counts
- Furbearers survey
- Herp collection
- Insect collection
- Mammal collection
- Bird collection
- MOFWIS
- Rare, Threatened, and Endangered

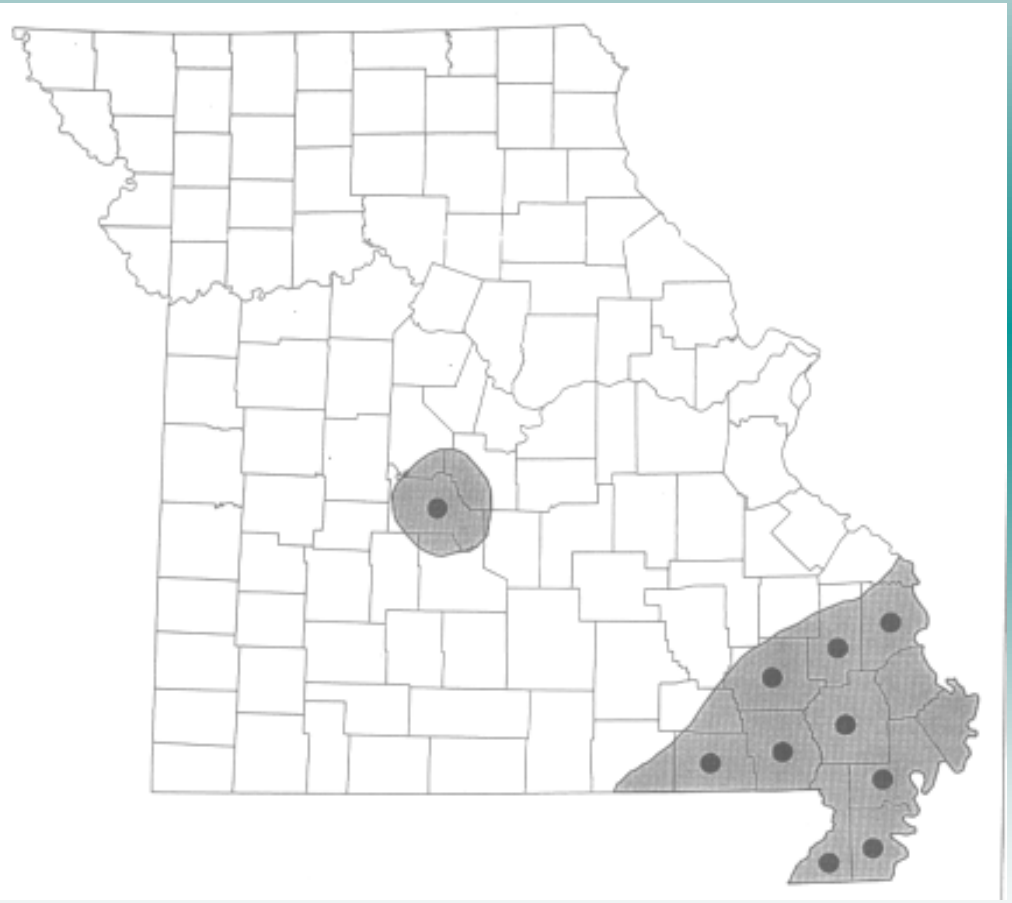
GAP Analysis
Data Layer Tracking

Vertebrate Distributions

- Reptiles
  - Ranges
- Amphibians
  - Ranges
- Birds
  - Breeding Bird Atlas
  - Museum Records - MU
  - Museum Records - KU
- Mammals
  - Archers Index - sign station
  - Museum records - MU
  - Deer Management Units
- Species Lists for Areas



Distribution of Green Tree Frog (Hyla cinerea) in Missouri



Each dot represents a known country record.

The shaded area is presumed range.

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

http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

General Information

- Introduction
- About the BBS
- Help Index
- A Note on Taxonomy

Survey Results

- Summary information on population change by region and time period
- This program allows you to display trends for 3 time intervals, by either species or region.
- This program allows you to display annual indices of abundance for any species in any region.
- These are relative abundance maps, estimated over interval 1982-1996.
- These are maps of population change, based on 1966-1996 interval.
- These maps, based on BBS data in Alaska, are very rough. We will update them occasionally.
- These lists provide mean abundances for all species encountered on the BBS in a state/province, summarized by physiographic region.

Interactive Mapping Information

- This program allows you to estimate mean abundance from BBS data for any species, at any location in the survey area. (This now includes Alaska!)

Analytical Tools

- This program allows you to estimate (and plot) population change for any species, on any BBS route.
- This program allows you to estimate population change for any species and time interval, in any region covered by the BBS

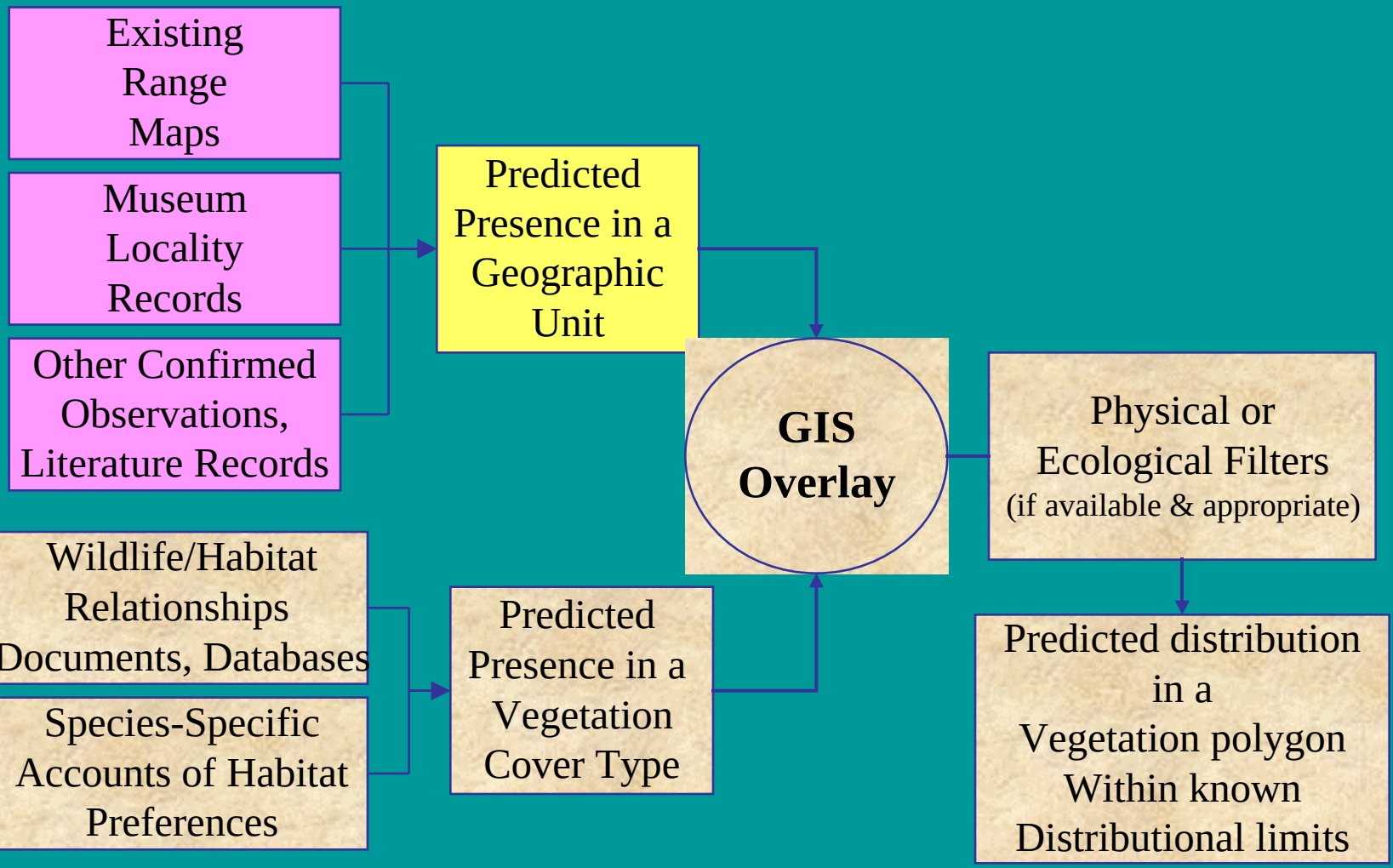
Learning Tools

- This link transfers you to the species identification section, in which is contained pictures, songs, and identification tips of most North American Bird Species.
- This link transfers you to the species information section, that contains links to species-specific information such as life history, identification, distribution maps, pictures, and songs.
- Test your skills of identifying North American bird songs, pictures, and breeding and wintering distributions.
- Check out some of our ongoing research projects on migratory birds.

