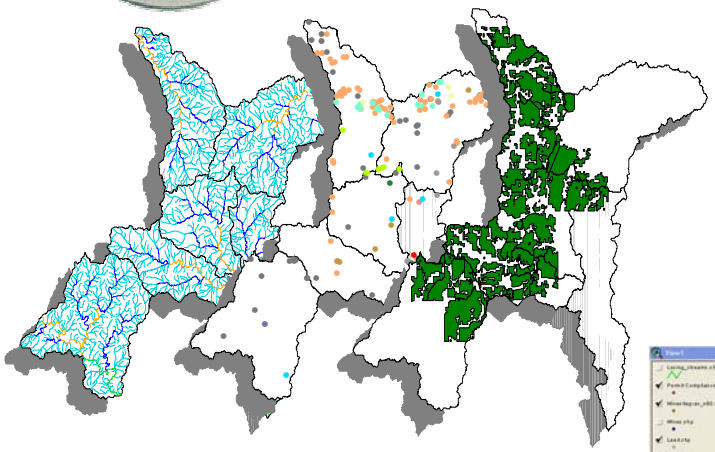
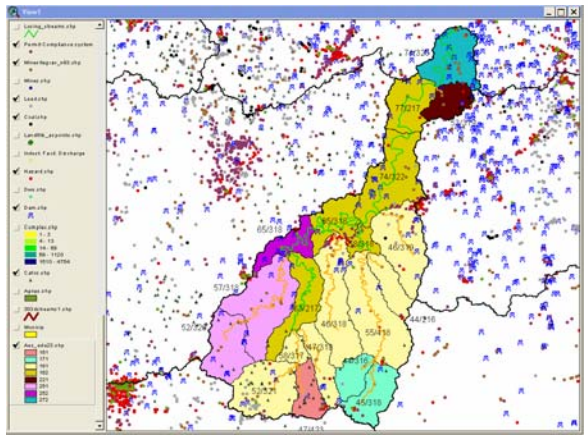
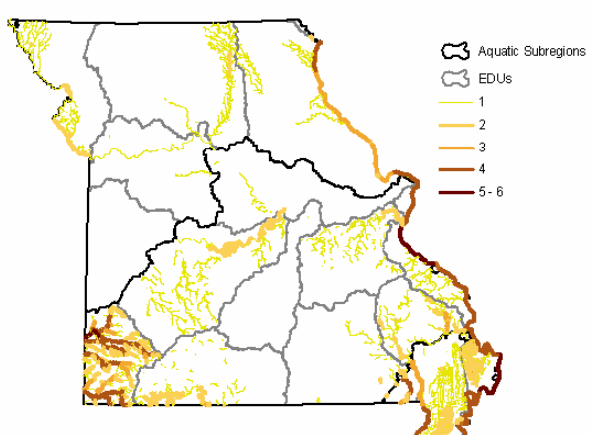
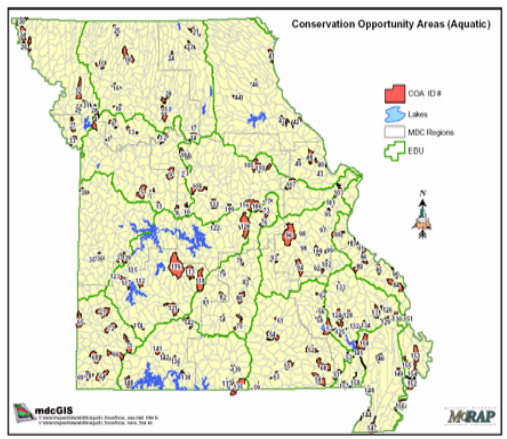
Overview of Relevant MoRAP Projects









Phase 1 Planning Workshop

September 6th and 7th 2006

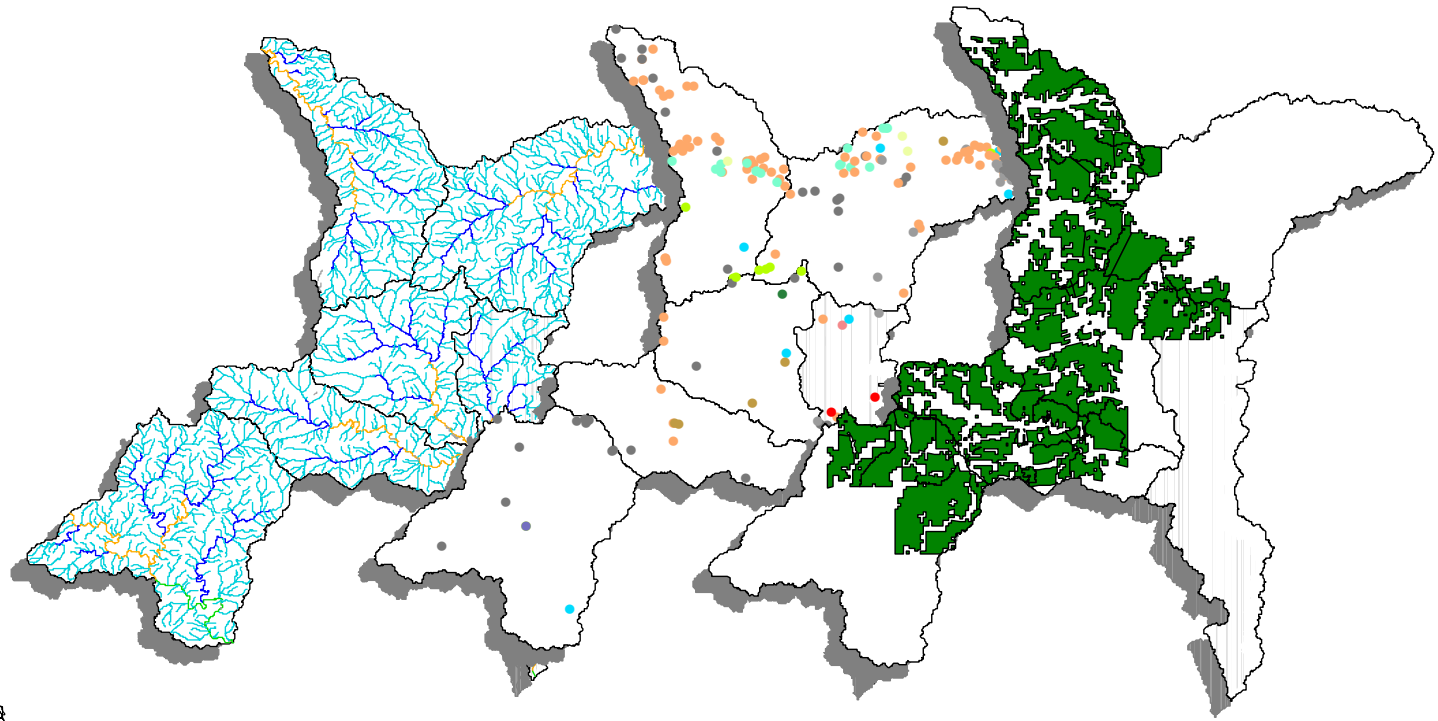
Richard A. Schoettger Conference Building

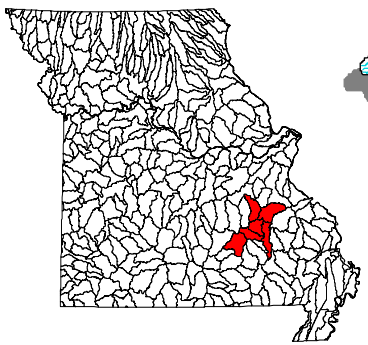
USGS Columbia Environmental Research Center

4200 New Haven Road, Columbia, MO 65201

A Watershed Inventory for Select Watersheds Draining MTNF Lands

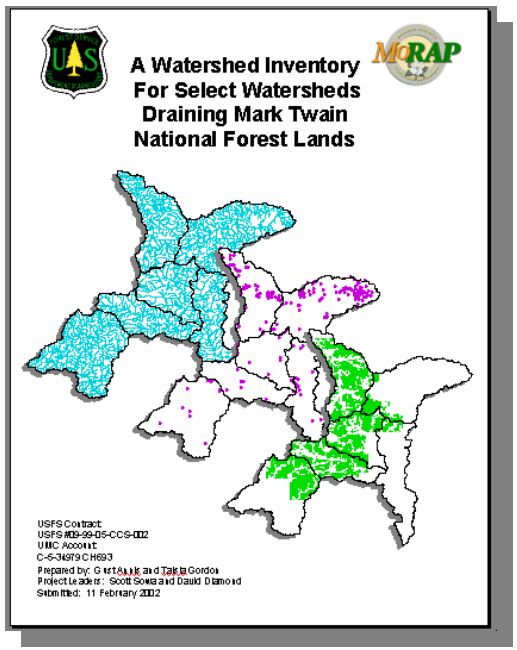
February 11, 2002

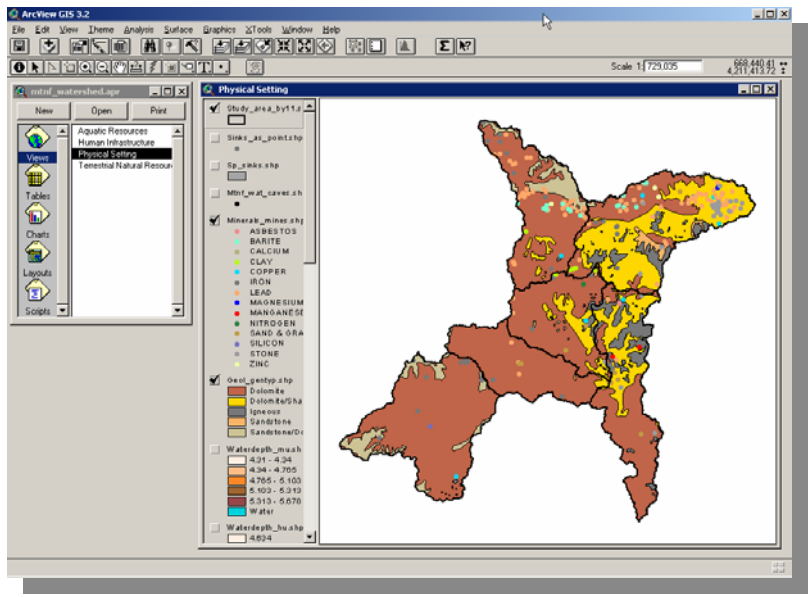




Products

1. Map and table-based printed report
2. ArcView project
3. CD of data layers including coverages, grids, shapefiles, and tables





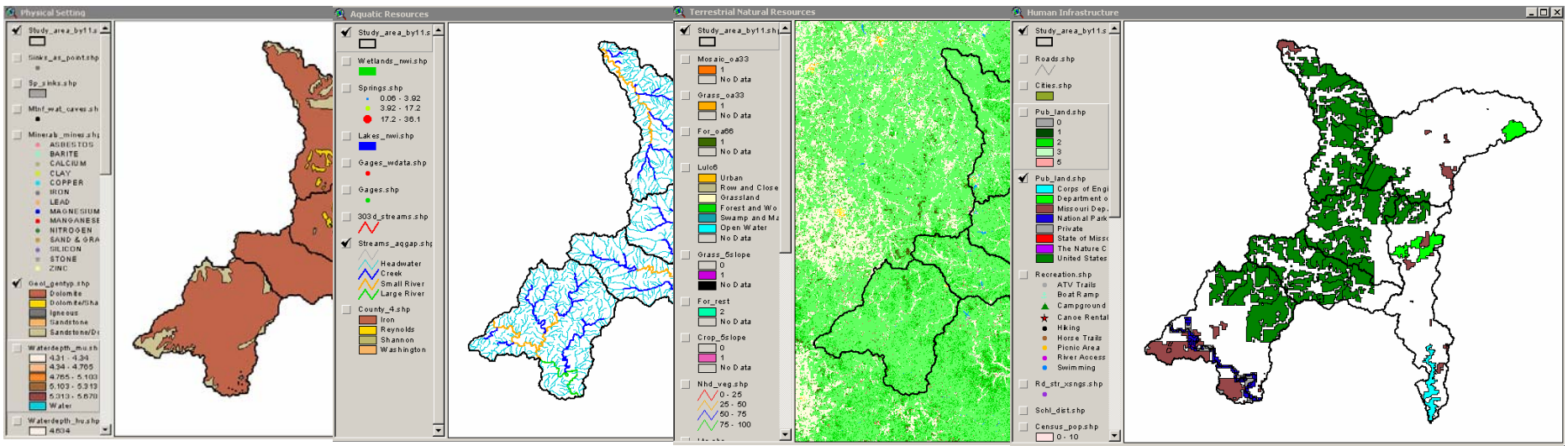
Product Structure

- Physical Setting
  - ✓ Climate
  - ✓ Geophysical
- Terrestrial Resources
  - ✓ Land Cover
  - ✓ Conservation and Restoration Sites
  - ✓ Terrestrial Species
- Aquatic Resources
  - ✓ Stream data
  - ✓ Lakes, Springs, Wetlands
  - ✓ Aquatic Species
- Human Infrastructure
  - ✓ Transportation
  - ✓ Public Lands / Recreation
  - ✓ Point source pollution and facilities

ArcView Project

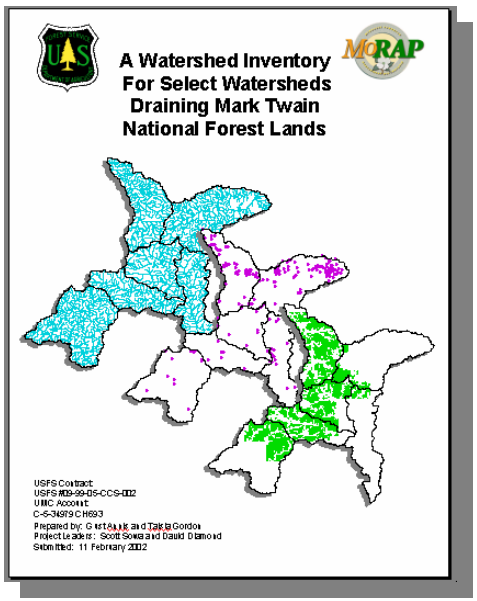
- Designed with four distinct Views
- Each view represents a compilation of themes by category
- Folders within categories contain relevant .dbf files and useful legends
- Structure, views and themes correspond with report

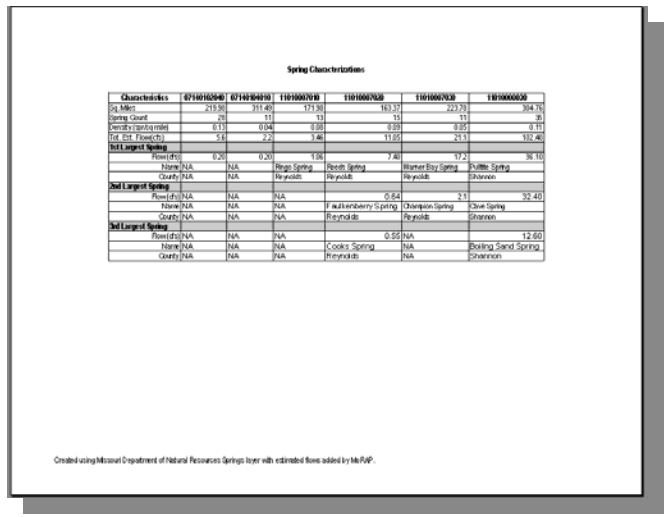
Physical Setting **Aquatic Resources** **Terrestrial Resources** **Human Infrastructure**



Map and Table-based Report

- 134 page report organized into four sections that correspond with four ArcView project views
- Structured as a series of maps and tables
- Indexed by a table of contents
- Most maps have an accompanying table and vice versa





The Missouri Aquatic GAP Pilot Project

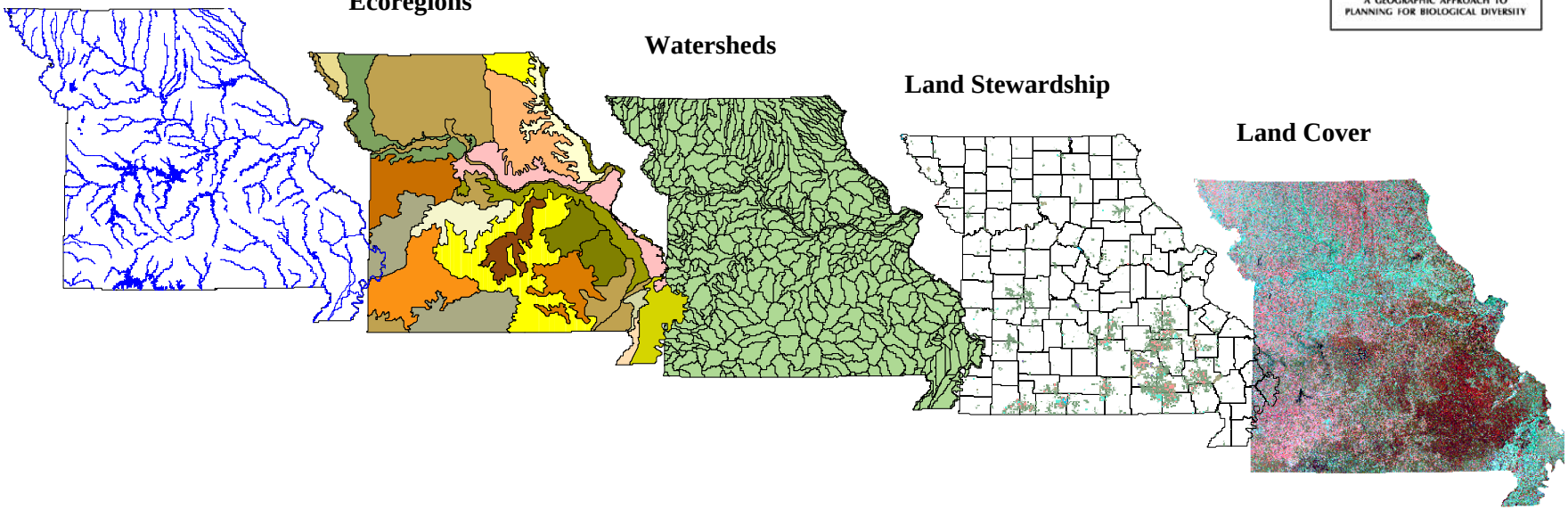
Surface Waters

Ecoregions

Watersheds

Land Stewardship

Land Cover



Objectives

- Assess how well various elements of biodiversity are represented within the existing matrix of public lands

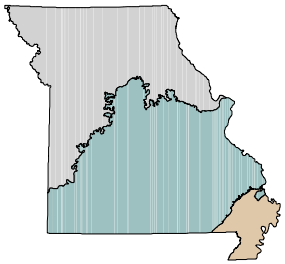
- Identify habitat types and species not adequately represented in the current network of biodiversity management areas

Four Principal GIS Datasets

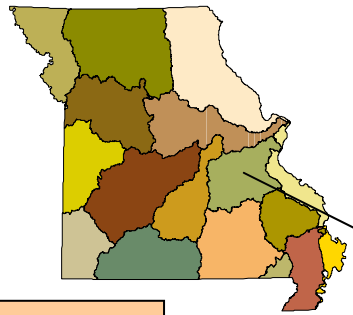
- Hierarchical riverine ecosystem classfication
- Predicted species distribution models
- Local, watershed, and upstream network ownership/stewardship
- Human Threat Index

Levels 4-7 of Hierarchy

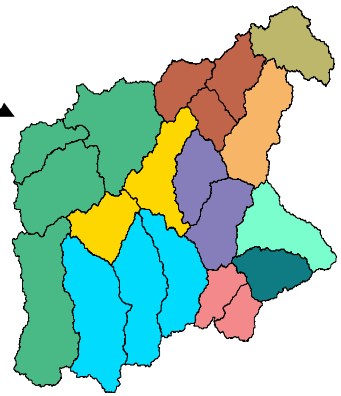
Level 4
Subregions



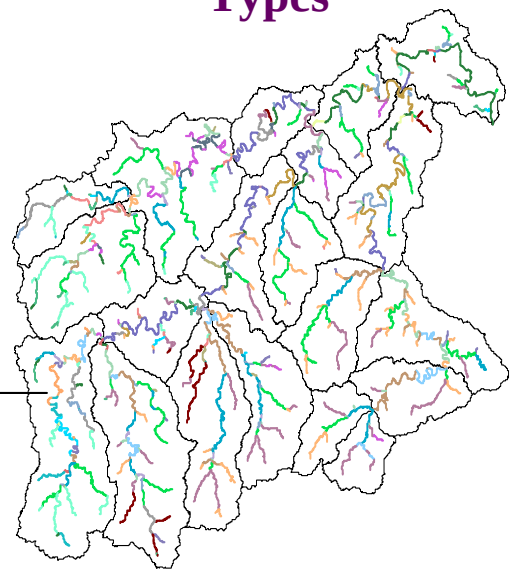
Level 5
Ecological Drainage Units



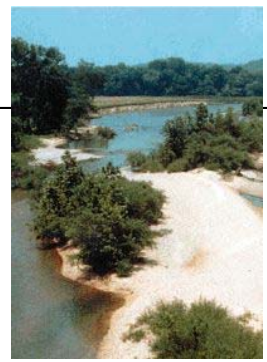
Level 6
Aquatic Ecological System Types



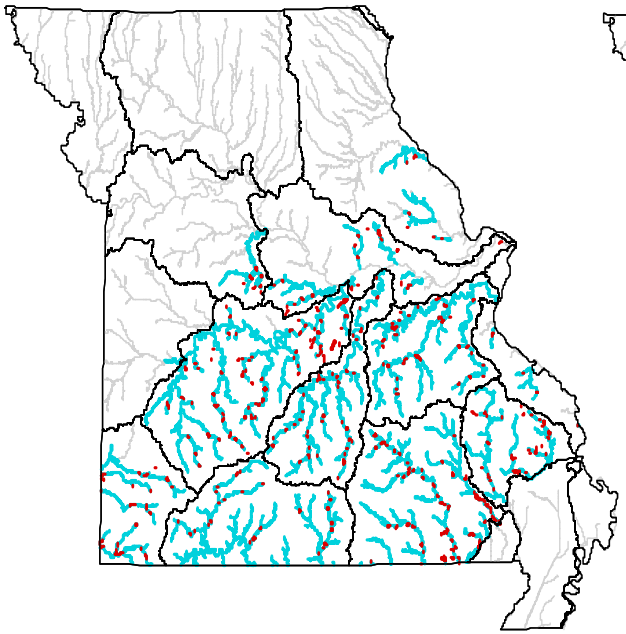
Level 7
Valley Segment Types

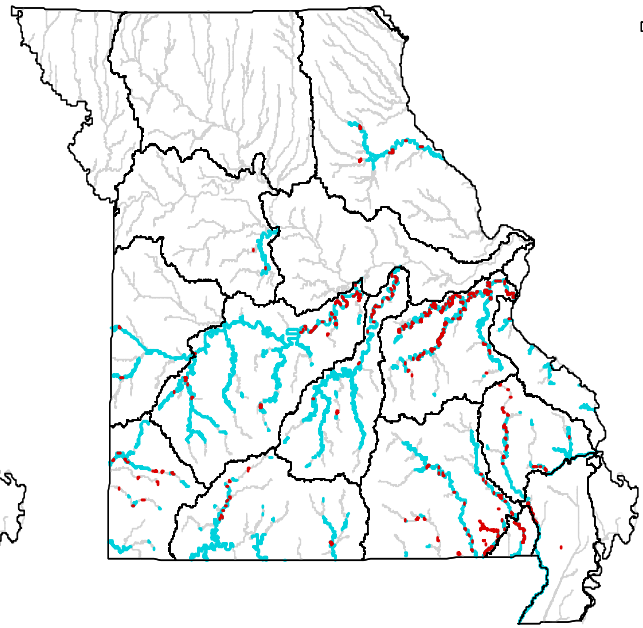


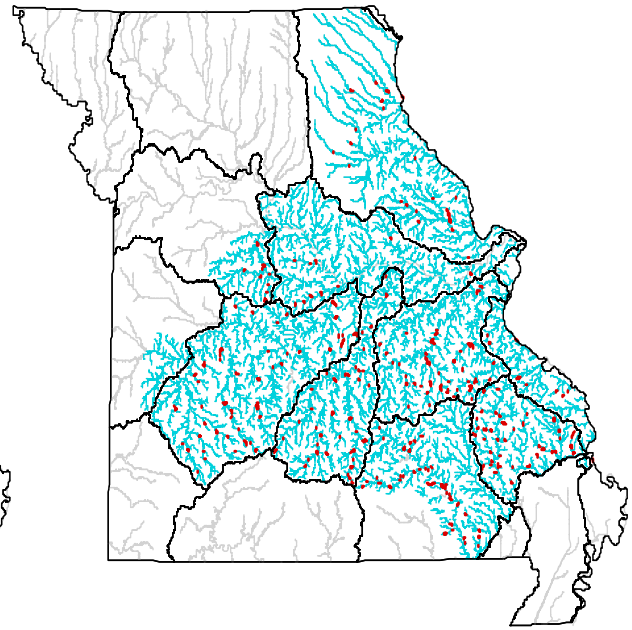
Zone:
Nearctic zoogeographic zone
Subzone:
Arctic/Atlantic Drainages
Region:
Mississippi Drainage
Subregion:
Ozark Plateau
Ecological Drainage Unit:
Ozark Plateau/Meramec Drainage
Aquatic Ecological System:
Upper Meramec/Dry Fork, Oak/Woodland Plain, sandstone dominated, low gradient and spring density stream complex
Valley Segment Type:
Warm, perennial, creek with a relatively high gradient, flowing through sandstone, and connecting to another creek



Predicted Distribution Models







Black redhorse

Round pigtoe

Golden crayfish

- 571 total models constructed for 315 different species
  - Anywhere from 1 to 4 models developed for each species

“Hyperdistribution”

Plains: 10 Species

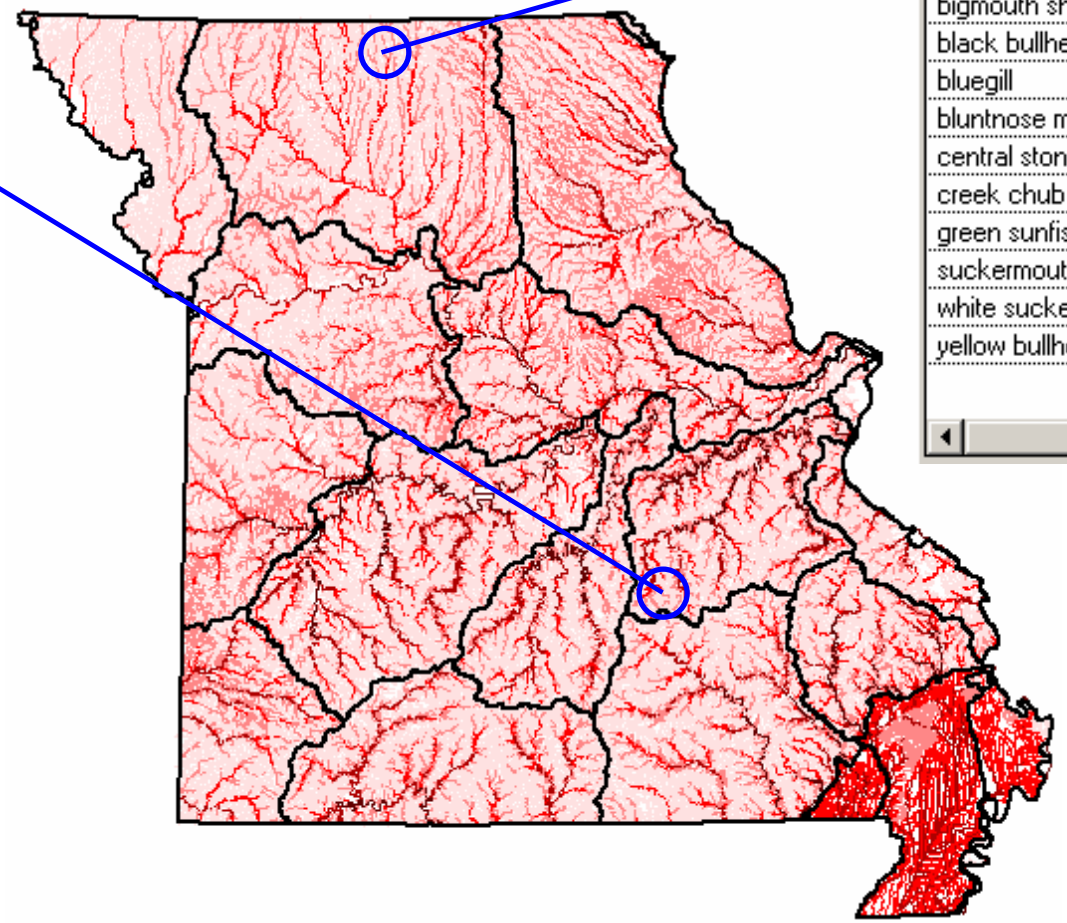
sum7.dbf

Vernacular
bigmouth shiner
black bullhead
bluegill
bluntnose minnow
central stoneroller
creek chub
green sunfish
suckermouth minnow
white sucker
yellow bullhead

Ozarks: 27 Species

sum6.dbf

Vernacular
Ozark minnow
bigeye chub
black bullhead
blackspotted topminnow
bleeding shiner
bluegill
bluntnose minnow
brook silverside
central stoneroller
common carp
creek chub
creek chubsucker
golden redhorse
golden shiner
green sunfish
greenside darter
largescale stoneroller
logperch
longear sunfish
northern hog sucker
northern studfish
plains topminnow
rainbow darter
slender madtom
smallmouth bass



Species Habitat Reports

Banded Darter
Etheostoma zonale

Native: Yes

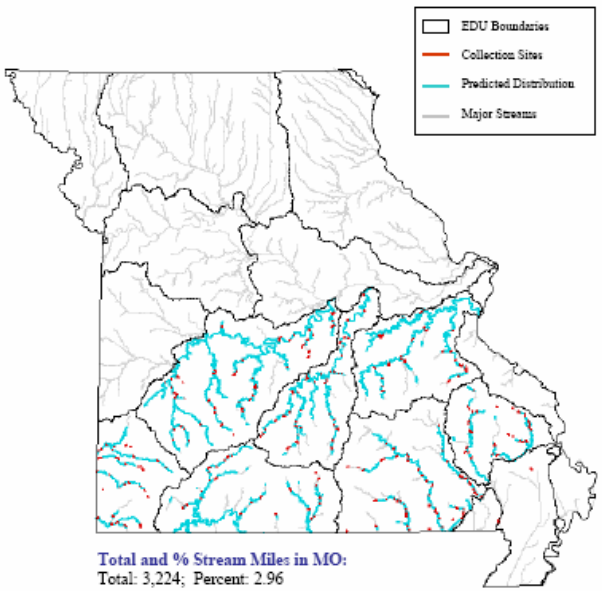
Endemism: Region

State Rank: S?

ITIS Code: 168449

Global Rank: G5

Modeled By: Gust Annis, Pam Haverland
Michael Morey, Scott Sowa,
John Stanovick



Total and % Stream Miles in MO:
Total: 3,224; Percent: 2.96

State Range:
The Banded darter can be found in all the principal drainage systems of the Ozarks where it is one of the most abundant and widespread darters (Pflieger 1971). However, it is not found in the short, direct tributaries of the Mississippi River. Its distribution in Missouri is remarkably similar to the greenside darter (Pflieger 1997).

Habitat Affinities:
Adult banded darters are often found in swift riffles over gravel or rubble bottoms (Cross and Collins 1975; Etnier and Starnes 1993; Pflieger 1971; Robinson and Buchanan 1988). They are found in abundance within rocky riffles having dense growths of filamentous algae (*Cladophora*), eel grass (*Valisneria*) pondweed (*Potamogeton*) (Lachner et al. 1950; Miller and Robinson 1973; Pflieger 1997) or aquatic mosses (Trautman 1957). Juveniles prefer quiet water around emergent aquatic plants such as waterwillow (*Justicia*) (Pflieger 1997) or in accumulations of leaves (Robinson and Buchanan 1988). Trautman (1957) found that spawning concentrations were highest in riffles of streams with moderate to high gradients with a width less than 50 ft. and depth less than 2 ft. Trautman (1957) also found that the banded darter winters in deeper waters.

Predictive Model(s):

Ozark Model
(([Linkr] = 5) and ([Rgrad_subr] >= 1) and ([Rgrad_subr] <= 2)) or (([Linkr] >= 6))

Mississippi Alluvial Basin Model
The distribution is based upon existing collection records and professional review.

References:

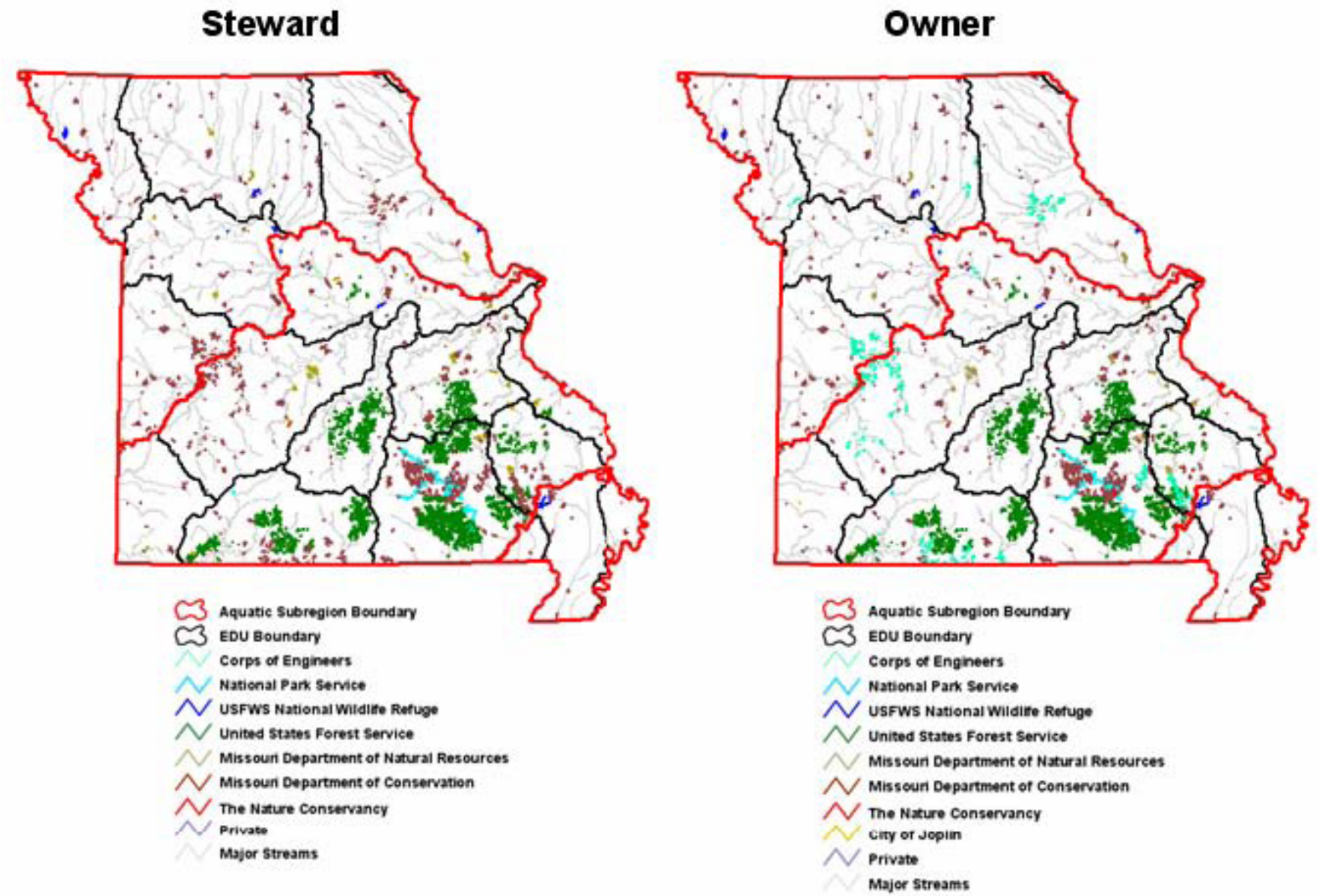
Aadland, L. P, C. M. Cook, M. T. Negus, H. G. Drewes and C. S. Anderson. 1991. Microhabitat preferences of selected stream fishes and community-orientedapproach to instream flow assessments. Minnesota Department of Natural Resources, Section of Fisheries. 142 pp.

Adamson, S.W. and T.E. Wissing. 1977. Food habits and feeding periodicity of the rainbow, fantail, and banded darters in Four Mile Creek. *Ohio Journal of. Science* 77(4):164-169.