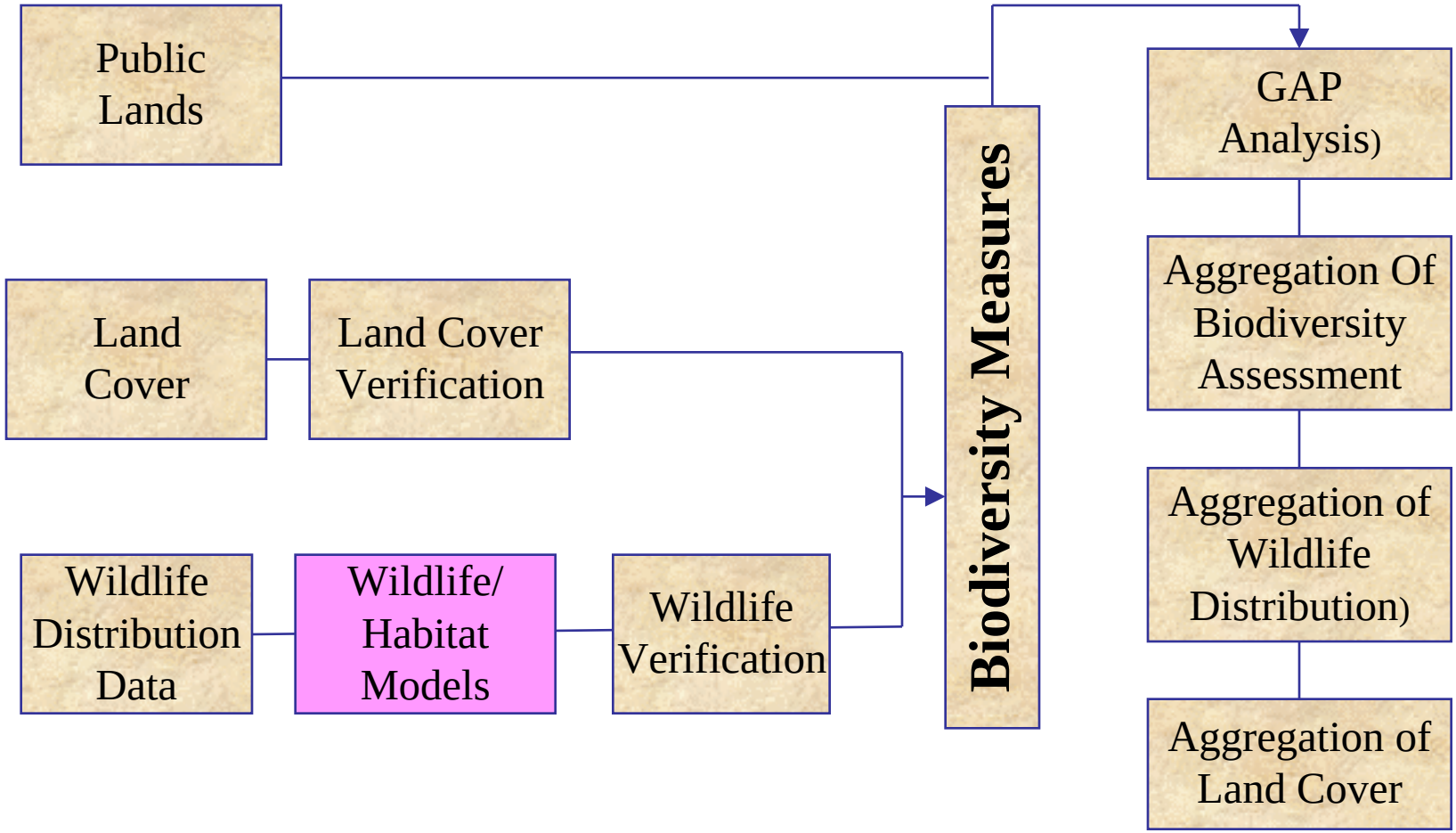
Links to Additional Information Sources

Monitoring Programs at Patuxent
Patuxent Wildlife Research Center

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



Data Resources



Wildlife/Habitat Models

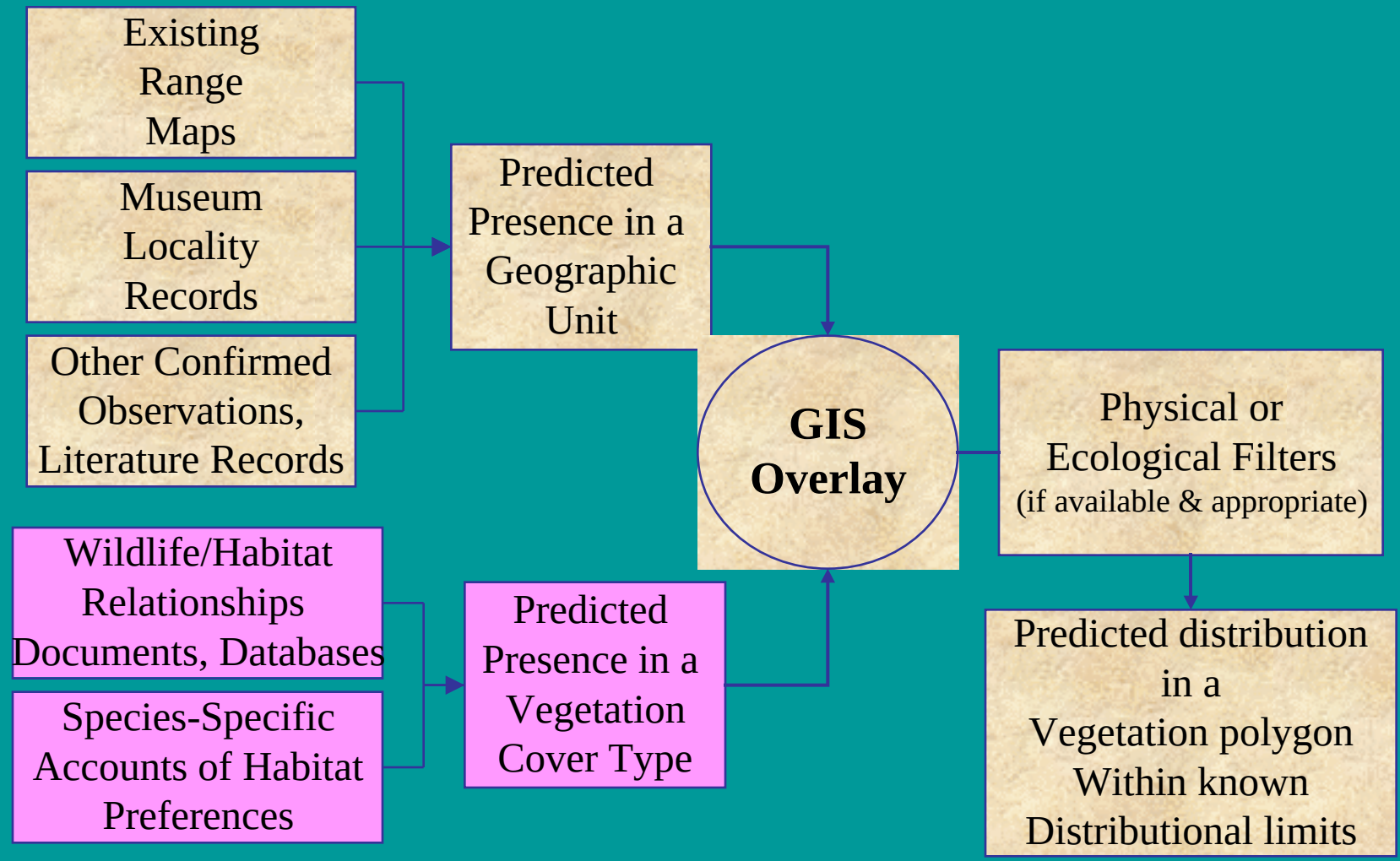
- MoFWIS
- WHAG
- HEP
- PATREC
  - Biologist review and evaluation
  - “Indicator species”
  - “Guild representatives”