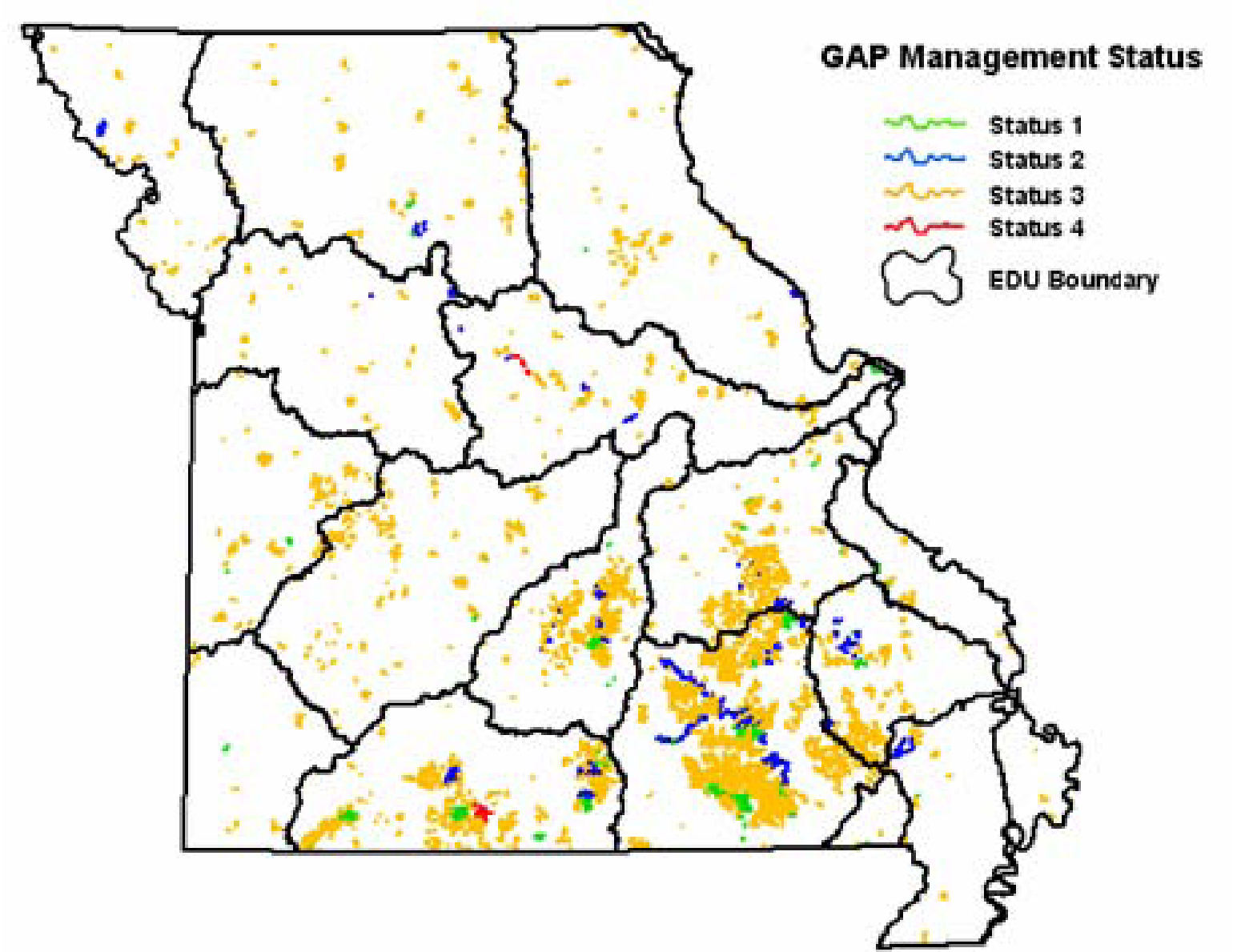
Bart, H. L., Jr., and L. M. Page. 1992. The influence of size and phylogeny on life history variation in North American percids. Pages 553-572 in R. L. Mayden, editor. Systematics, historical ecology, and North American freshwater fishes. Stanford University Press, Stanford, California. xxvi + 969 pp.

Becker, G. C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison. 1052 pp.

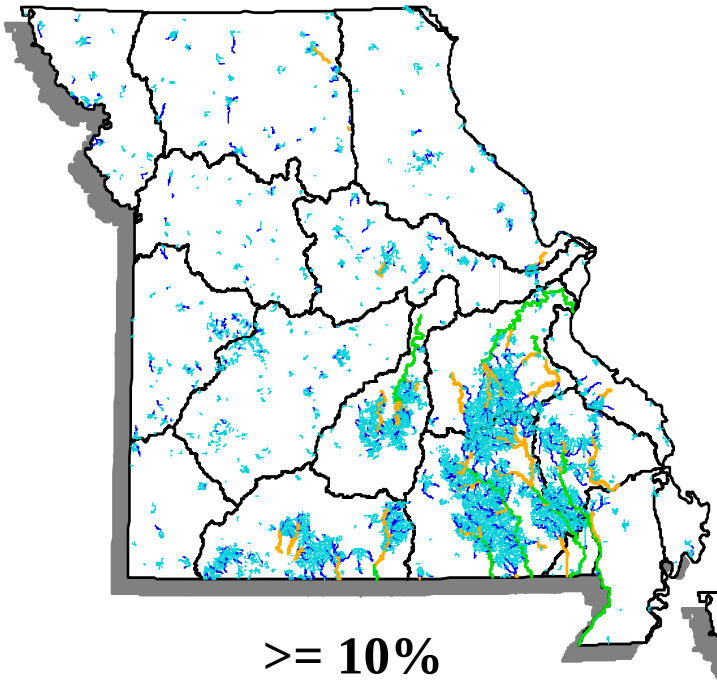
Ownership and Stewardship



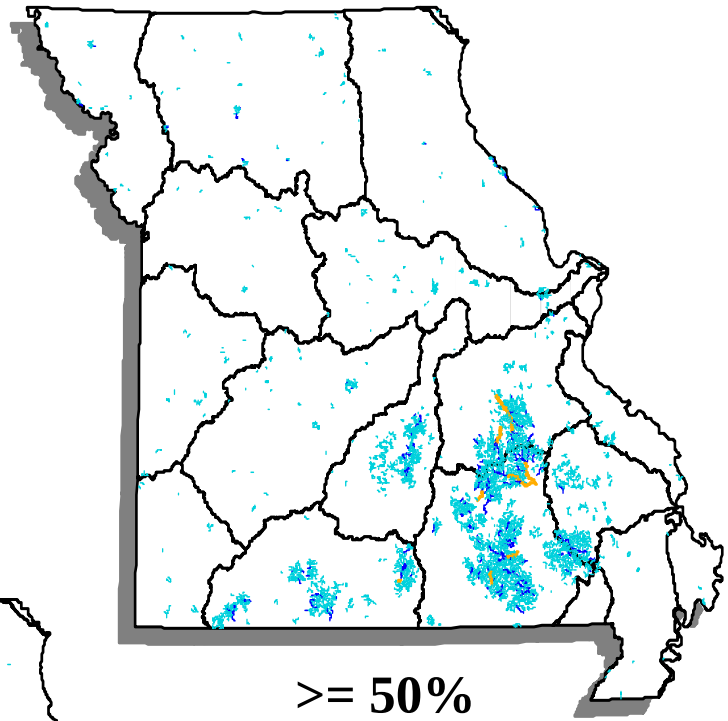
Mapping Local Stewardship



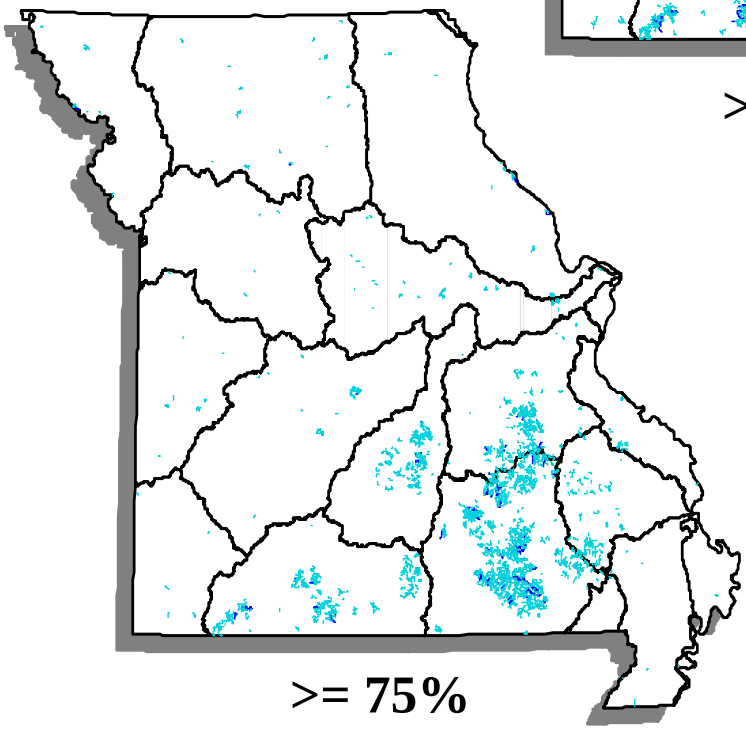
Mapping Watershed Stewardship



>= 10%



>= 50%



>= 75%

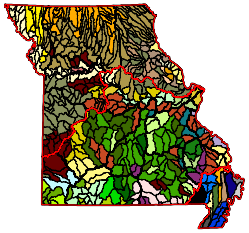
Headwater

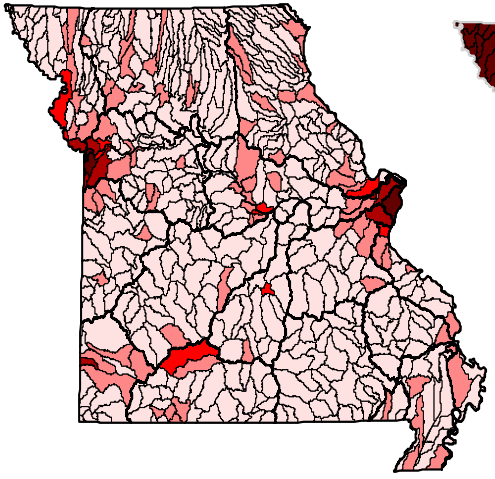
Creek

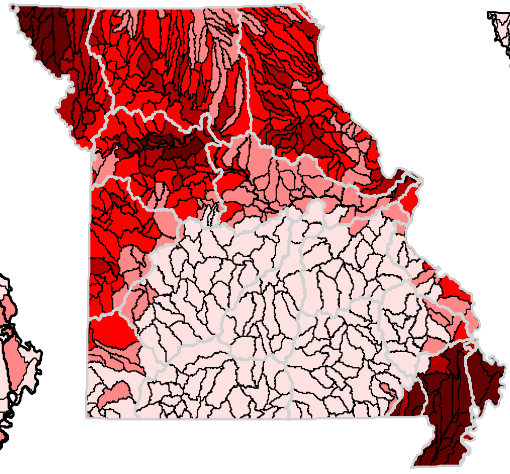
Small River

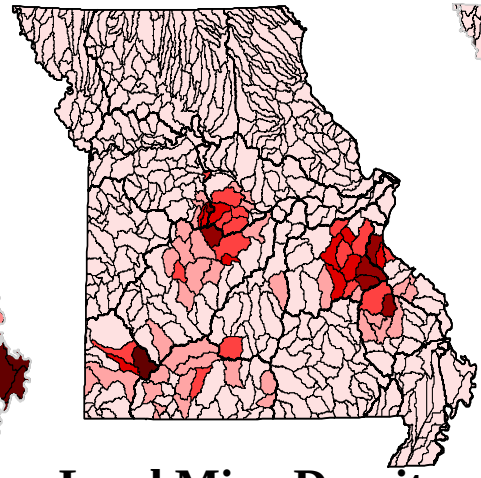
Large River

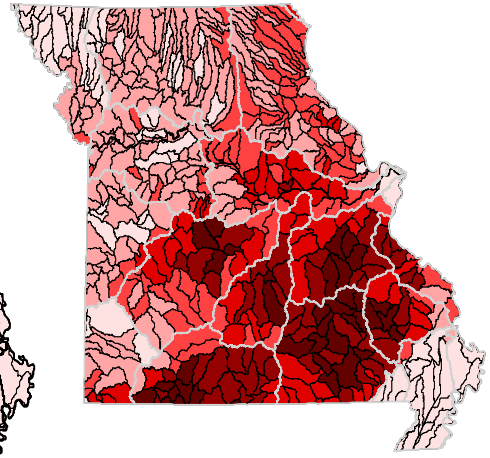
EDU Boundary











Percent Urban **Percent Cropland** **Lead Mine Density** **Riparian Forest**

Attributes of Mo_aes_no_atts.shp

N_index_a	Pfor	Purb	Pgrschg	Stndcat7	Pfor_a	Pwetl	Pwetl_a	Purb_a	Pagp	Pagp_a	Pagc
63129600.0	4.6733	0.7236	1.950	0.02911	30719700.0	1.8081	11885400.0	4756500.0	21.1641	139122000.0	68.5054
44426700.0	8.3388	1.1371	-2.259	0.02734	28229400.0	1.6302	5518800.0	3849300.0	31.4877	106596000.0	54.2490
87714000.0	11.5990	1.8831	19.094	0.00987	53461800.0	1.6080	7411500.0	8679600.0	46.4294	214002000.0	32.3911
38376900.0	11.0445	0.1387	-3.261	0.00804	22499100.0	1.2021	2448900.0	282600.0	44.7170	91094400.0	36.2694
17636400.0	2.5608	0.6827	-10.089	0.00000	5620500.0	2.8572	6271200.0	1498500.0	17.7593	38979000.0	73.5226
117477000.0	12.7244	1.5937	9.233	0.03354	74214900.0	1.0420	6077700.0	9295200.0	50.6270	295281900.0	27.6202
46512000.0	13.4467	1.9184	-3.716	0.01482	33314400.0	1.8963	4698000.0	4752900.0	33.1771	82197000.0	46.1276
21305700.0	10.3359	2.0993	5.626	0.03312	14294700.0	2.0648	2855700.0	2903400.0	33.0934	45768600.0	49.2965
26120700.0	9.1666	0.0644	11.042	0.03643	15754500.0	1.8632	3202200.0	110700.0	42.8112	73578600.0	41.9058
17995500.0	7.3856	0.1121	-6.551	0.05027	9483300.0	1.9065	2448000.0	144000.0	31.8226	40860900.0	54.0503
65268000.0	7.8013	1.2999	15.010	0.04766	37684800.0	1.1018	5322600.0	6279300.0	39.2811	189751500.0	45.9077

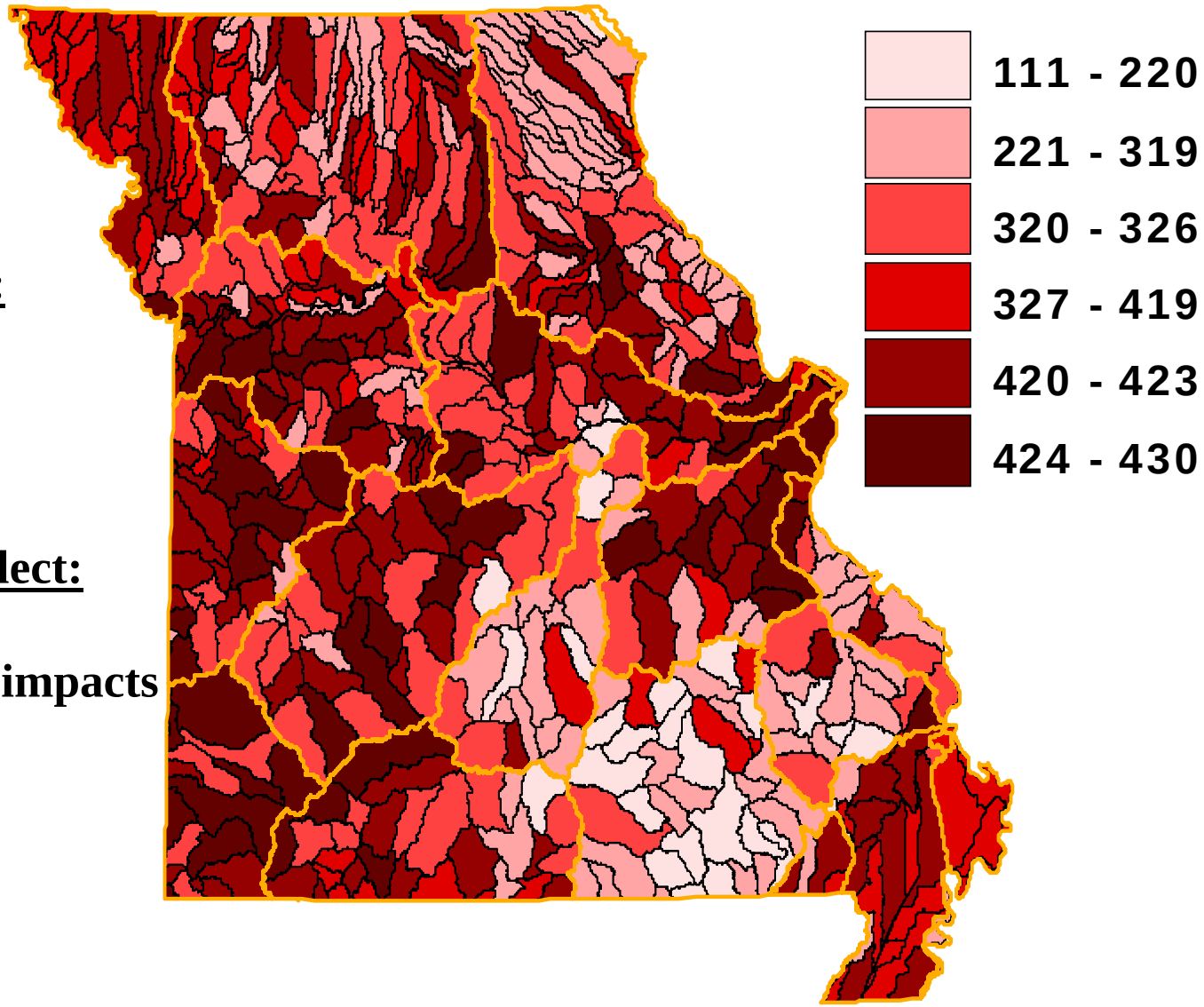
Human Threat Index

First number reflects:

Highest magnitude of individual stressor

Last two numbers reflect:

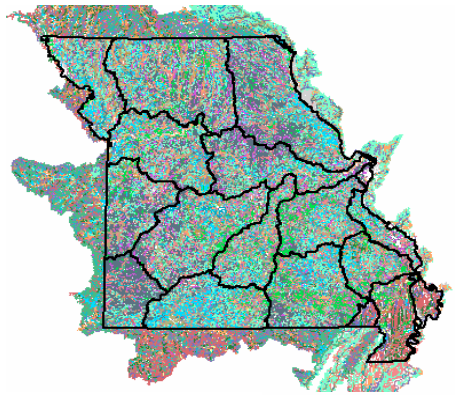
Degree of cumulative impacts



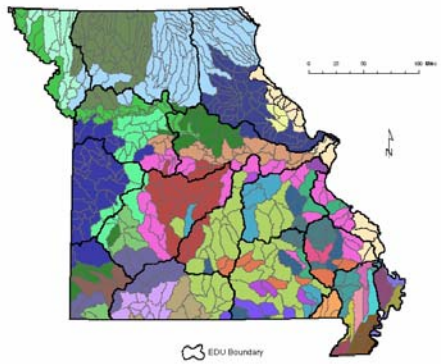
Gap Analyses:Key Questions

Abiotic Surrogates (Habitats)

- How well are the various stream types (VSTs) represented?

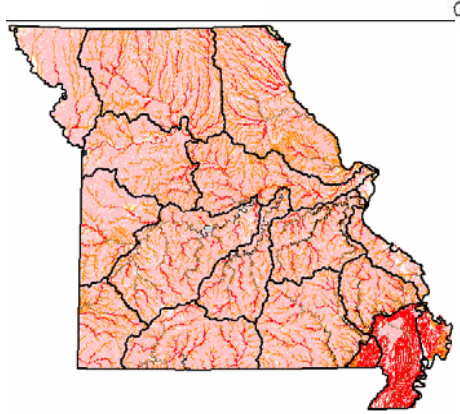


- How well are the various watershed types (AES-Types) represented?



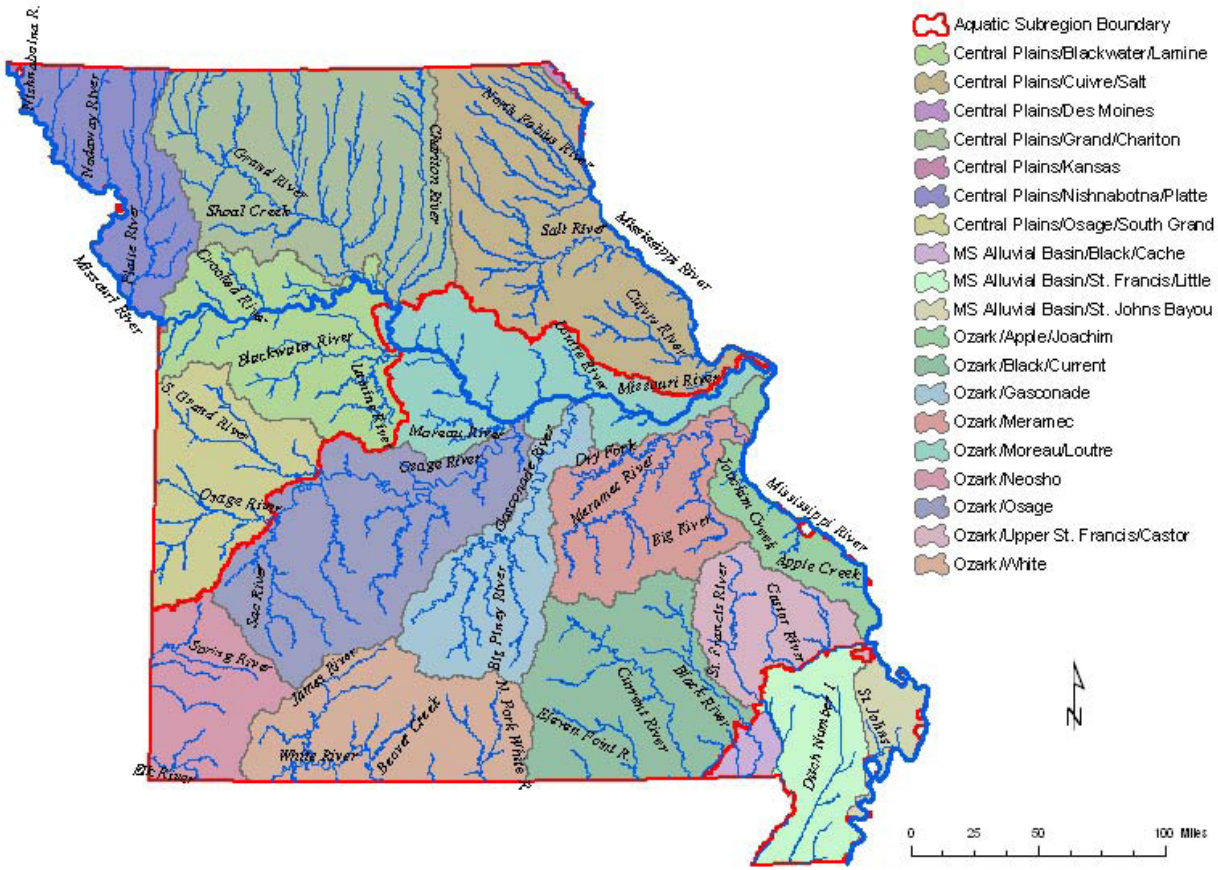
Biotic Surrogates

- How well is each species represented?



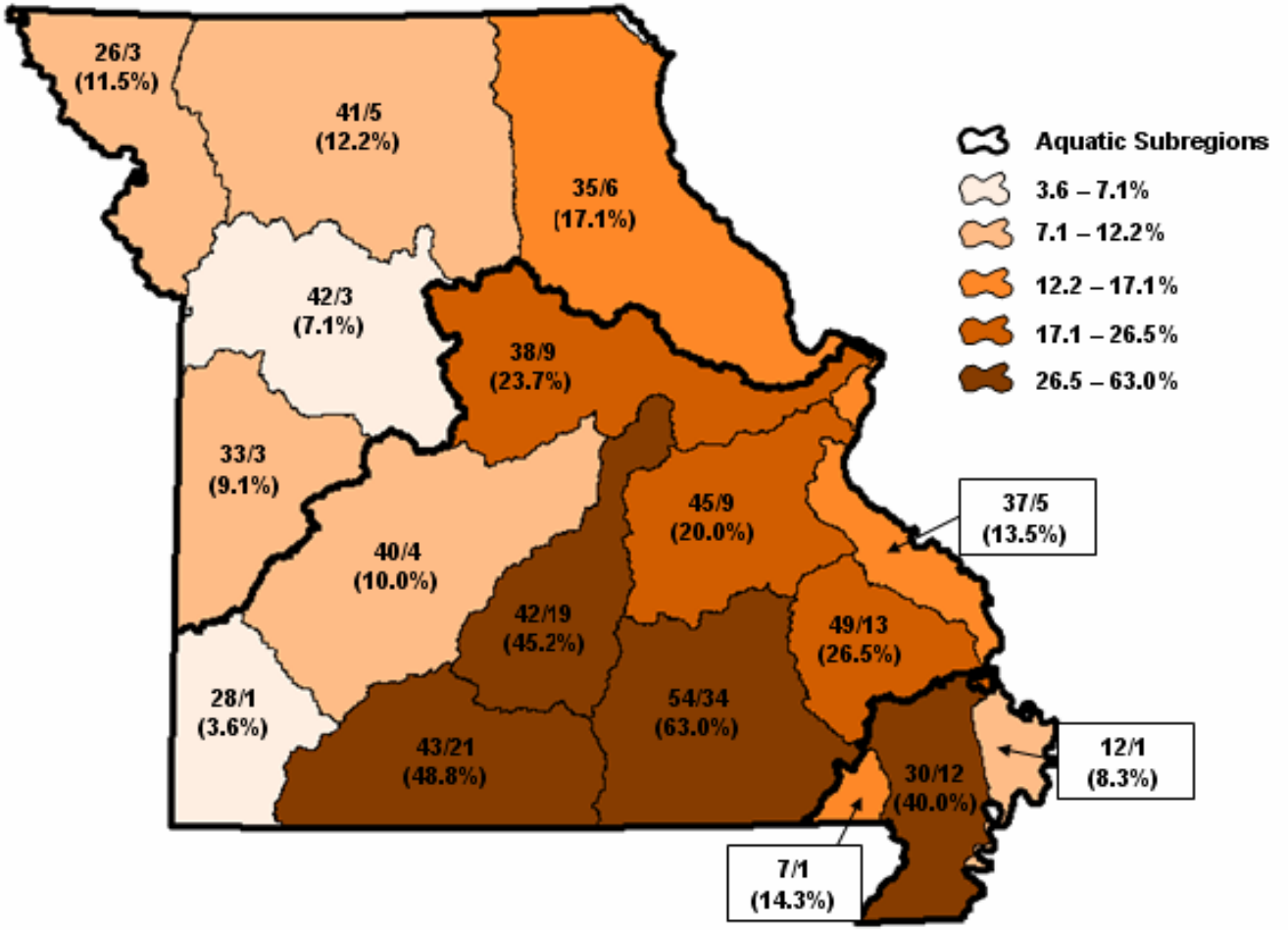
Data Analyzed for Three Geographic Units

- Statewide
- Subregion
- EDU



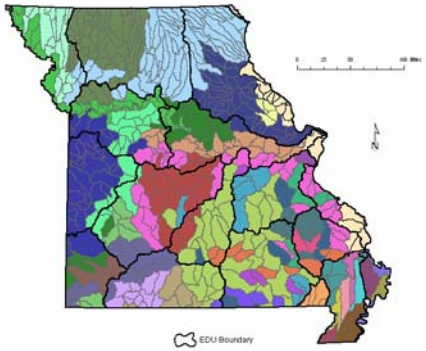
VST Gap Analyses

		Status 1 or 2	
State/Subregion	Total VSTs	Number	Percent
Statewide	74	57	77
Central Plains	45	14	31
Ozarks	65	49	75
Mississippi Alluvial Basin	30	13	43



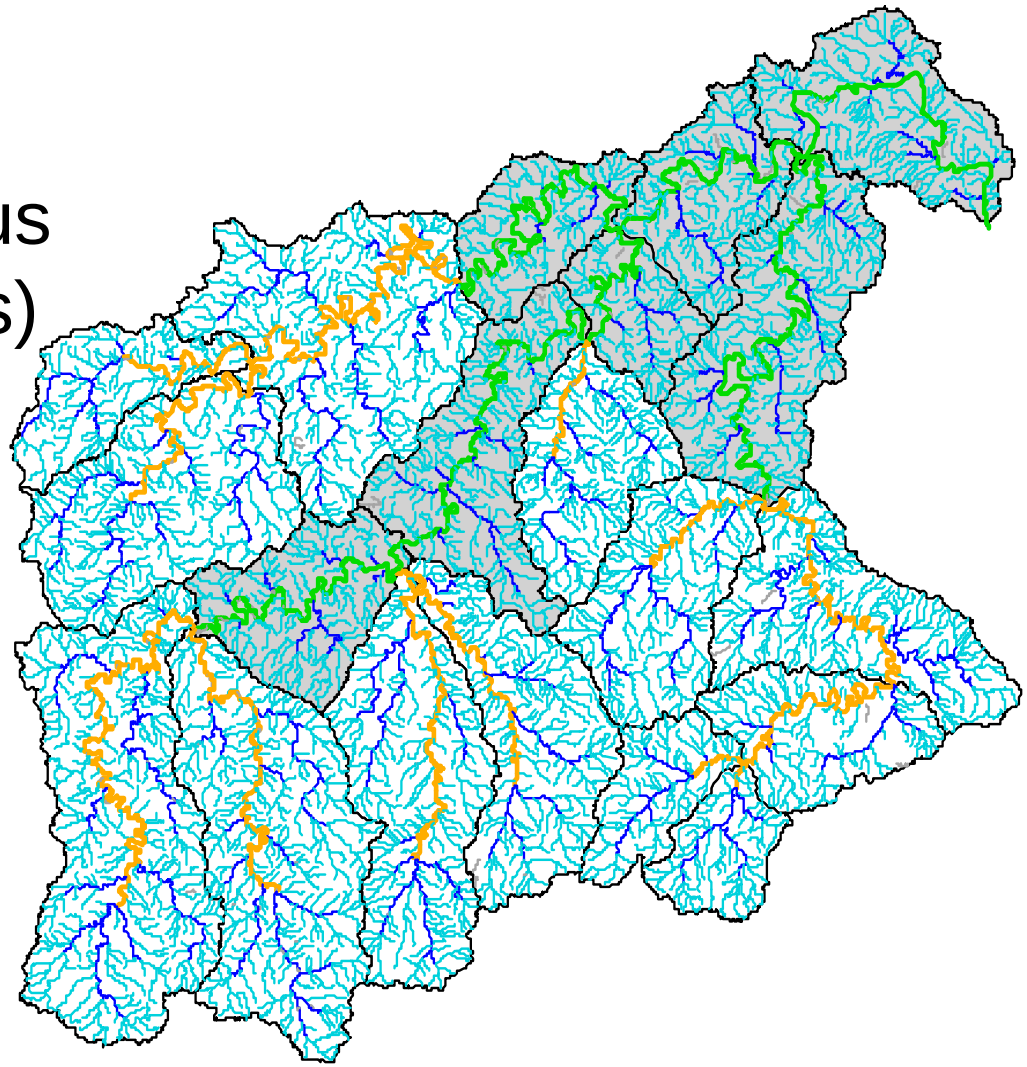
Statewide Analyses by Individual Variables

Temperature	Total Length (km)	Km in Status 1 or 2	Percent in Status 1 or 2
Cold	557.5	59.3	10.6
Warm	171,700.1	1248.8	0.7
Stream Size	**Total Length (km)**	**Length in Status 1 or 2**	**Percent in Status 1 or 2**
Headwater	128,799.4	771.6	0.6
Creek	27,173.8	180.9	0.7
Small River	11,486.5	210.3	1.8
Large River	3,239.19	145.3	4.49
Flow	**Total Length (km)**	**Length in Status 1 or 2**	**Percent in Status 1 or 2**
Intermittent	120,089.1	718.5	0.6
Perennial	46,574.33	580.9	1.25
Geology	**Total Length (km)**	**Length in Status 1 or 2**	**Percent in Status 1 or 2**
Alluvium	12,404.3	78.7	0.6
Clay	304.1	0	0.0
Igneous	664.3	58.1	8.8
Limestone/Dolomite	135,075.5	871.3	0.7
Sandstone	23,622.9	300.0	1.3
Relative Gradient	**Total Length (km)**	**Length in Status 1 or 2**	**Percent in Status 1 or 2**
Low	72,260.0	298.5	0.4
Moderate	53,649.3	344.6	0.6
High	37,409.2	639.7	1.7



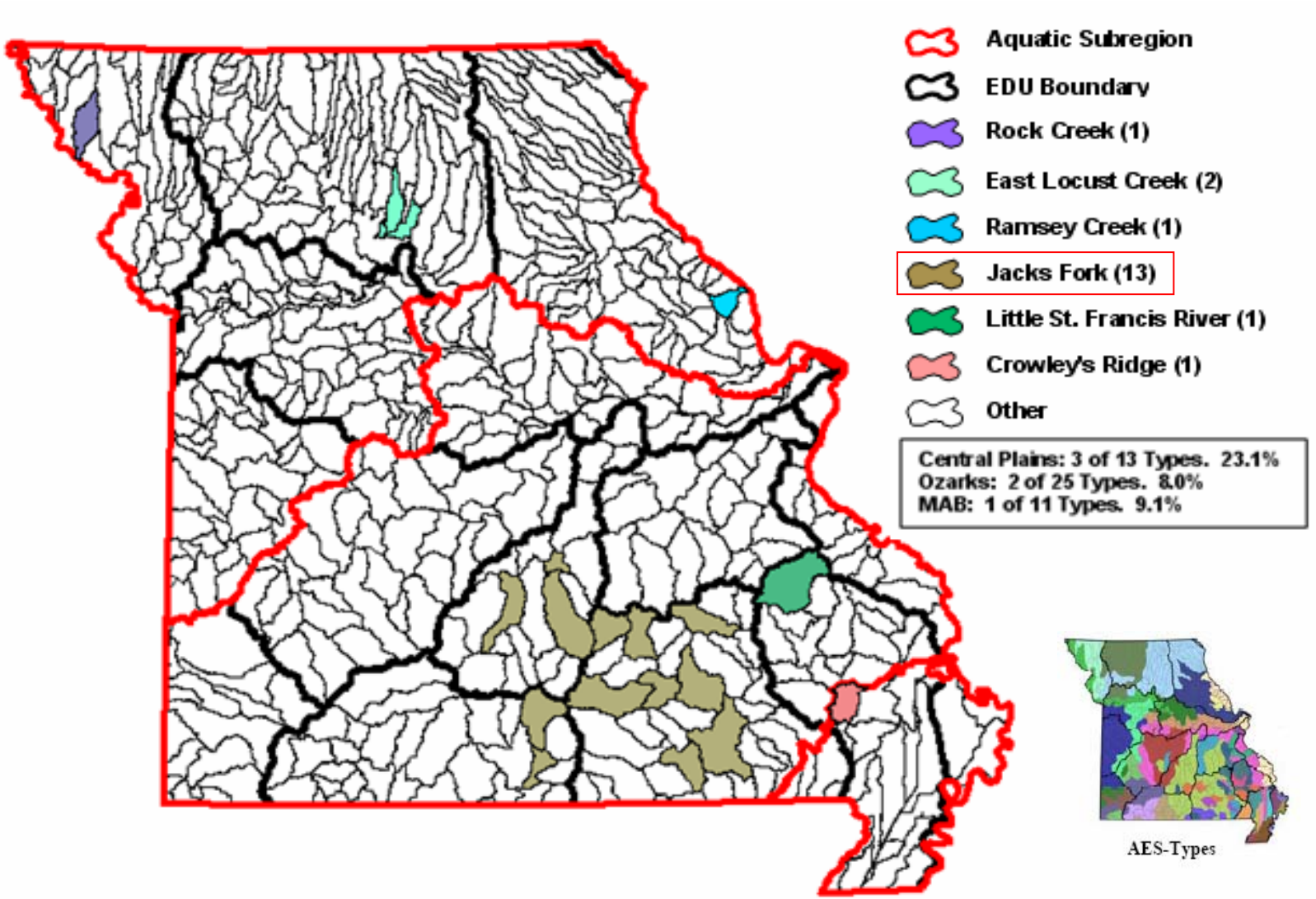
AES-Type Analyses

- How well are the various watershed types (AESs) represented?