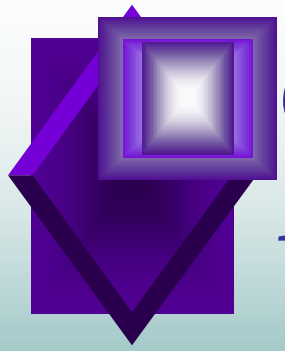
Habitat Classification & Comparison

(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

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





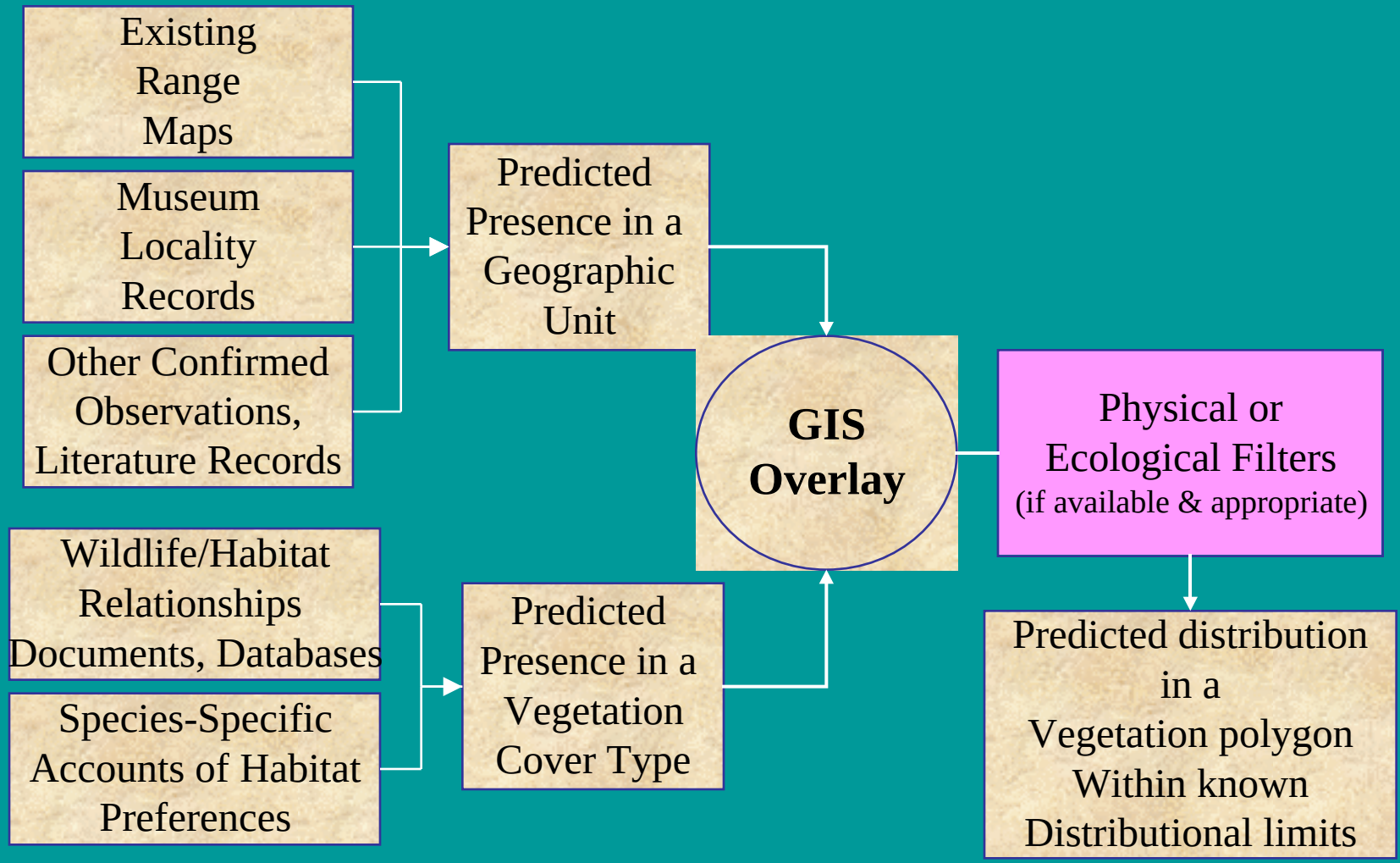
GAP Analysis
Data Layer Tracking

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

Min Jan Temperature Isoclines
Max July Temperature Isoclines
Precipitation Isoclines
Prairies
Caves
Springs
Sinkholes / Karst
Population Density
Road Density

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

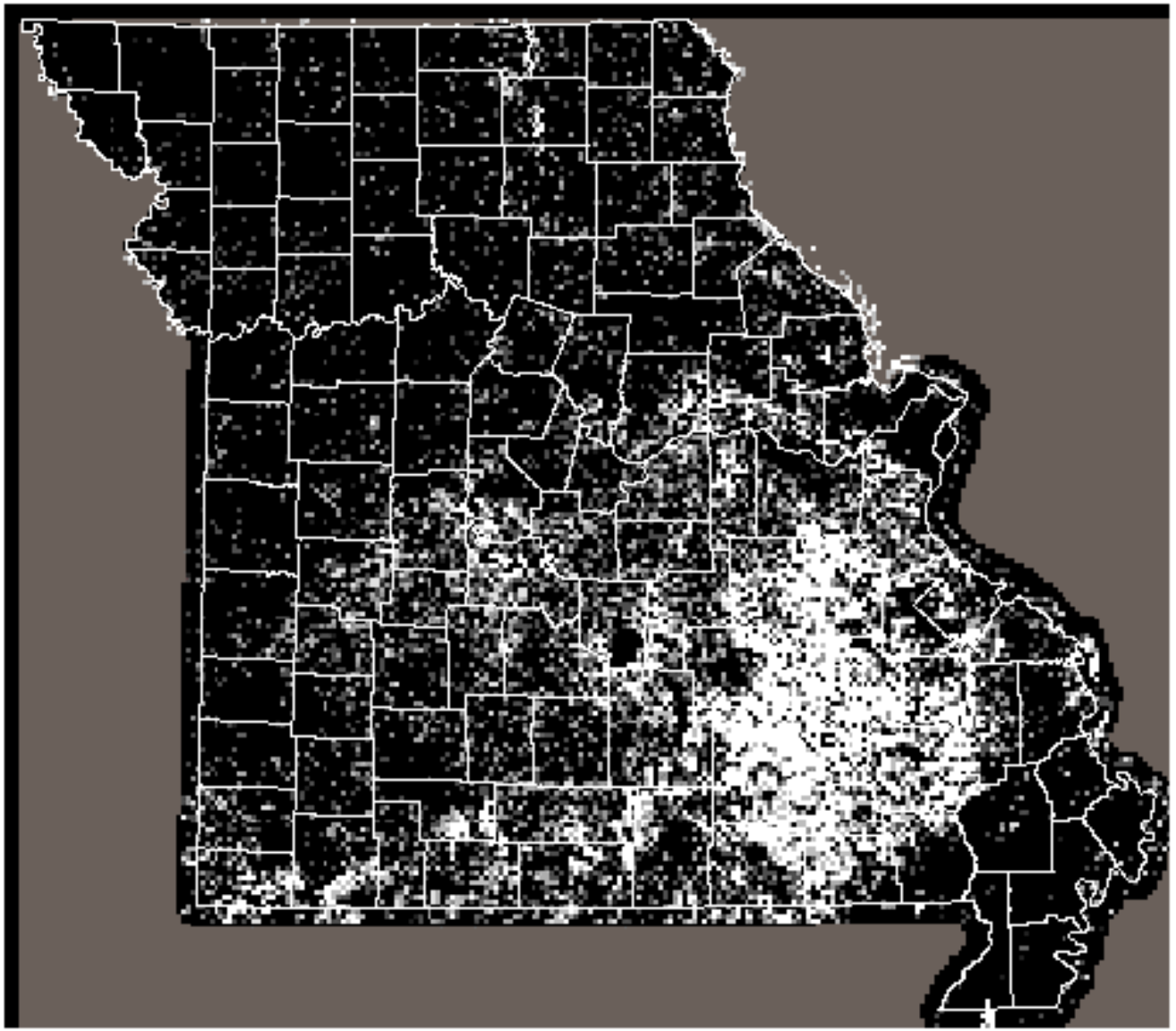


Ovenbird (Seiurus aurocapillus) Model Example

/*OVEN – Ovenbird
/* General Habitat:
/* PREFER LARGE CONTIGUOUS TRACTS OF MATURE UPLAND HARDWOODS, WITH SAWTIMBER SIZE CLASS TREES. MODERATE TO DENSE WOODY UNDERSTORY IS PREFERRED. REQUIRE DENSE GROUND VEGETATION AND ABUNDANT LITTER.
/* Breeding Adult Niche Requirements:
/* Not common floodplain
/* Natural Features: ridges
/* Occurrence negatively correlated with slope
/* Occurrence positively correlated with size of forest stand
/* Distance to forest opening specified in comments
/* Occurrence positively correlated with % canopy closure
/* Occurrence negatively correlated with relative moistness of habitat
/* WERE NOT FOUND IN FOREST STANDS <340 HA. ONLY 24% OF MALES FOUND IN FRAGMENTED FORESTS (<200 HA, <20% OF AREA IN 5 KM RADIUS FORESTED)WERE PAIRED. 75% OF MALES FOUND IN INTACT FOREST (500 HA, 65 & 80% OF AREA IN 5 KM RADIUS FORESTED) WERE PAIRED DENSITIES WERE SIGNIFICANTLY HIGHER IN FOREST TRACT 800 HA. NO MALES FOUND ON 350 HA TRACTS WERE PAIRED, 65% OF MALES ON 900 HA TRACTS WERE PAIRED. PAIRING SUCCESS WAS POSITIVELY RELATED TO DISTANCE FROM FOREST EDGE;
/* Natural Divisions – n
/* Breeding periphery – non–wintering
/* Missouri quad percentages 17.9%
/* locally abundant

oven-g = upland-82b + dec-f-91 + for4-rc-29g +
dec-w-73 + for-int-82 + mix-f-64 + ev-for-64

Resulting Missouri Predicted Distribution

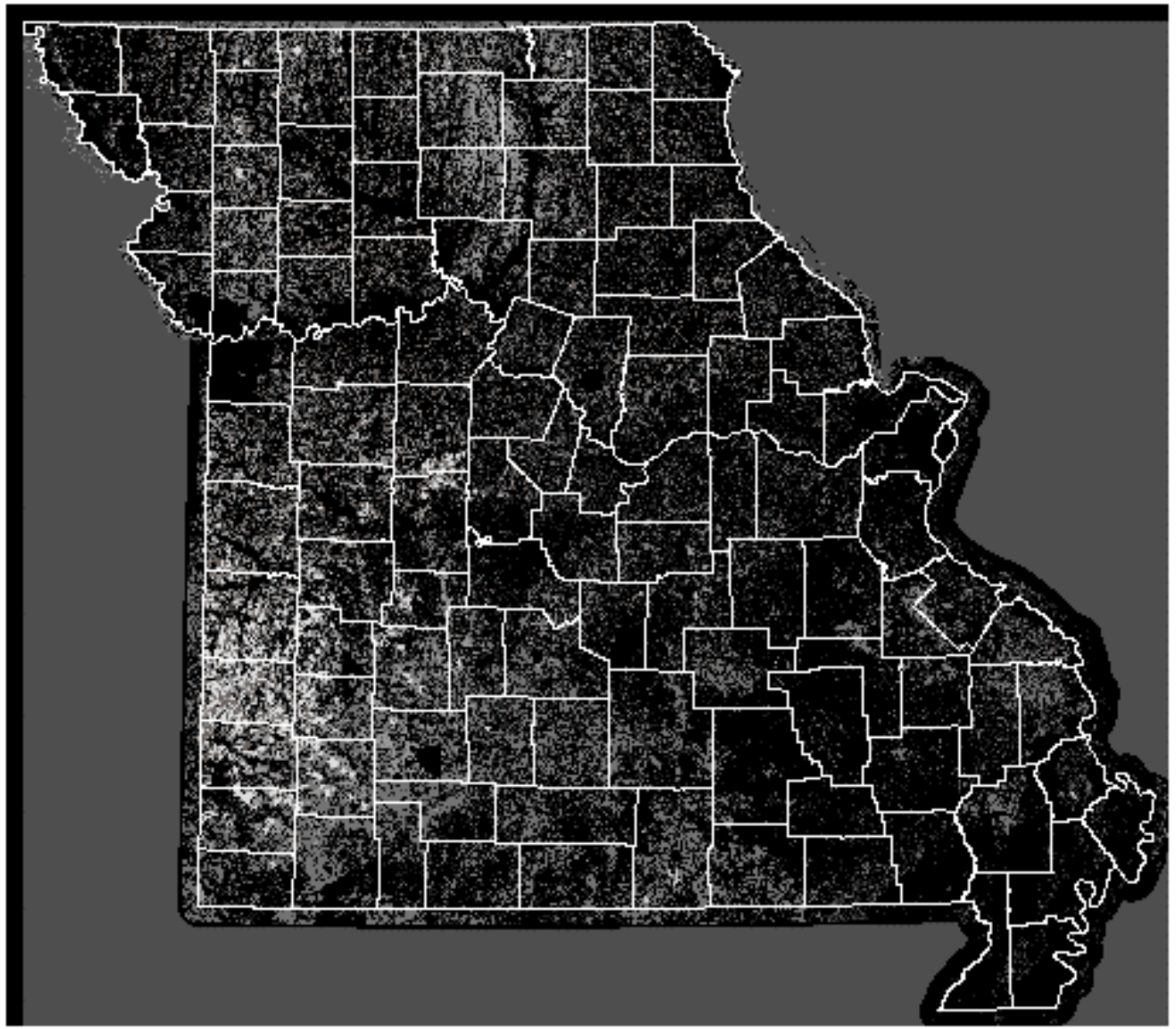


Greater Prairie Chicken (Tympanuchus cupido)

/*GPCH – Greater Prairie Chicken
/* General Habitat:
/* PREFER GRASSLAND TRACTS OF AT LEAST 80 ACRES. SHOULD INCLUDE HERBACEOUS VEGETATION 8–1 6" 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 4 60 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
```

Resulting Missouri Predicted Distribution

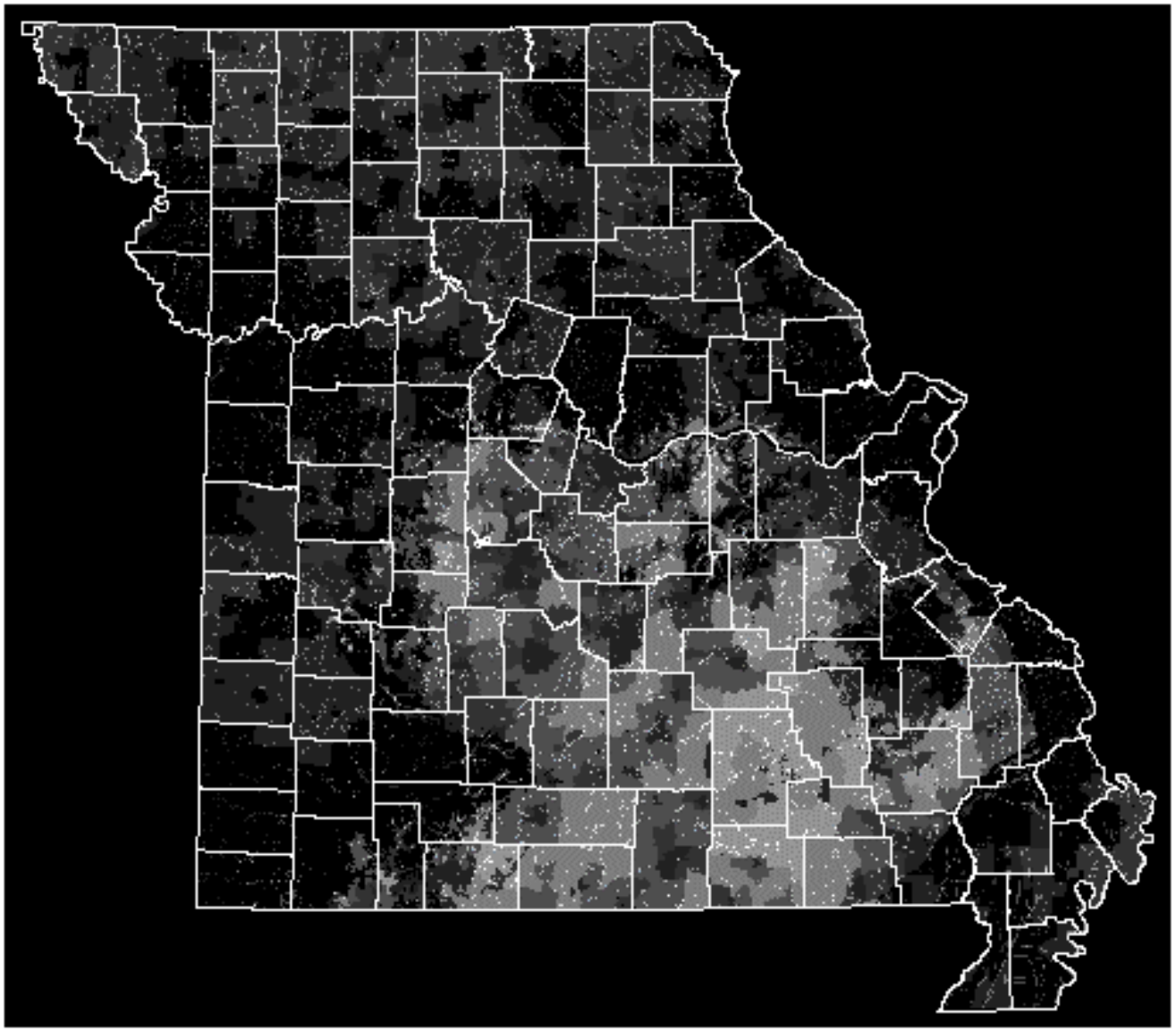


Hellbender (Cryptobranchus alleganiensis)

/* HELLBENDER, EASTERN
/* INHABIT RIFFLES IN STREAMS WITH GRAVEL OR RUBBLE BOTTOMS. USUALLY IN
/* WATER <1 .3 M DEEP. LAY EGGS UNDER LARGE FLAT ROCKS.
/* Breeding Adult Niche Requirements:
/* Bottom Type: gravel, rubble
/* Water Level: permanently flooded
/* Underwater cover: Large flat rock
/* Inland Wetlands: permanent stream
/* Natural Features: riffles
/* IN MO, FOUND IN WATER UP TO 1 .3 M DEEP. NEED FLAT ROCKS TO
/* LAY EGGS UNDER.
/**********
/* HELLBENDER, OZARK
/* INHABIT RIFFLES IN STREAMS WITH GRAVEL OR RUBBLE BOTTOMS. LAY EGGS
/* UNDER LARGE FLAT ROCKS.
/* Breeding Adult Niche Requirements:
/* Bottom Type: gravel, rubble
/* Water Level: permanently flooded
/* Inland Wetlands: permanent stream
/* Natural Features: pools, riffles
/* Underwater cover: Large flat rock

hell-g = riverine-82 + p-strm-91 + rockgeo-91 + pop-d-10-0g