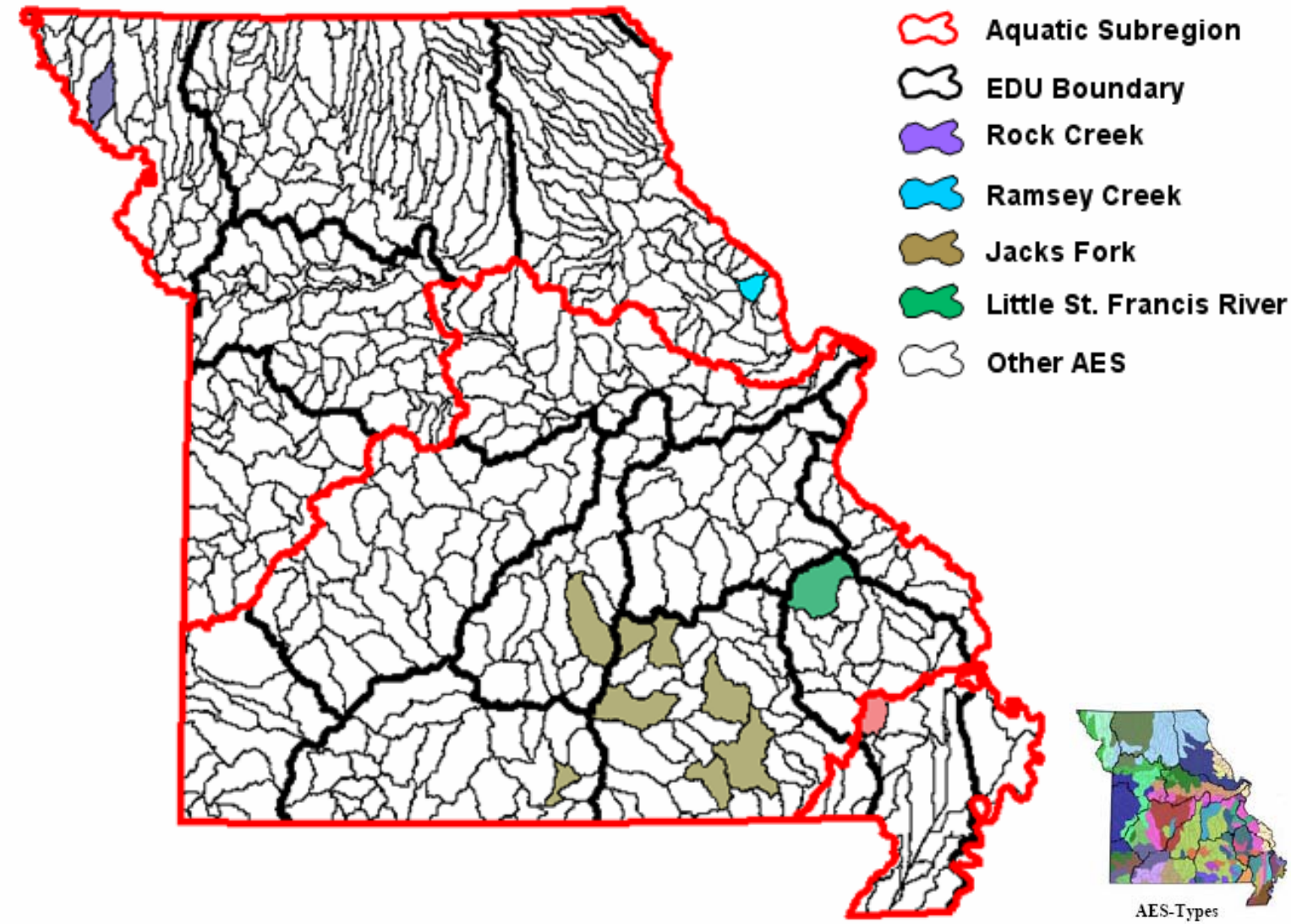
- Identified AESs with all 3 size classes represented in status 1 or 2 lands

Results: AES-Type Analyses Using Least Stringent Criteria



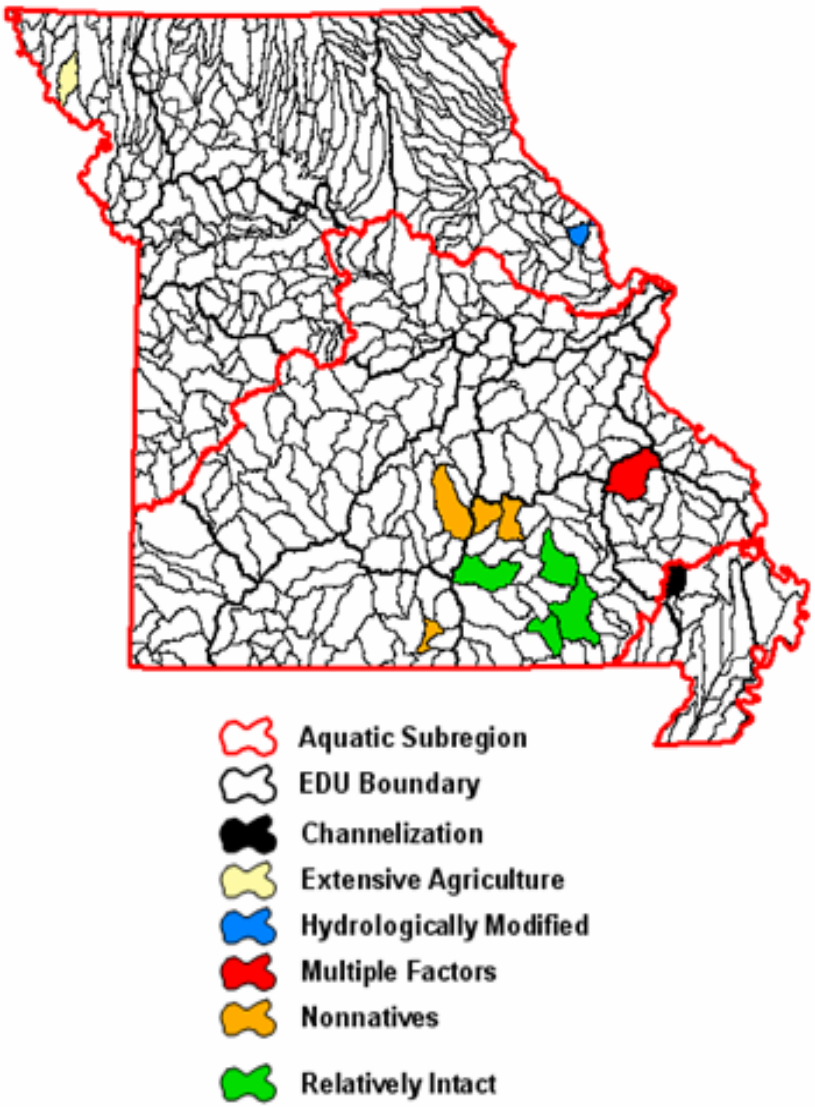
All Size Classes Represented in Status 1 or 2 lands

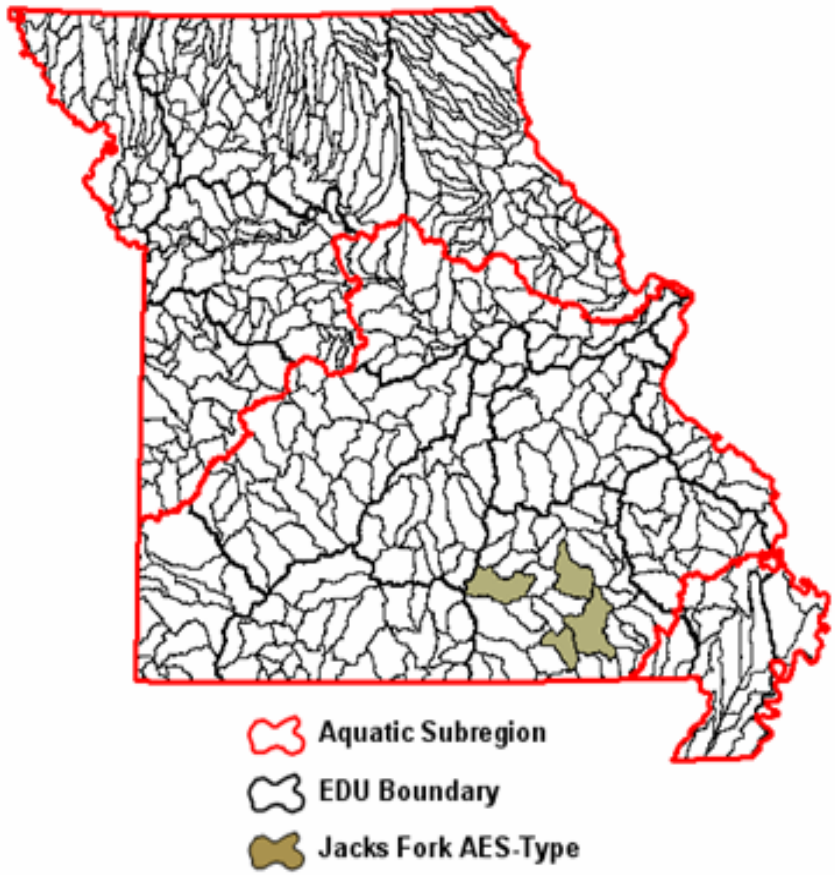
Results: AES-Type Analyses Using More Stringent Criteria (Connectivity)



All size classes represented as an interconnected matrix in Status 1 or 2

Results: AES-Type Analyses
Using Most Stringent Criteria (Ecological Integrity)

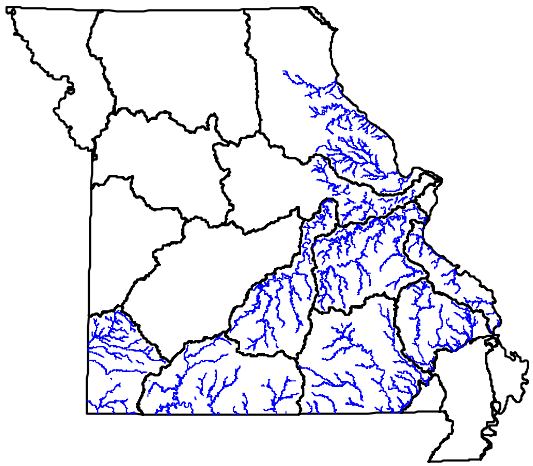




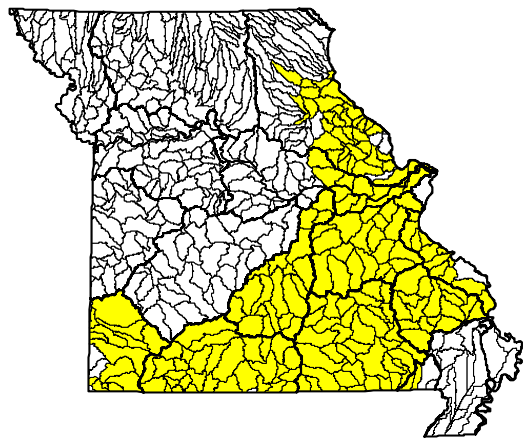
- All size classes
- Interconnected matrix
- Relatively undisturbed

Species Analyses

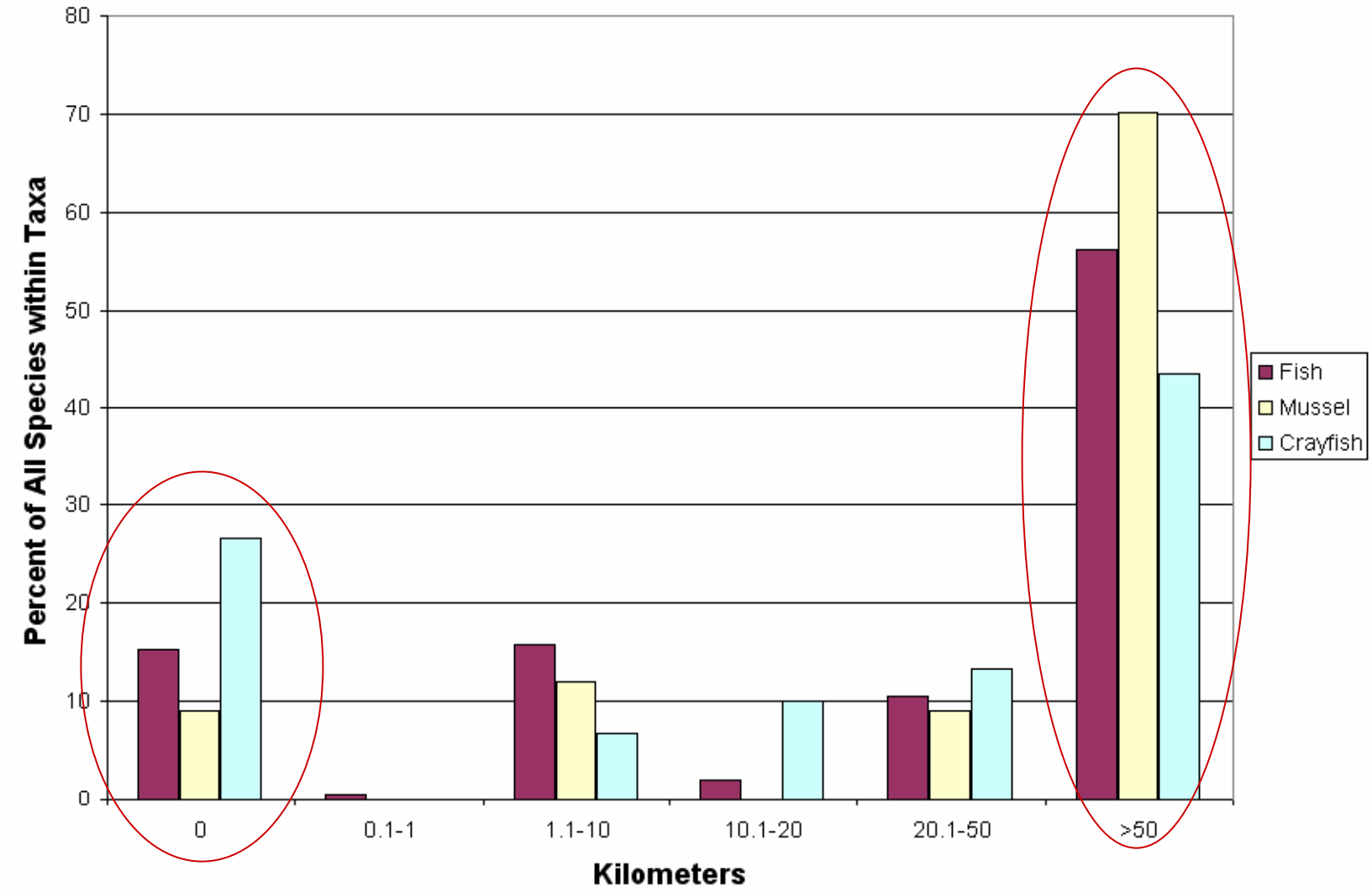
- How well is each species represented in status 1 or 2 lands?
  - Analyses based on length



  - Analyses based on distinct occurrences

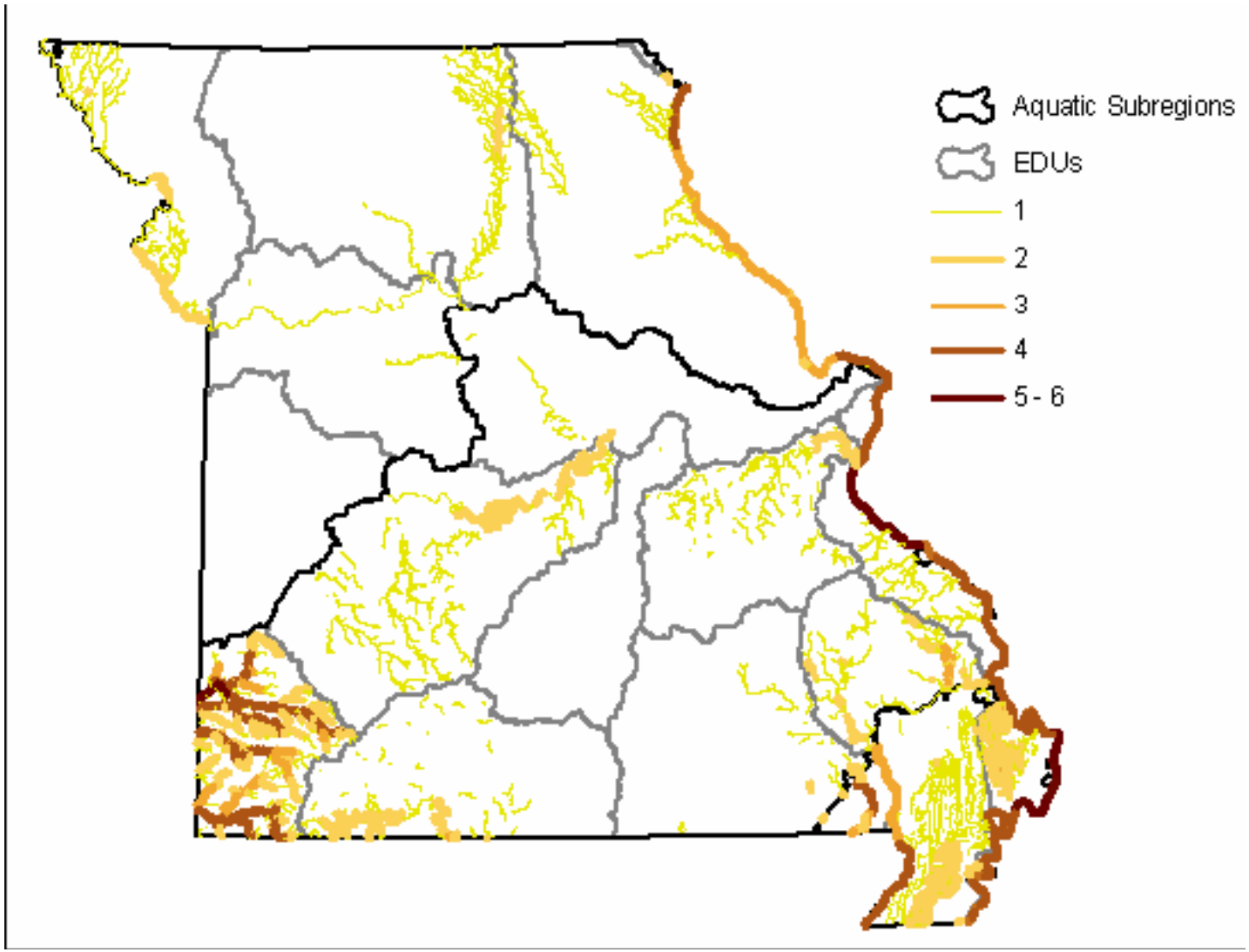


Statewide: 6 Categories of Species Representation



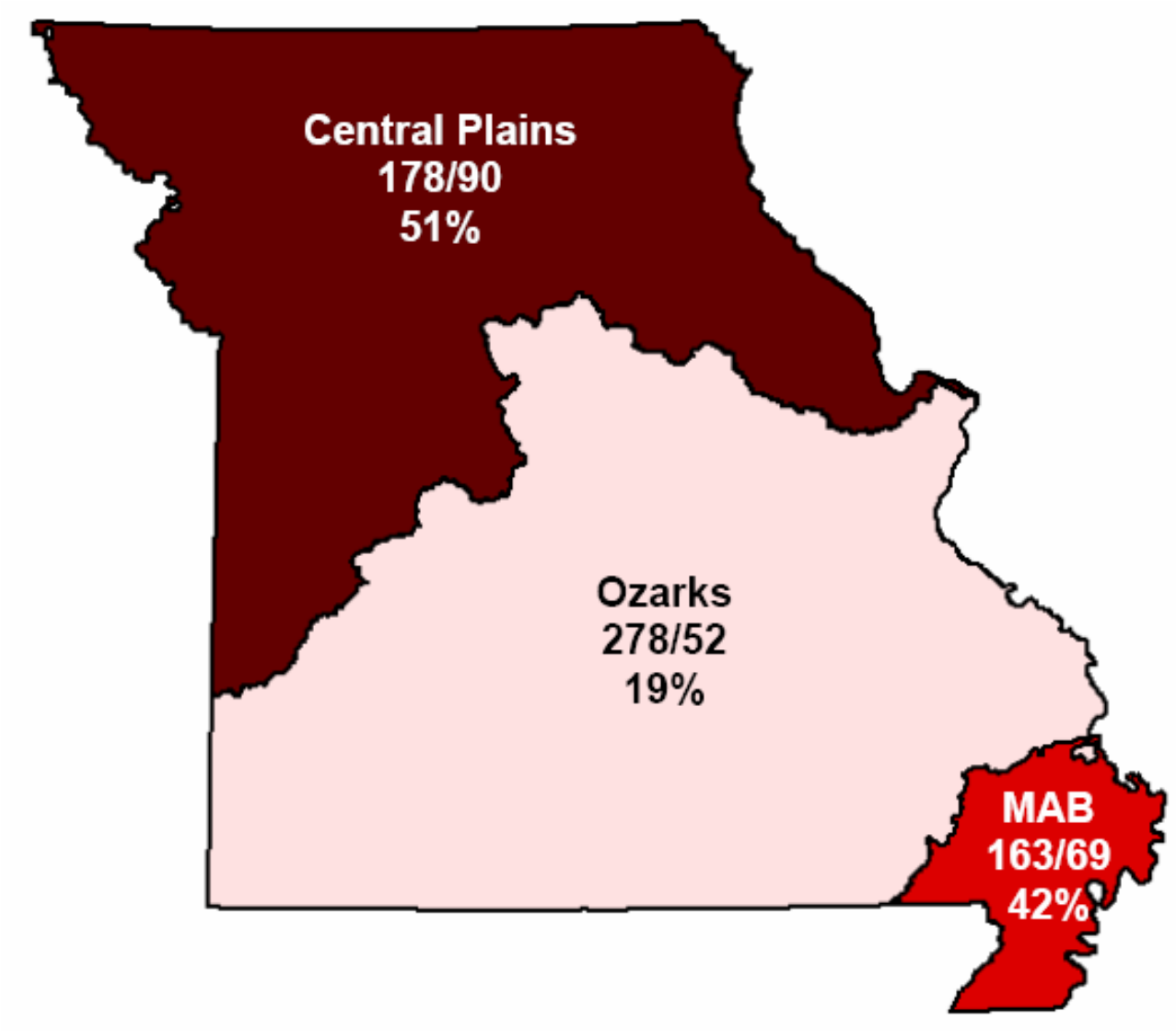
Most species are well represented in status 1 or 2 lands