Resulting Missouri Predicted Distribution

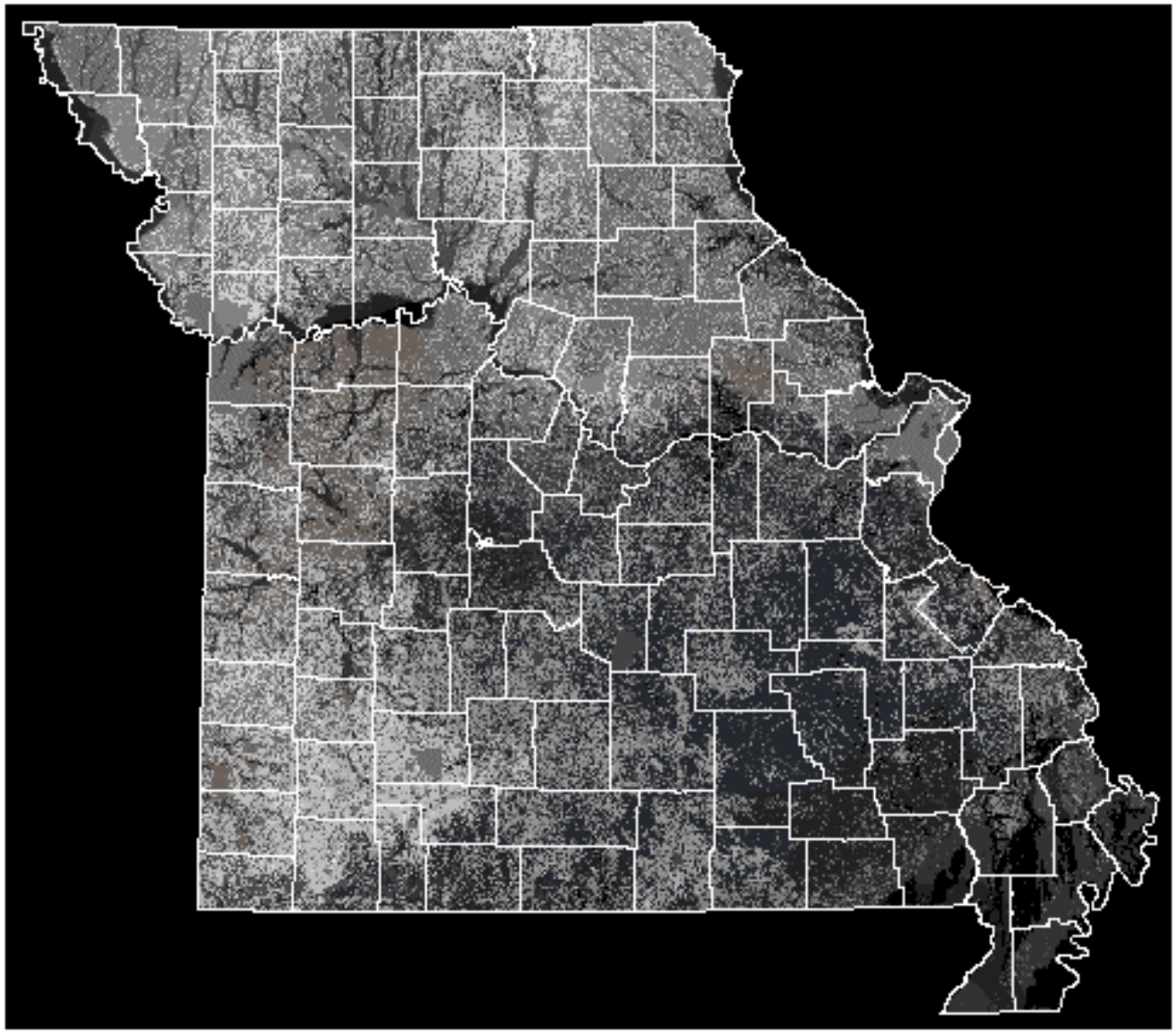


Ornate Box Turtle (Terrapene ornata)

/* TURTLE, ORNATE BOX
/* OCCUR IN GRASSLAND, OPEN WOODLAND AND CEDAR GLADES NEAR RIVERS OR
/* STREAMS.
/* **Breeding Adult Niche Requirements:**
/* Sandy soil
/* Abandoned field successional stage
/* Stable prairie/grassland successional stage
/* Climax grassland successional stage
/* MAY BE FOUND NEAR RIVERS, STREAMS, OR SMALL CREEKS, FREE
/* WATER IS IMPORTANT . FOUND IN TREELESS PLAINS, PRAIRIES, PASTURES, OPEN
/* WOODLANDS AND FIELDS, AND CEDAR GLADES.
/*

orboxt-g = jult-1-10g2 + grass-82 + eco-f-g-82 + eco-evg-g-91 +
glade-nf-91 + prair-nf-73 + for-int-37 + upland-82b +
str-g-82 + g2-1x-19 + finegeo-91

Resulting Missouri Predicted Distribution

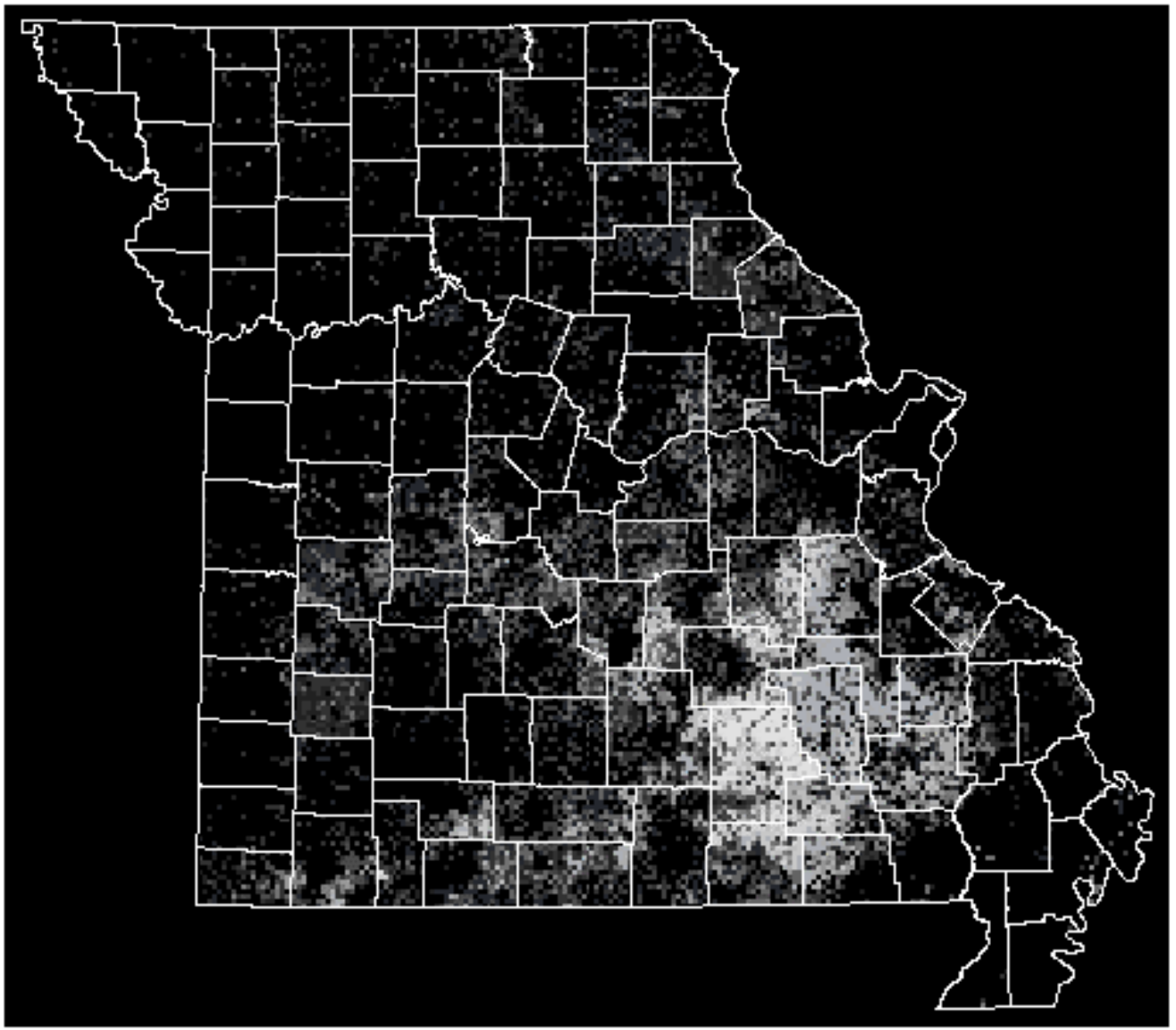


Black Bear (Ursus americanus)

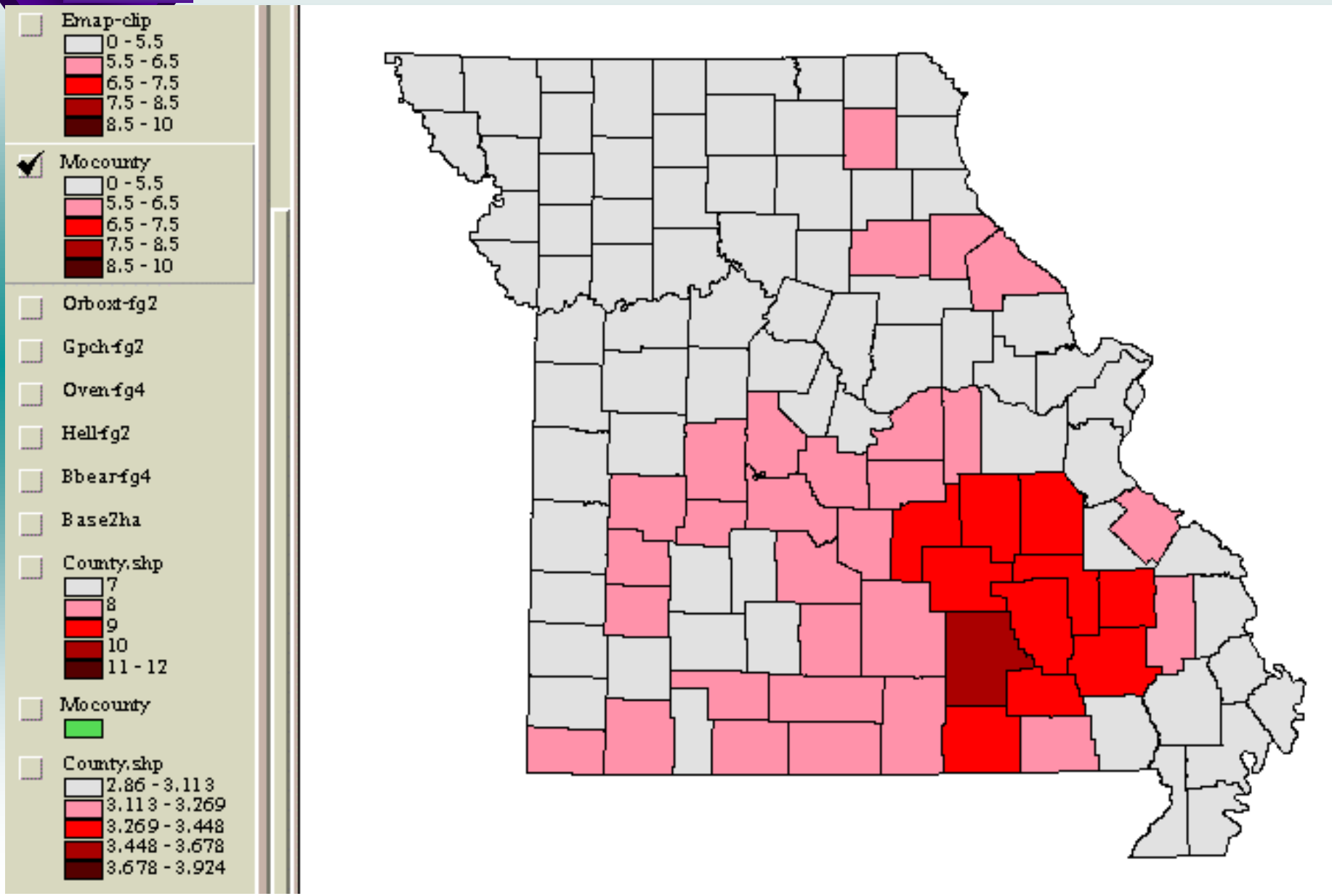
/* Black Bear
/* INHABIT FORESTS WITH SNAGS, DENSE THICKETS AND BRUSH PILES.
/* Breeding Adult Niche Requirements:
/* Elevation specified in comments
/* Inland Wetlands: swamp
/* Natural Features: caves, dry
/* Slope specified in comments
/* Abandoned field successional stage
/* Distance to water specified 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
```

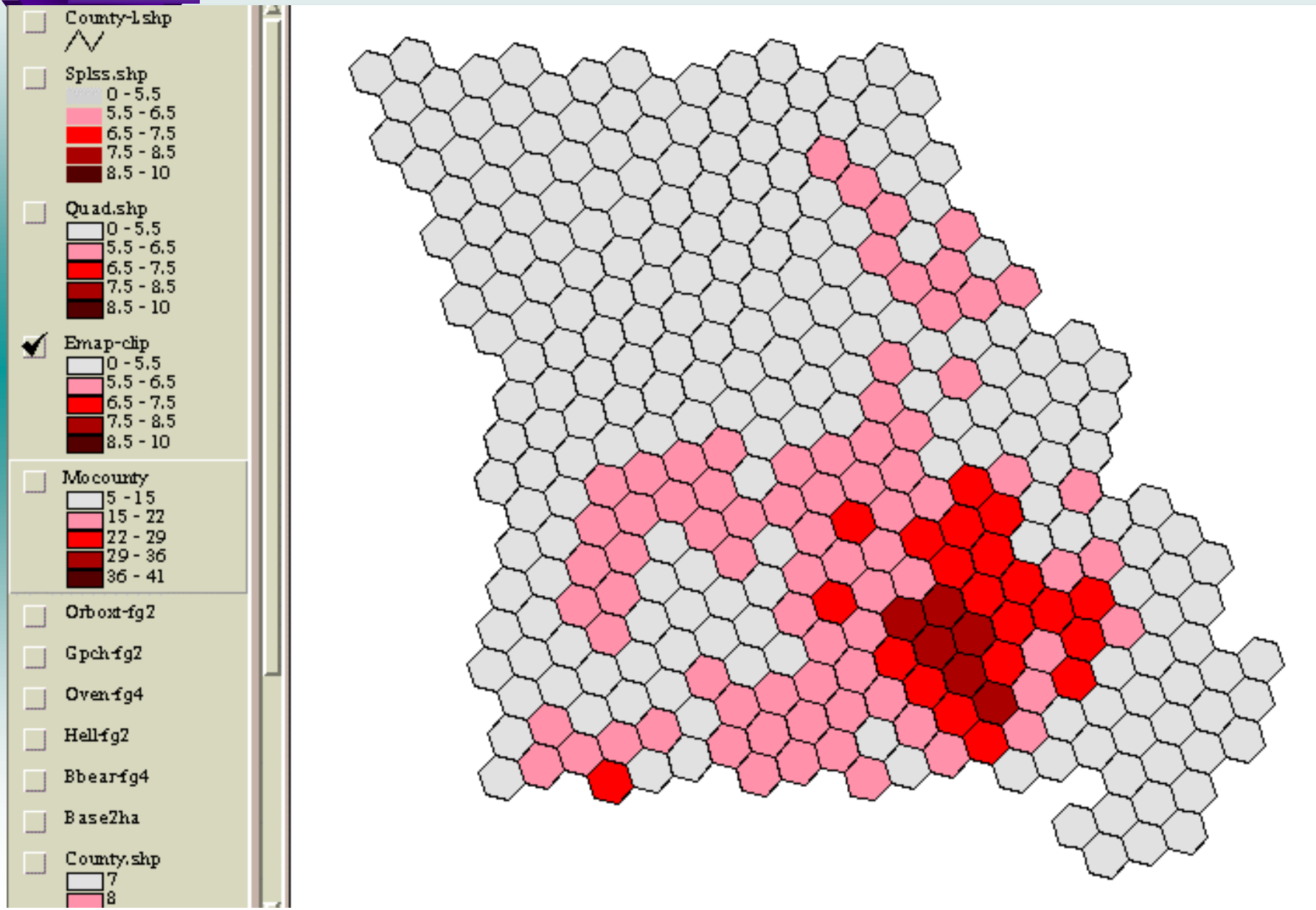
Resulting Missouri Predicted Distribution