Richness Map for the 45 Species Not Represented in Status 1 or 2 lands



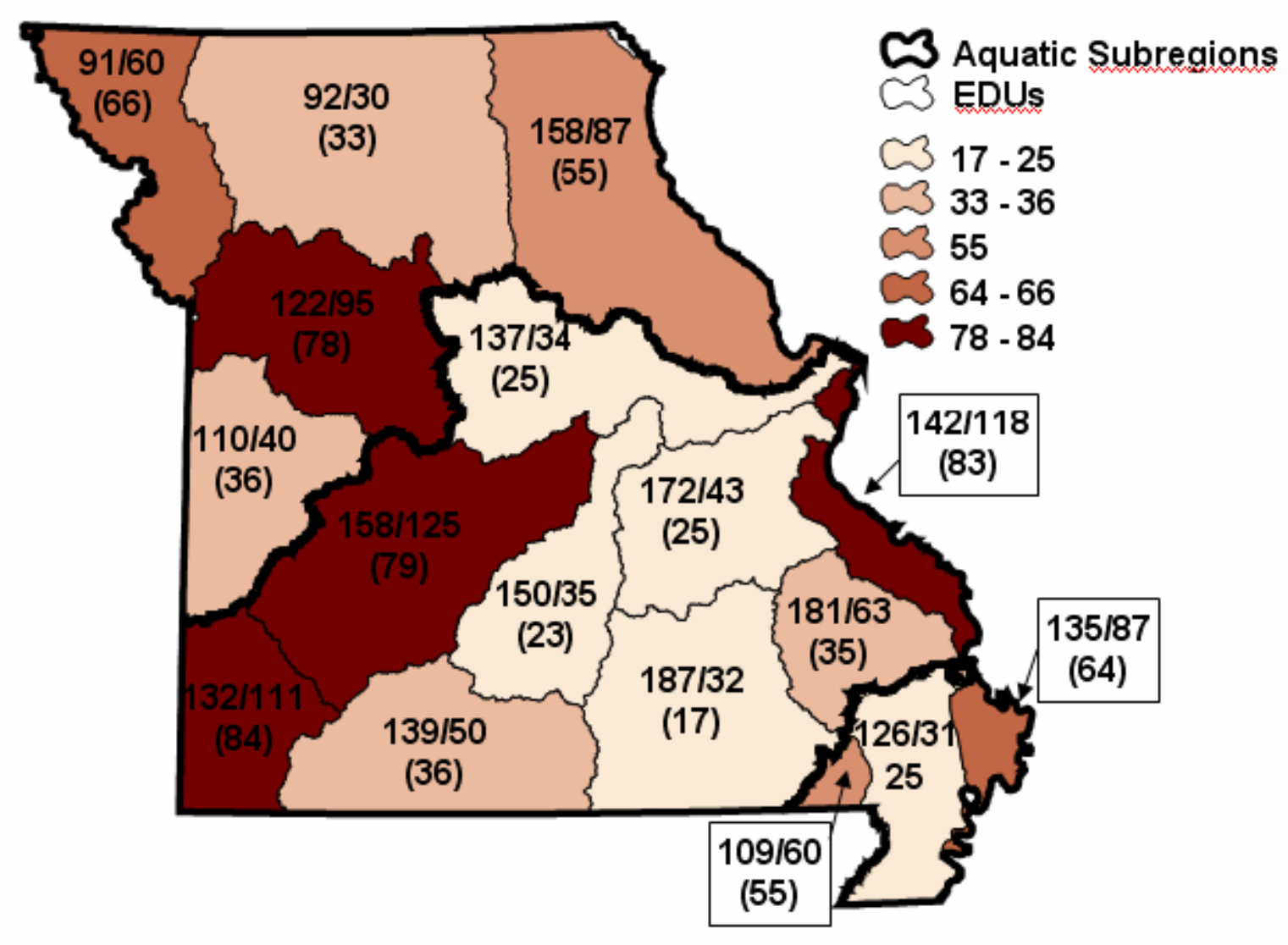
67% are state listed species, 22% are globally listed

Representation by Subregion



% not represented in Status 1 or 2

Representation by EDU



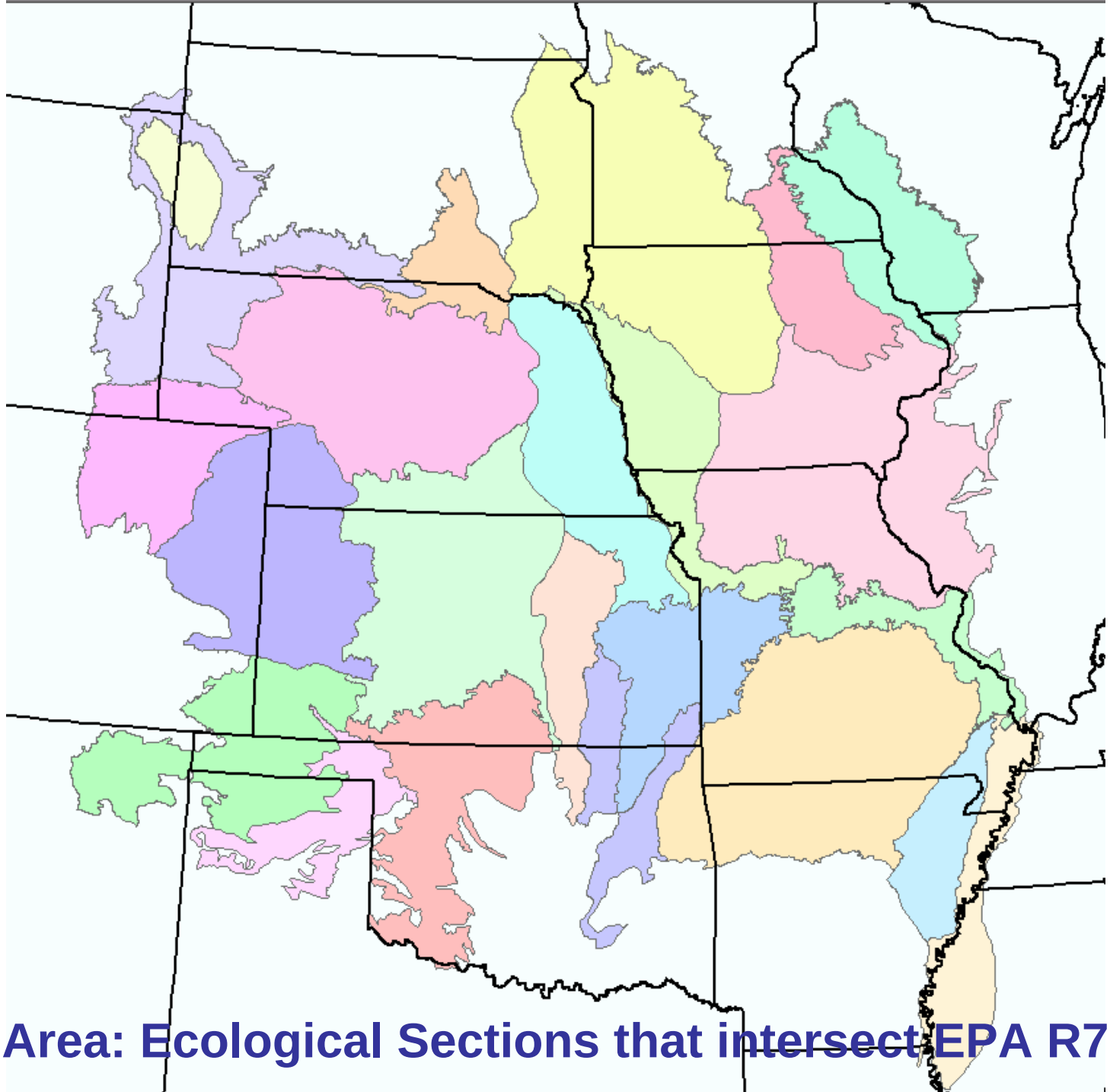
% not represented in Status 1 or 2

Terrestrial Conservation Focus Areas for the Midwestern USA

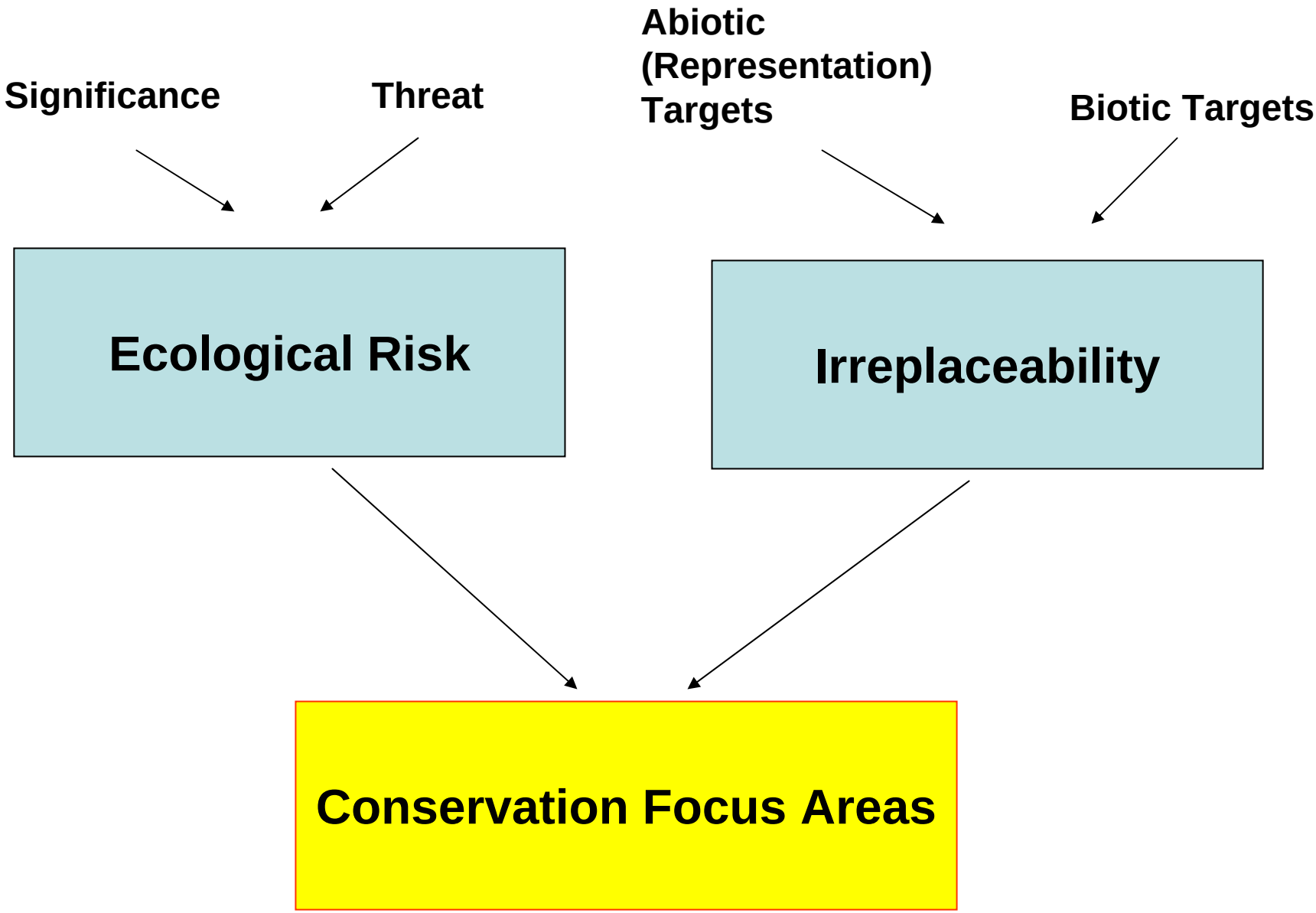
Natural Areas Association

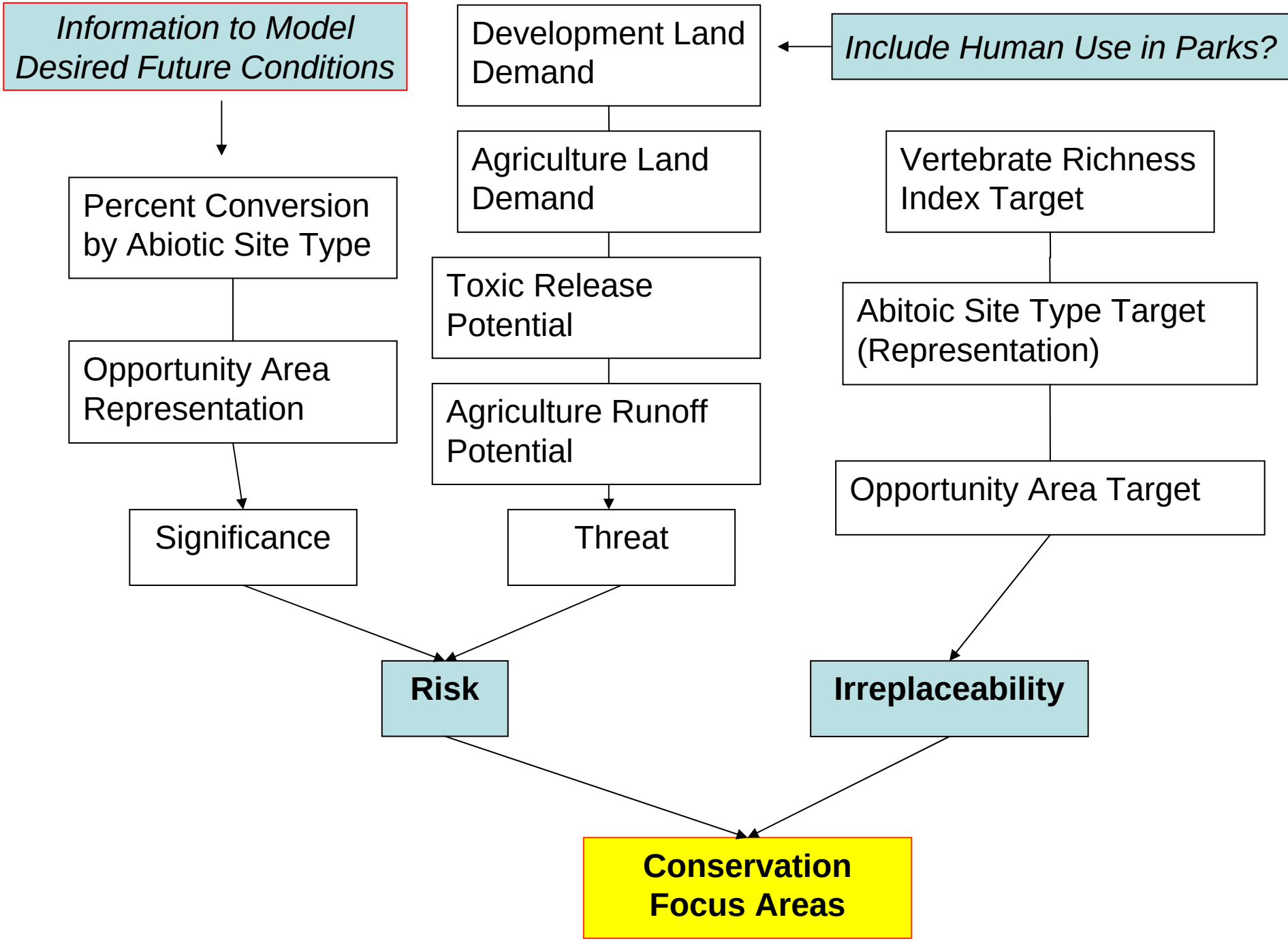
September 21, 2005

David Diamond (diamondd@missouir.edu)
and Scott Sowa (sowas@missouri.edu)

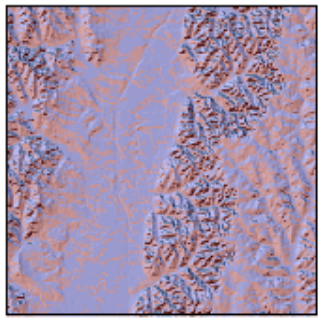


Study Area: Ecological Sections that intersect EPA R7 States


Significance
Threat
Abiotic (Representation) Targets
Biotic Targets
Ecological Risk
Irreplaceability
Conservation Focus Areas

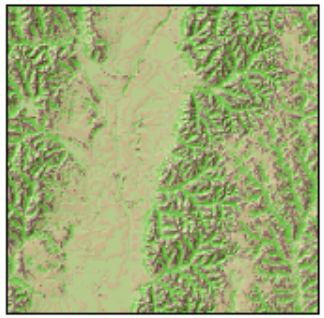

Information to Model Desired Future Conditions
Development Land Demand
Include Human Use in Parks?
Percent Conversion by Abiotic Site Type
Agriculture Land Demand
Vertebrate Richness Index Target
Opportunity Area Representation
Toxic Release Potential
Abitoic Site Type Target (Representation)
Agriculture Runoff Potential
Opportunity Area Target
Significance
Threat
Risk
Irreplaceability
Conservation Focus Areas

Solar Insolation + Land Position + Flats



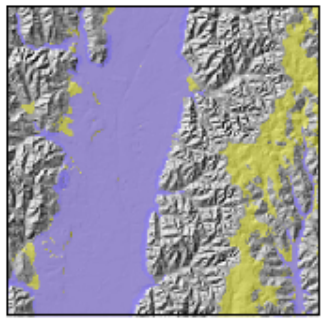
Solar Insolation

- 1 Less Light
- 2
- 3
- 4 More Light



Land Position

- 1 Low
- 2
- 3
- 4 High

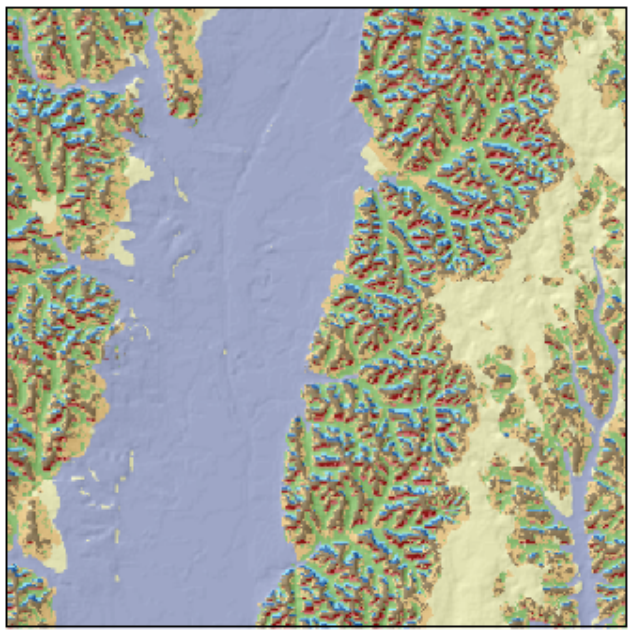


Flat Areas

- Stream Valleys
- Upper Flats

SSURGO Soils May Be Desired at Finer Resolution

e Type

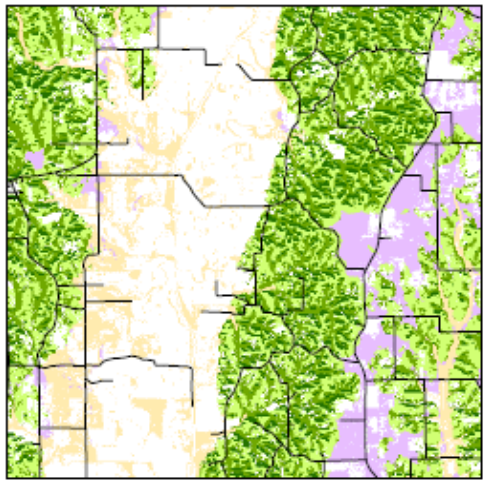


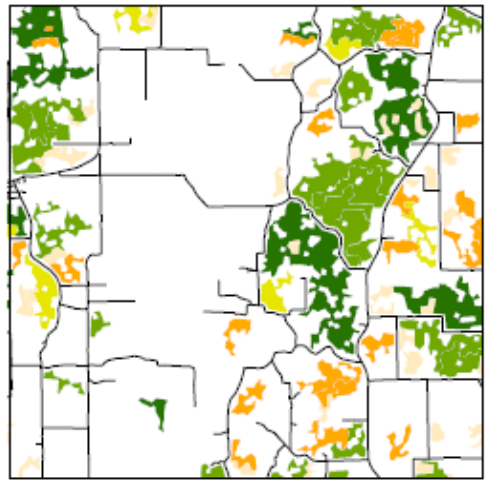
Abiotic Site Types

- 1 low to mid wet slopes
- 2 mid to high wet slopes
- 3 valleys and toe slopes
- 4 gentle uplands and gentle slopes
- 5 well-drained uplands and ridges
- 6 low to mid dry slopes
- 7 mid to high dry slopes
- 8 floodplains and well-defined stream valleys
- 9 flat uplands


M331A
332D
222L
222M
331F
332C
251B
251G
331H
251H
251C
331C
332E
223S
251F
251E
255A
331B
332F
223A
316F
234D
255A
234B
0
75
150
300 Miles

Percent Conversion + Opportunity Area Rank





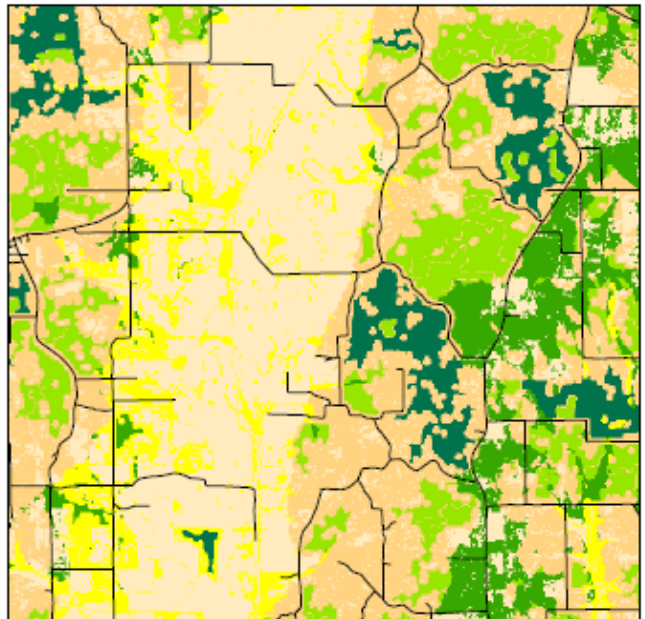
Percent Conversion

- 10 - 20%
- 20 - 30%
- 30 - 40%
- 40 - 50%
- 50 - 60%
- 60 - 70%
- 70 - 80%
- Non-natural

Opportunity Area Rank

- 1
- 2
- 3
- 4
- 5

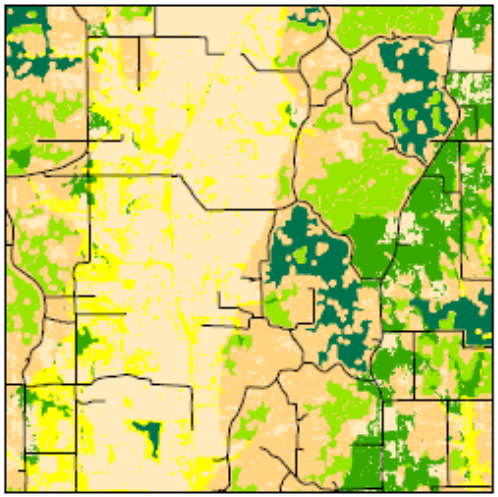
= Significance

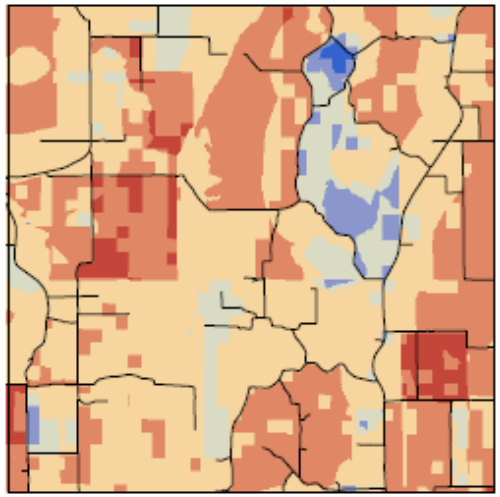


Significance Rank

- 1
- 2
- 3
- 4
- 5
- 6

Significance + Threat





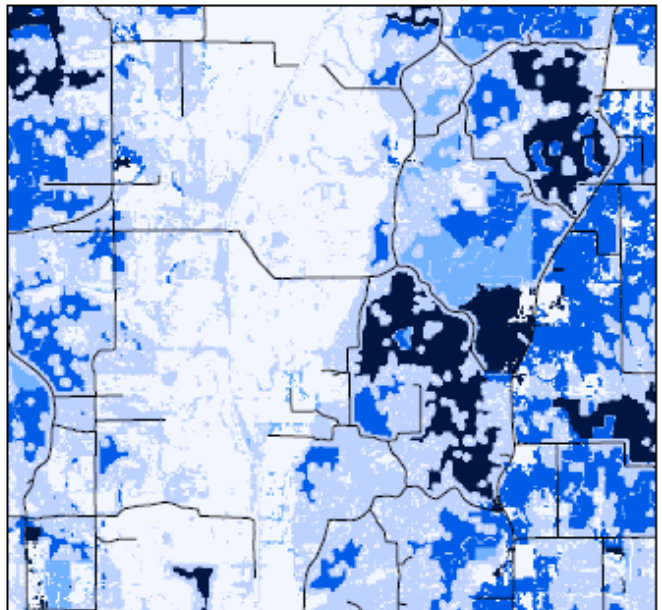
Significance Rank

1
2
3
4
5
6

Threat Rank

1
2
3
4
5
6

= Risk

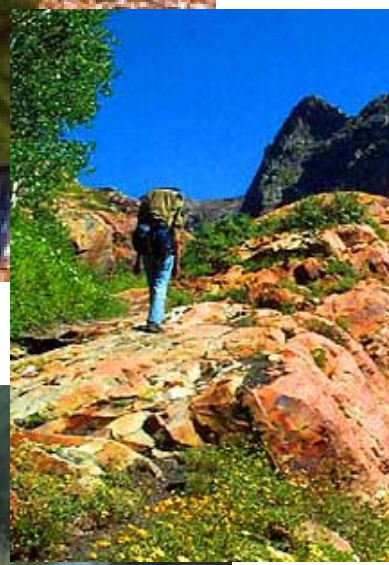


Risk Rank

1
2
3
4

Missouri Wildlife Action Plan

- Monies from the Federal State Wildlife Grant (SWG) Program are being used to develop wildlife action plans (WAPs)
- SWG started in 2001
  - Revenues generated from taxes on items
    used for non-consumptive outdoor recreation
- Appropriations $50-80 million nationally
  - Missouri ~ $1 million annually
- All states were required to develop a WAP by October 2005



Goal and Objective of Aquatic Component of WAP

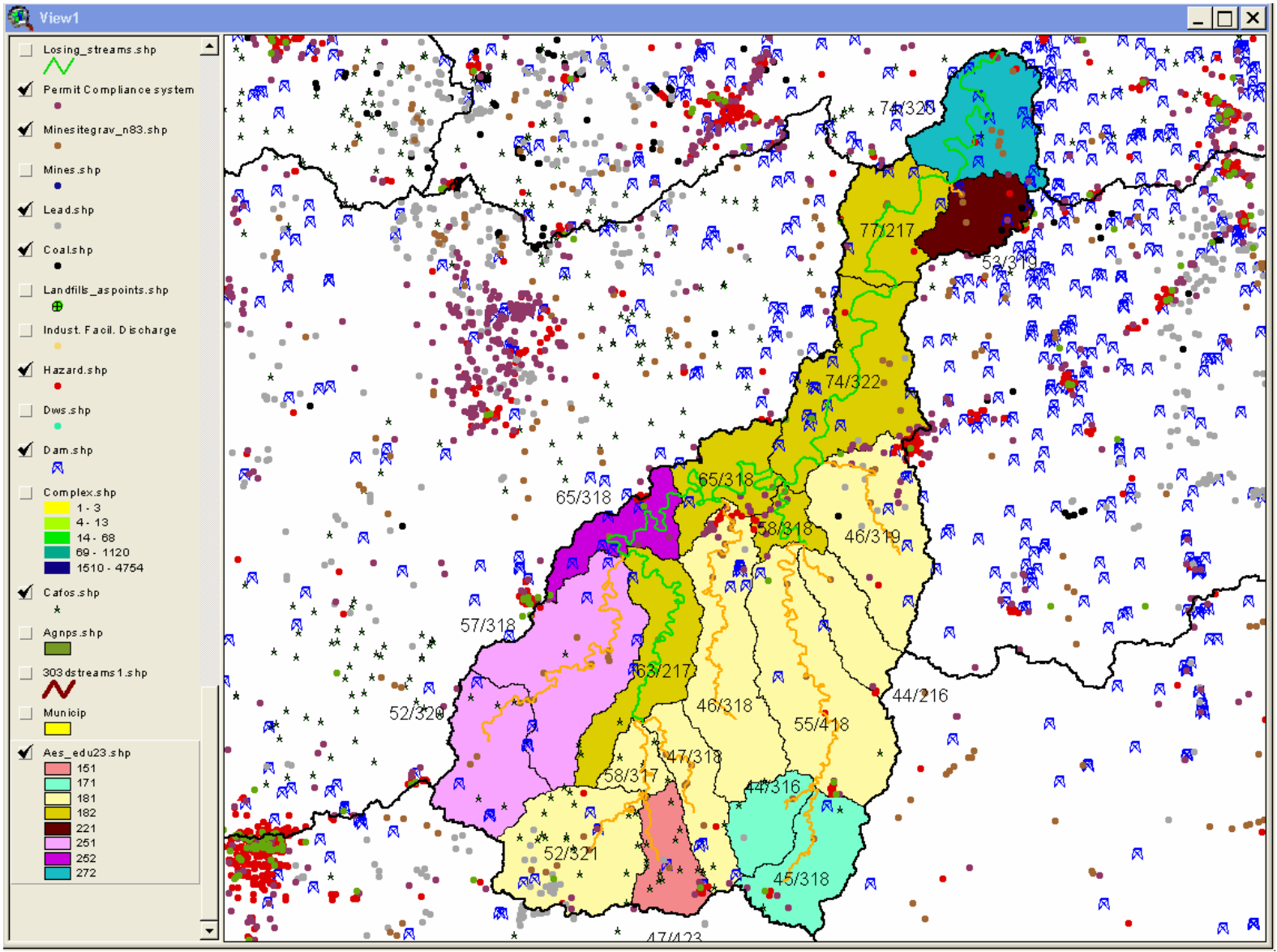
GOAL:

"Ensure the long term persistence of native aquatic plant and animal communities, by conserving the conditions and processes that sustain them, so people may benefit from their values in the future."

OBJECTIVE:

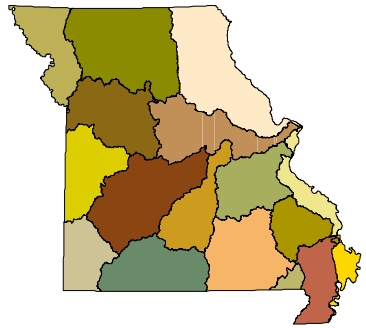
"Identify and map a set of aquatic conservation opportunity areas that holistically represent the full breadth of distinct riverine ecosystems in Missouri and multiple populations of all native aquatic species"

Geospatial Decision Support Systems



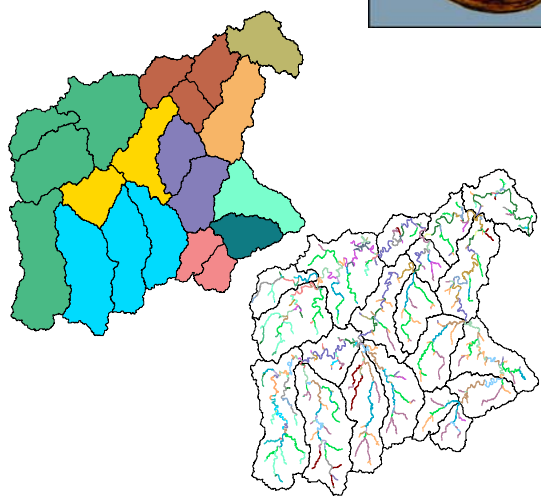
General Conservation Strategy

- Generate separate conservation plans for each Ecological Drainage Unit (EDU)

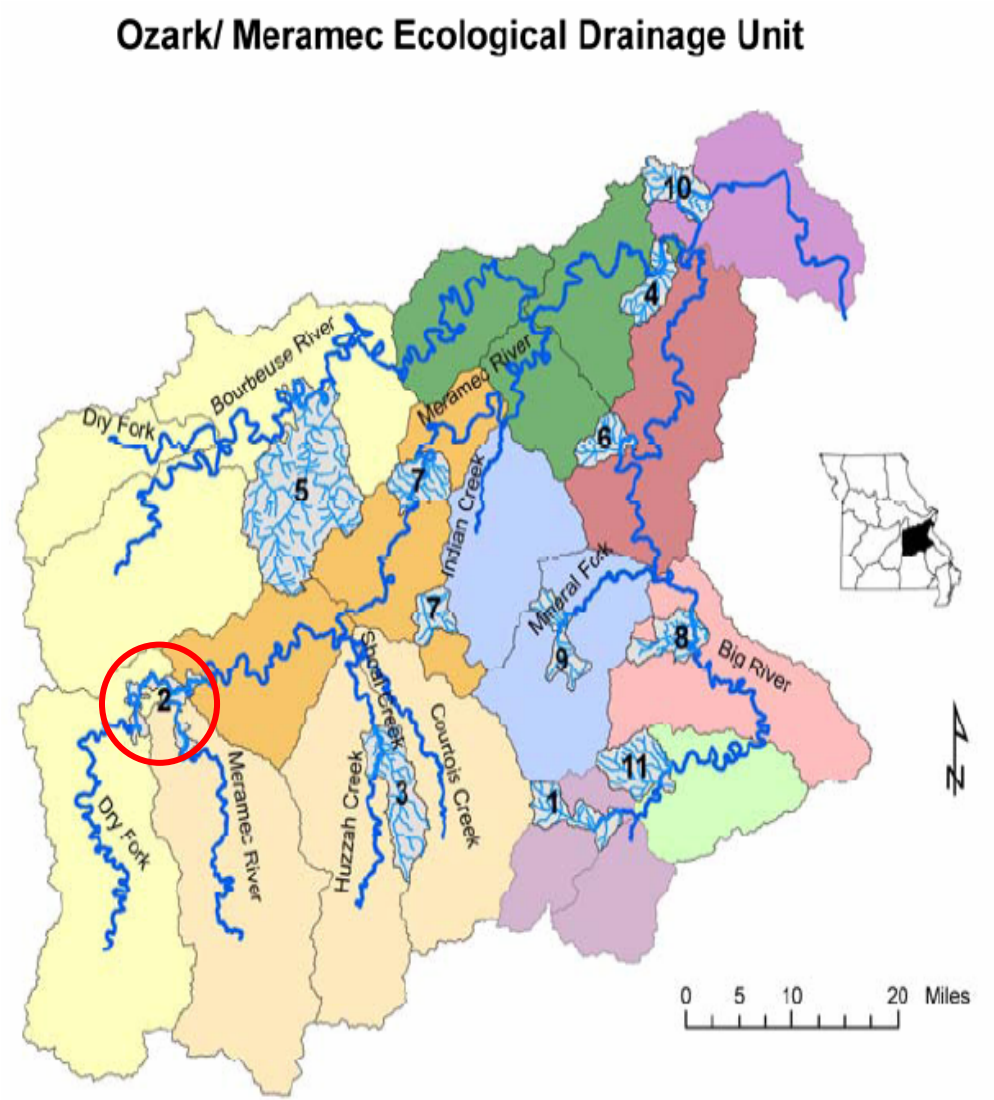


- Represent 2 populations of all target species within each EDU
  - Biotic Conservation Targets