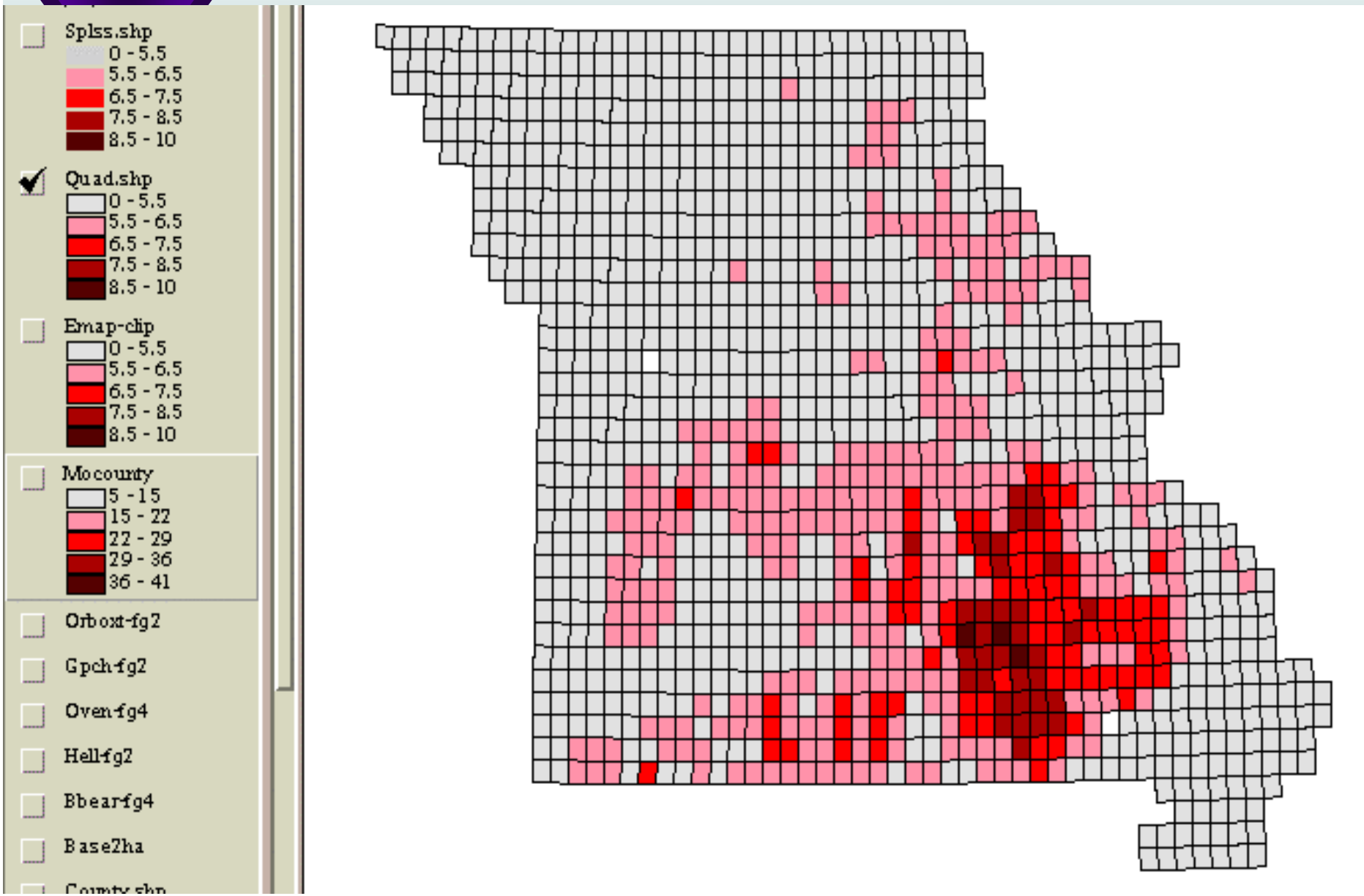
Reporting Level - County



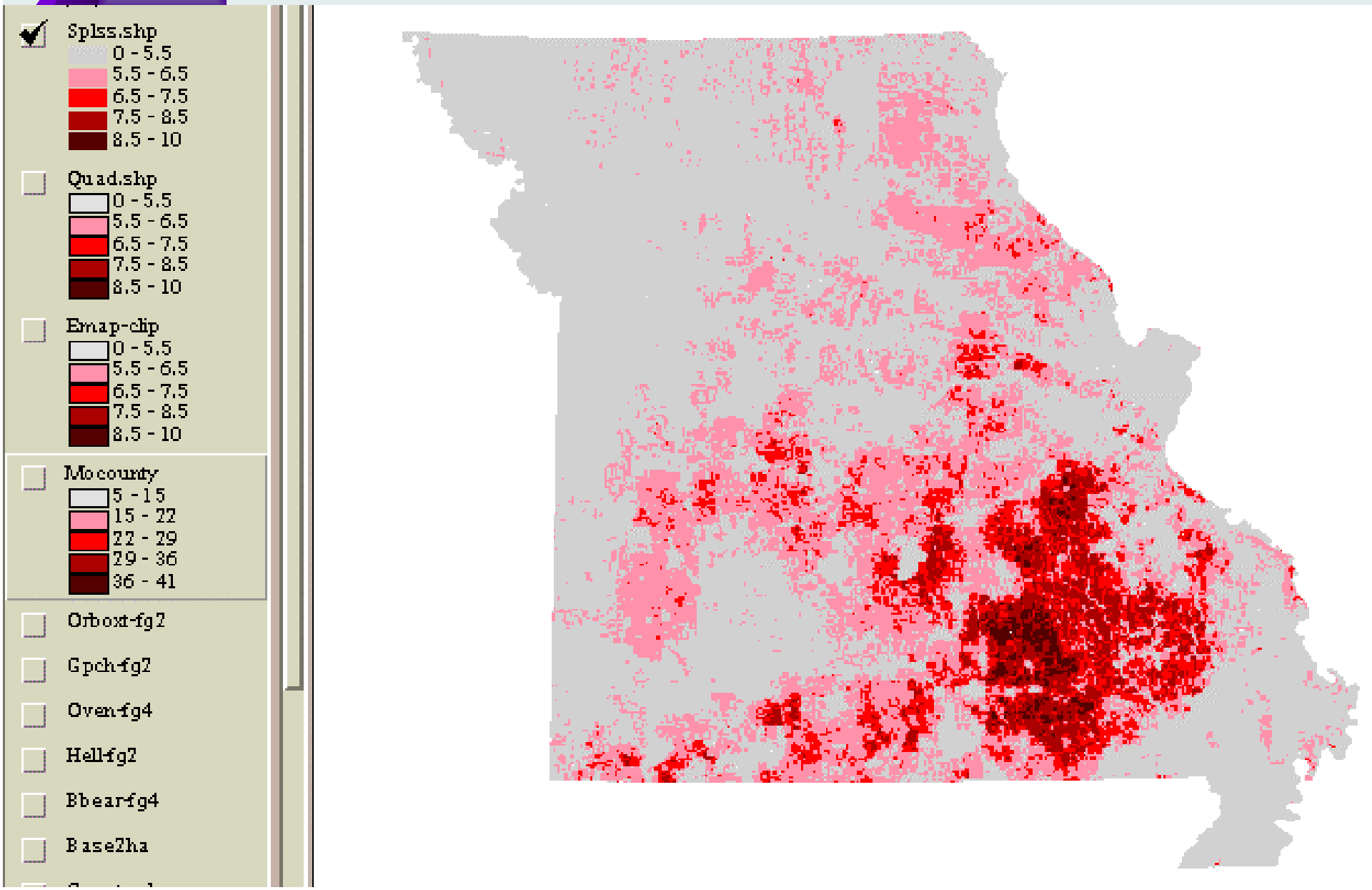
Reporting Level EMAP Hexagons



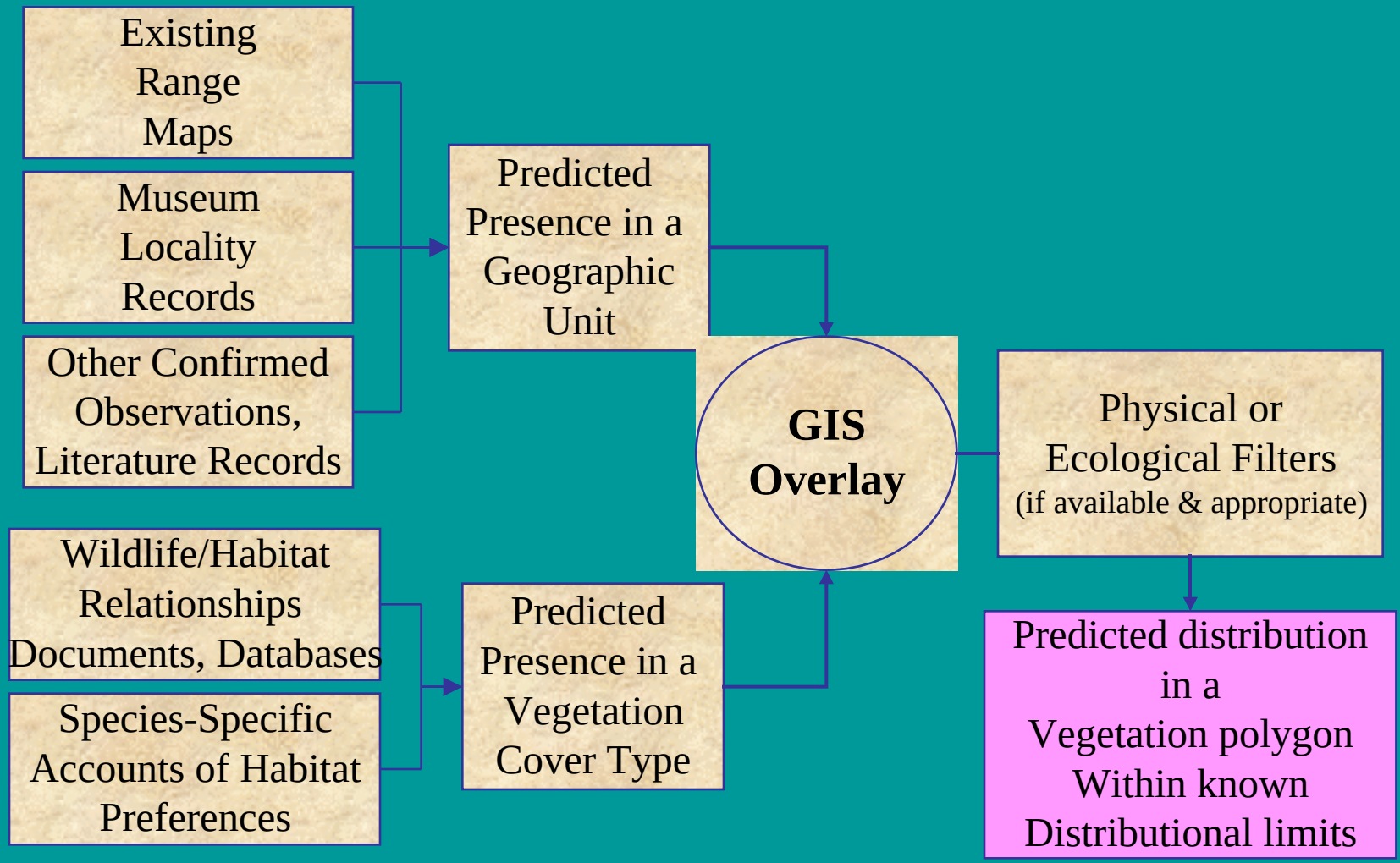
Reporting Level Quadrangles



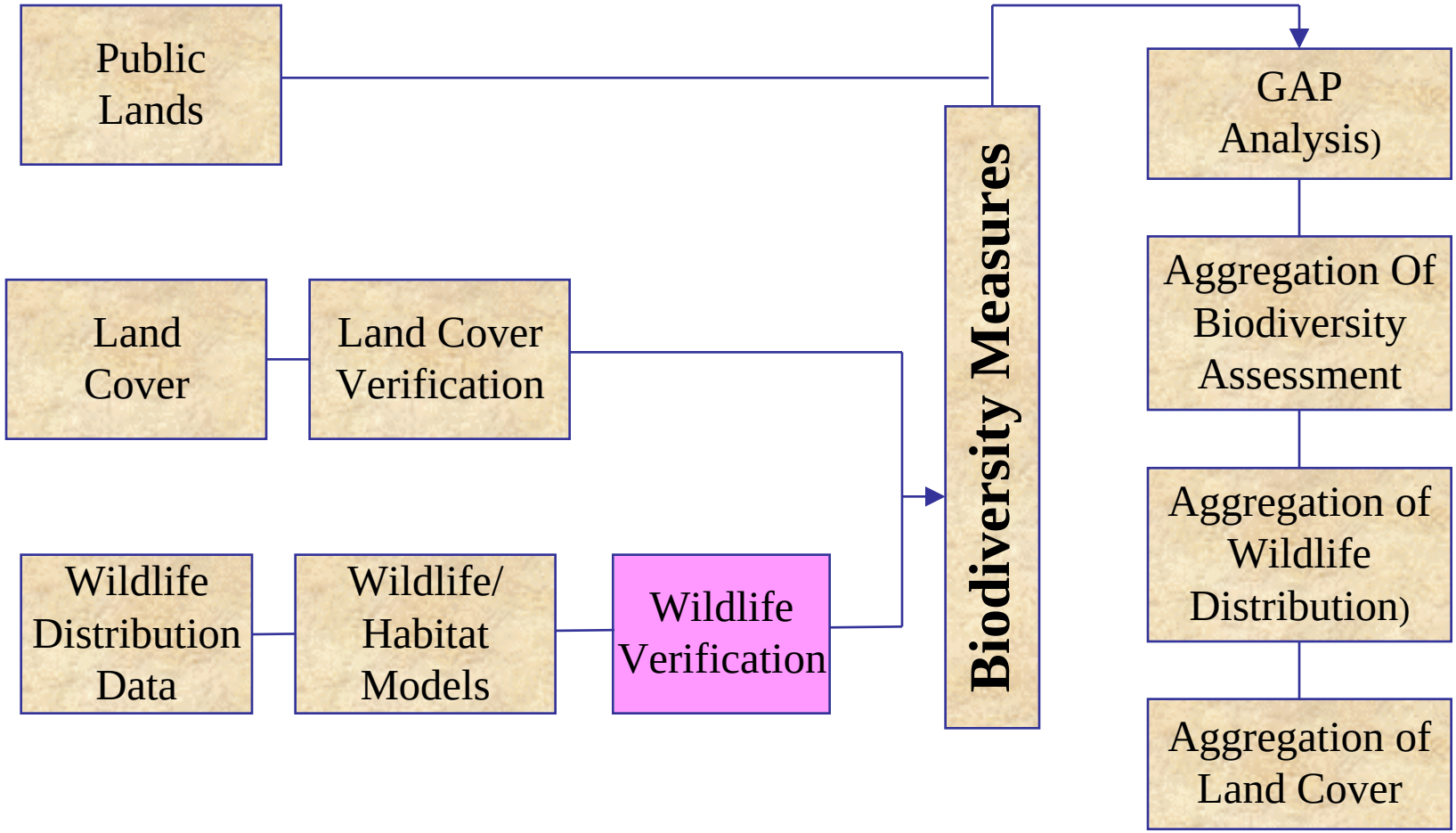
Reporting Level Sections



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



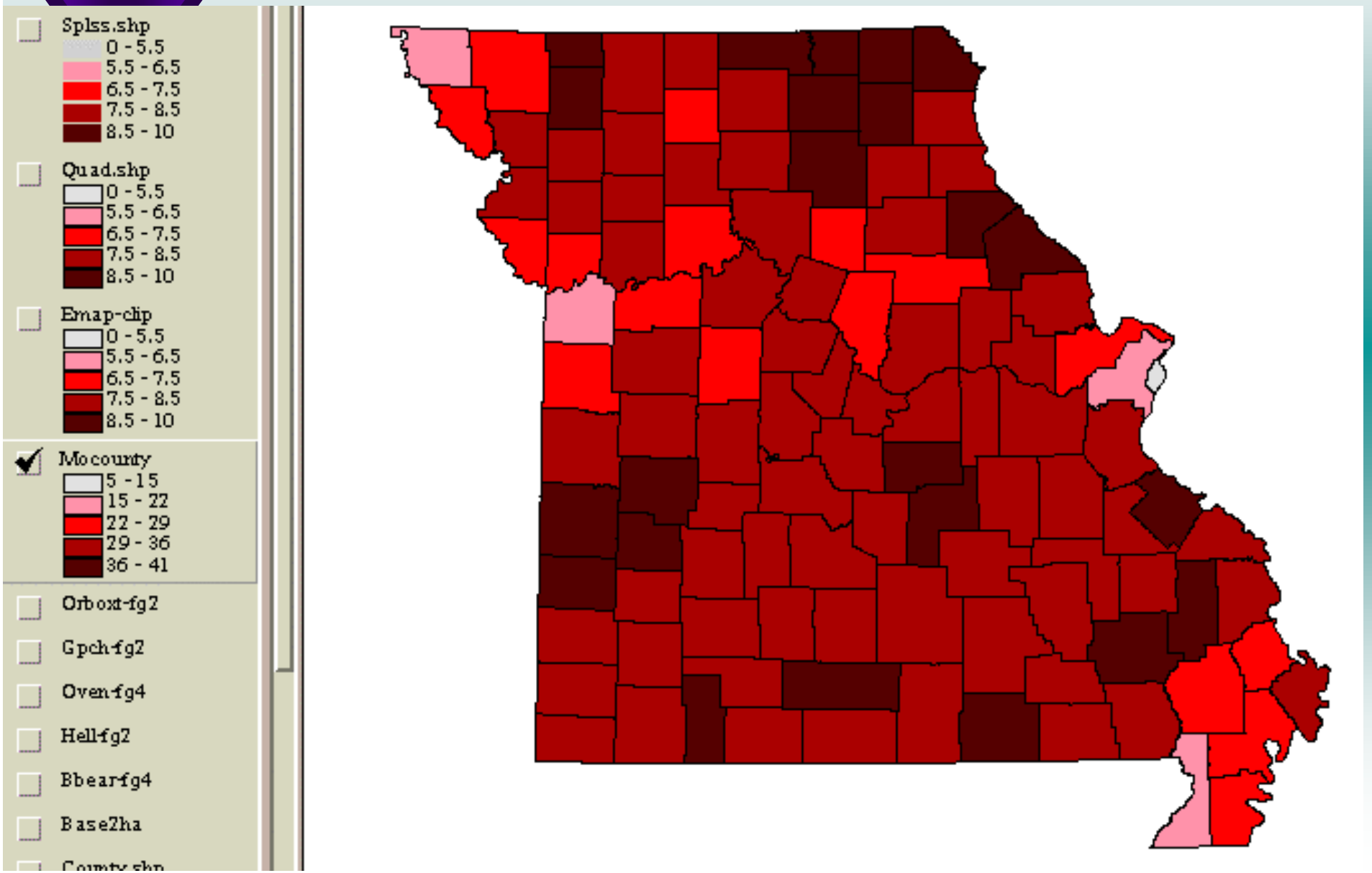
Data Resources

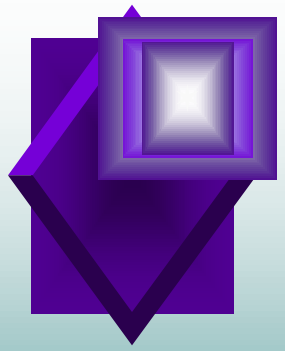


Wildlife Verification

- Sampling scheme
- Sampling effort
- Sampling methodologies - herps / birds / mammals
- Testing and model evaluation
- Presence / absence

Mammal Species Richness





- 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 to enhance cartographic ease.

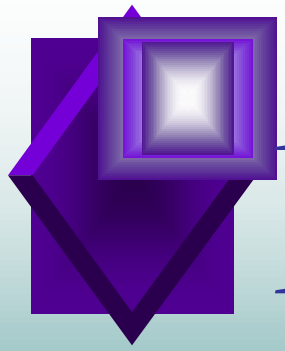
In some types of operations…

the accuracy of suitability is determined by the accuracy of the least accurate layer.

In other cases…

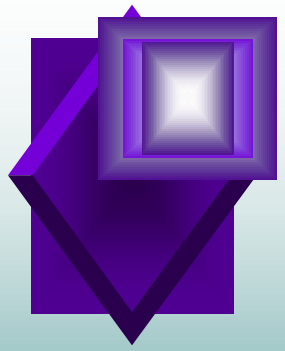
the accuracy of the result is significantly better than the accuracy of the least accurate layer.

How then do we determine the impact of inaccuracy on the result?



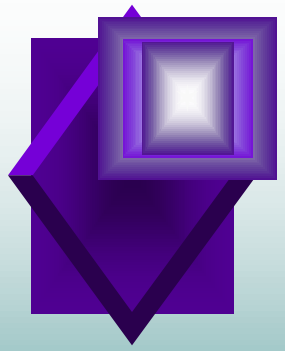
Effects of Cascading on an Error will be Complex

- Do errors get worse?
- Do errors cancel out?
- Are errors independent or related?



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.



Inaccuracy arises primarily from...

- **Randomness**
  - May occur when an observation can assume a range of values
- **Vagueness**
  - May result from imprecision in taxonomic definitions
- **Incompleteness of Evidence**
  - May occur when sampling has been applied, there are missing values, or surrogate variables have been employed.

Data Layers

GAP ANALYSIS

1. Current Vegetation Cover (1:100K; 240 AC MMU)
2. Vertebrate Dist./Habitat Relations.
3. Heritage/Special Features.
4. Public Land Ownership

GAP ANALYSIS II

1. ECS Layer (LTA all; ELT select lands)
2. Historic Vegetation (use in ECS)
3. Current Veg. Cover (1:24K; 5ac MMU)
4. Aquatic Resources
5. Heritage Special Features
6. Public Land Ownership
7. Potential Conflicts/Threats
8. Recreation/Interp/Education
9. Resource Commodities

Biodiversity Assessment Strategy

GAP ANALYSIS

1. Use veg. cover and species dist / habitat relations to identify centers of potential species richness.
2. Overlay current public land ownership and identify gaps in conservation network.

GAP ANALYSIS II

1. Divide State & Planning Sections into Ecological Units (ECS)
2. Describe Historic Conditions (Hist. veg., ECS).
3. Assess Current Resource Status Trends (includes biological, as well as social & economic resources).
4. Develop Regional Resource management objectives.
5. Identify Resource Management Opportunity Areas (GAP)
6. Implement & Monitor Resource Management Objectives

Additional Resource Assessment

GAP ANALYSIS

None Planned

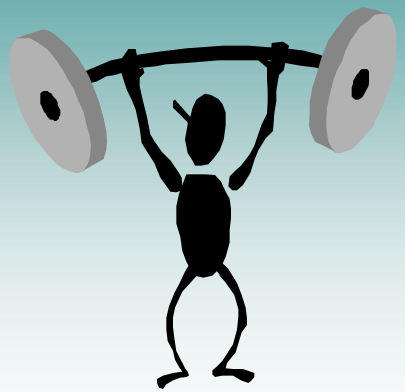
GAP ANALYSIS II

1. Identify potential conflicts/threats.
2. Use Rec/Interp/Educ layer to assess needs & identify regional objectives/strategies.
3. Use resource commodity information to assess needs and identify regional objectives/strategies.
4. Allocate lands/programs to integrate resource conservation & use.

Strengths of Program

GAP ANALYSIS

1. Current funding/staff in place.
2. Utilization of existing GRC resources (equipment, labor, etc.)



GAP ANALYSIS II

1. Develops information/methods to support coordinated management/planning within MO.
2. Focus conservation on ecosystems.
3. Higher resolution necessary for regional & area planning.
4. Adds use of natural resources (Red/Educ/Commodity) into conservation equation.
5. Develops interagency coordination/support

Weaknesses of Program

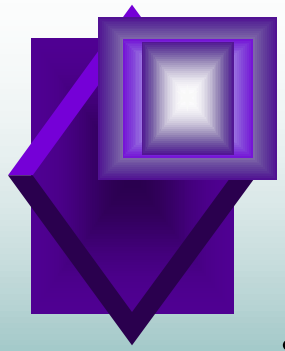
GAP ANALYSIS

1. Designed to meet national scale conservation objectives.
2. Focus on species richness, not ecosystems.
3. Gross information resolution.
4. Questionable species dist/habitat information
5. Questionable interagency coordination/support

GAP ANALYSIS II

1. No current funding/staff.
2. Higher costs of developing ECS, pres. veg., veg. cover map.

GIS helps us see the context ***as well as the*** substance ***of our problems more clearly and enables us to deal with them more effectively.***



The development and implementation of a GIS...

... goes ***beyond*** a simple increase in speed with which we can produce maps, or even the increase in the quality of our maps.

...GIS ***offers*** the ***capability*** and ***capacity*** of making changes in the way in which we solve problems.

...GIS will ***alter*** the ***quality of information*** on which we base the decisions required to solve problems.