- Represent all of the distinct watershed and stream types within each EDU
  - Abiotic Conservation Targets



Results for Pilot Area
Meramec EDU



Results

- 11 COAs selected: 300 km
- Full network: 10,684 km
- Represents 2.8% of entire network

- Representation of abiotic targets missed only 5 of the 103 target species

- Added a single COA to capture these species

COA Selection Criteria and Characteristics

	A	B	C	D	E
1	**NAME**	**Public Landowners**	**MDC Regions**	**Reason AES Selected**	**Reason VST's Selected**
2	Clear Creek	USFS; MDC	Primary: St. Louis	Higher local and watershed public ownership	Only place to achieve connectivity among size classes
3	Dry Fork/Upper Meramec	MDC	Primary: St. Louis; Secondary: Ozark	To capture target species not captured in other focus areas	To capture target species not captured in other focus areas
4	Flat River	MDNR	Primary: St. Louis; Secondary: Southeast	Only AES of Type	Only place to achieve connectivity among size classes
5	Fox Creek	MDC	Primary: St. Louis	Higher public land and no lead or coal mines	Relatively intact subwatershed and connectivity
6	Huzzah Creek	USFS; MDC	Primary: St. Louis	Highest target richness, higher public land, highest quality	Only place to achieve connectivity among size classes
7	Lower Big	None	Primary: St. Louis; Secondary: Southeast	Only AES of Type	Connectivity and low human disturbance
8	Lower Bourbeuse	MDC	Primary: St. Louis	Highest target richness	Connectivity and relatively low human disturbance
9	Lower Meramec	MDC	Primary: St. Louis	Only AES of Type	Connectivity, public lands and relatively low disturbance
10	Middle Meramec	MDNR; MDC	Primary: St. Louis	Public lands, higher target richness	Public lands
11	Mineral Fork	MDC	Primary: St. Louis	Much higher target richness	Only place to achieve connectivity among size classes
12	Upper Big	MDC	Primary: St. Louis	Only AES of Type	Connectivity

Continued

	A	F	G	H
1	**NAME**	**Potential Alternates**	**Potential VST Alternatives**	**Management Concerns**
2	Clear Creek	AESpolyid 371	None	gravel mining, upland pasture, floodplain row/crop, point sources, lead, small impoundments,
3	Dry Fork/Upper Meramec	None	None	gravel mining, floodplain row/crop, point sources, hazard, dams, roads, exotics
4	Flat River	None	None	upland pasture, floodplain row/crop, urban, point sources , ifd, lead, hazard, cafos, 303d, roads, exotics
5	Fox Creek	None	Lower Calvey Creek and tributaries	upland pasture, floodplain row/crop, point sources, hazard, roads, exotics
6	Huzzah Creek	Aespolyid 363	Upper Courtois Creek and tributaries	gravel mining, floodplain pasture/grazing, point sources, lead, small impoundments, roads, exotics
7	Lower Big	None	Tyrey Creek and tribs, or Calico Creek and tribs.	upland pasture, floodplain row/crop, point sources, lead, small impoundments, 303d, roads, exotics
8	Lower Bourbeuse	None	Red Oak Creek and tributaries	gravel mining, toxic release, upland pasture, floodplain row/crop, point sources, lead, coal, hazard, small impoundments, roads, exotics
9	Lower Meramec	None	None	upland pasture, floodplain row/crop, urban, point sources, ifd, hazard, small impoundments, roads, exotics
10	Middle Meramec	None	None	point sources, lead, coal, small impoundments, exotics
11	Mineral Fork	Aespolyid 361	Lower Indian Creek and tributaries	upland pasture, urban, point sources, ifd, lead, small impoundments, roads
12	Upper Big	None	Mill Creek or Tiff Creek and tributaries	gravel mining, point sources, lead, small impoundments, 303d, roads, exotics

Continued

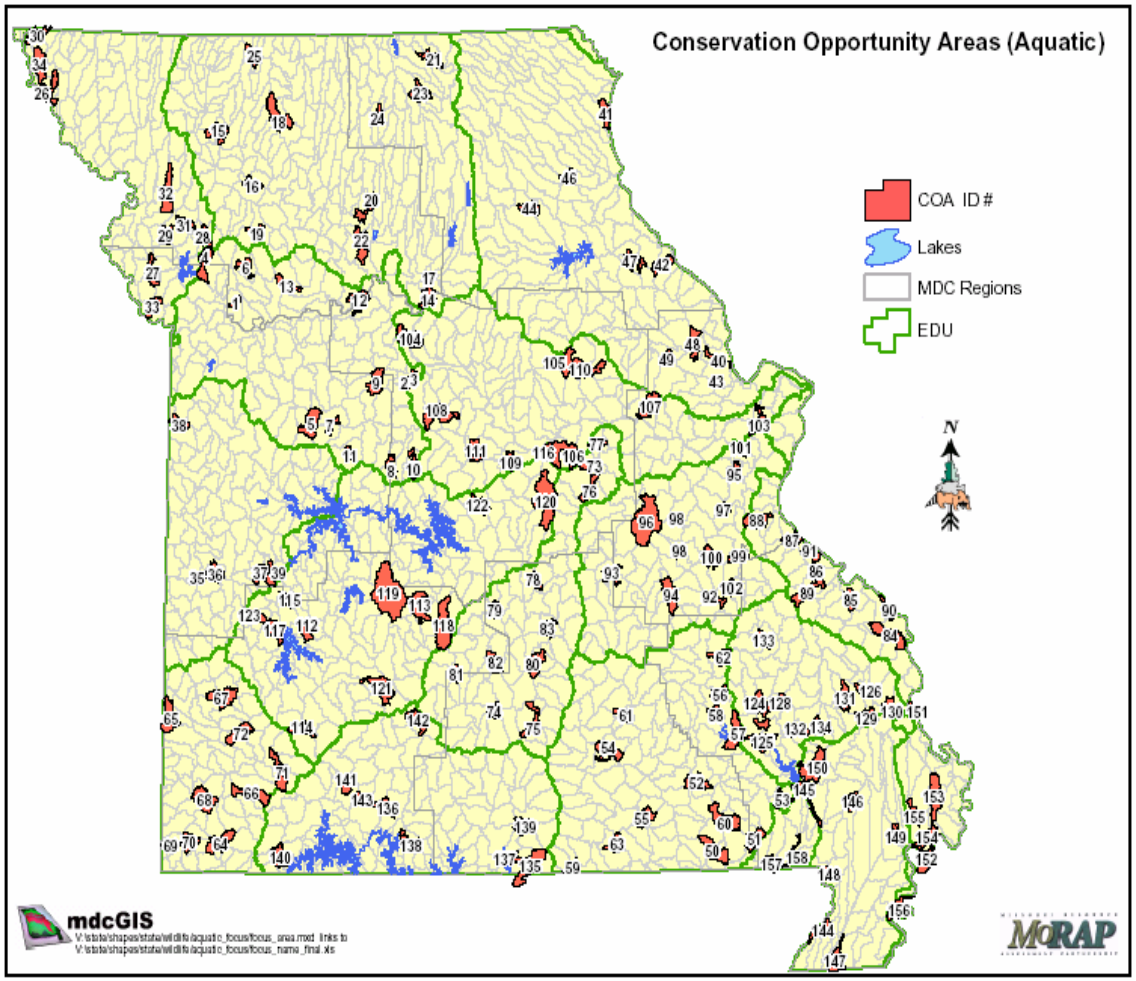
	A	I
1	**NAME**	**Exotics**
2	Clear Creek	None
3	Dry Fork/Upper Meramec	brown trout, common carp, rainbow trout, Asian clam
4	Flat River	common carp
5	Fox Creek	common carp, Asian clam, zebra mussel
6	Huzzah Creek	common carp, rainbow trout
7	Lower Big	common carp, Asian clam
8	Lower Bourbeuse	common carp, Asian clam
9	Lower Meramec	common carp, Asian clam, zebra mussel
10	Middle Meramec	common carp, Asian clam, zebra mussel
11	Mineral Fork	None
12	Upper Big	common carp, Asian clam

Other Info

- **Uncertainties**
- **Opportunities**
- **Species**
- **People**

Ozark/ Meramec Ecological Drainage Unit

Aquatic Conservation Opportunity Areas for Missouri



158 COAs selected

Full network: 174,059 km

COA network: 10,915 km

COAs represent 6.3%

Developing Synoptic Human Stressor Indicators for Assessing the Ecological Integrity of Freshwater Ecosystems in EPA Region 7

EPA Region 7

Goal:

Develop reach scale GIS-based Synoptic Human Stressor Indices (HSI) for assessing ecological integrity of freshwater ecosystems

Human Stressors (Missouri Example)

Land Use

Municipalities

Railroads

303d Streams

Airports

Toxic Release

Superfund

Point Sources

In-stream gravel mines

Landfills

Industrial Facility Discharges

Hazardous Waste Generators

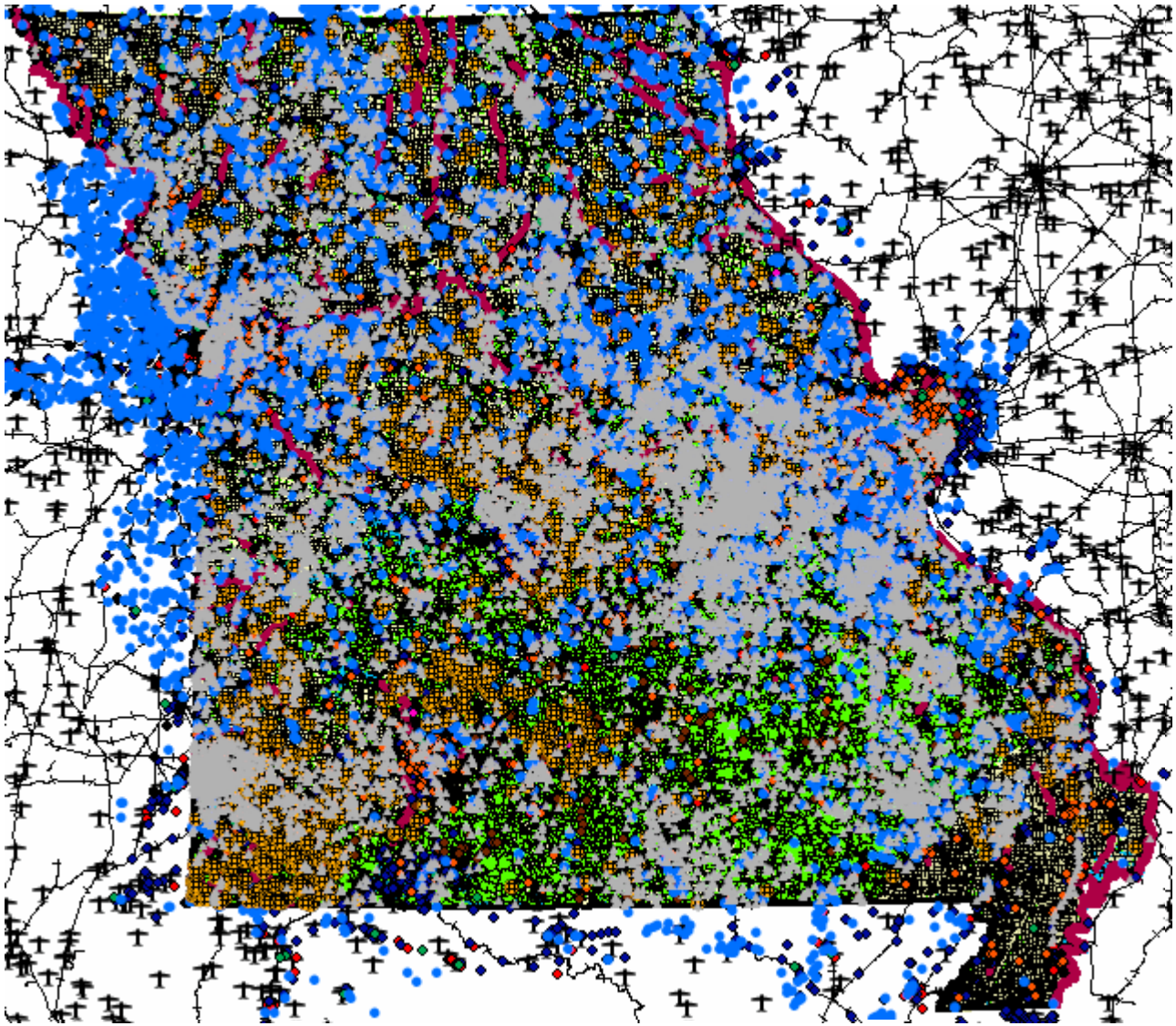
Drinking Water Supplies

Dams

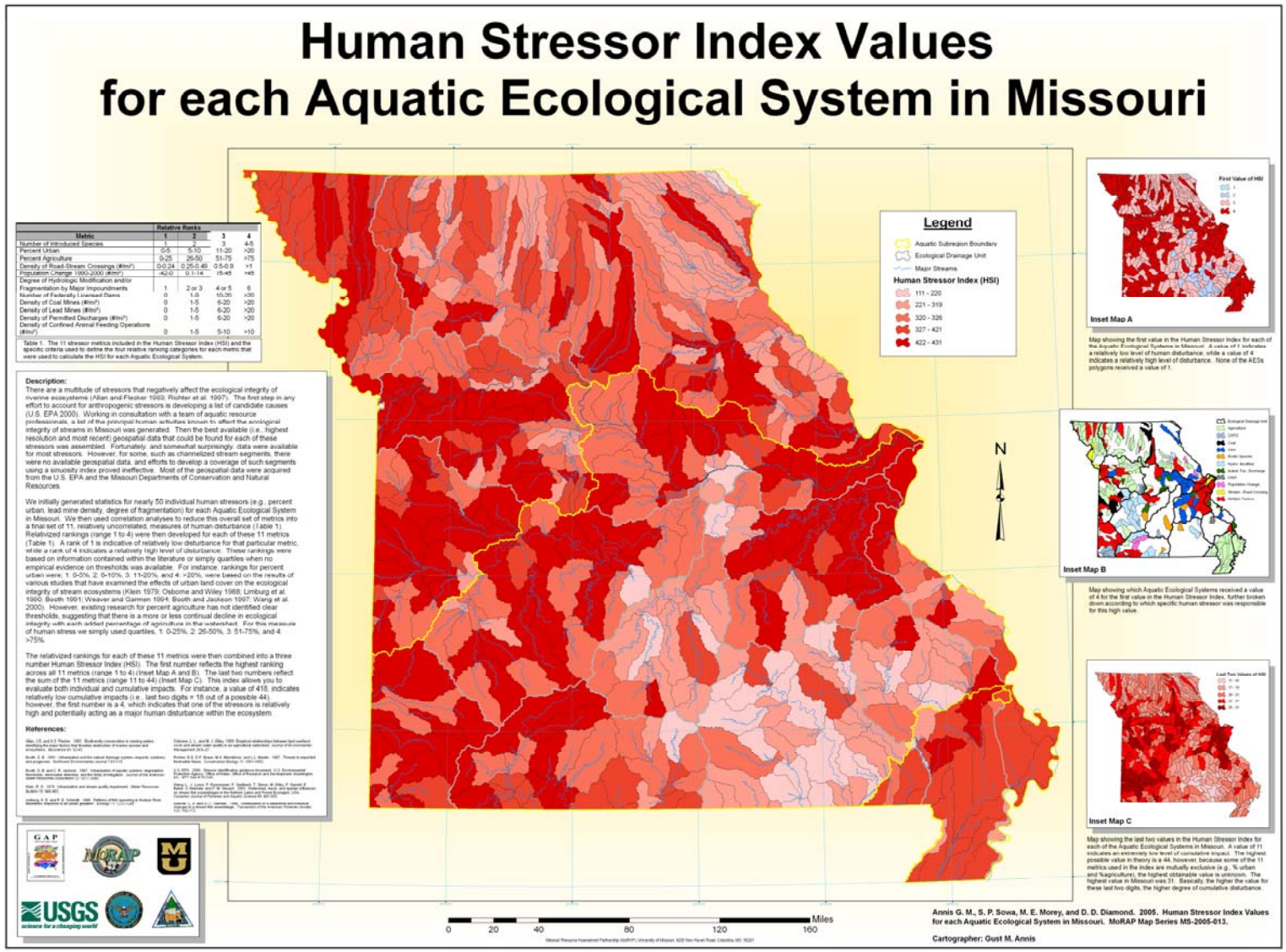
CAFOs

Mines

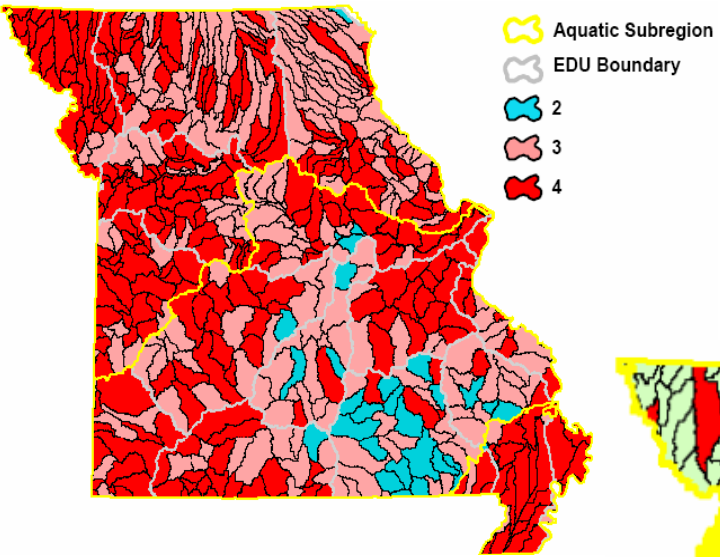
Roads



What do we have now?

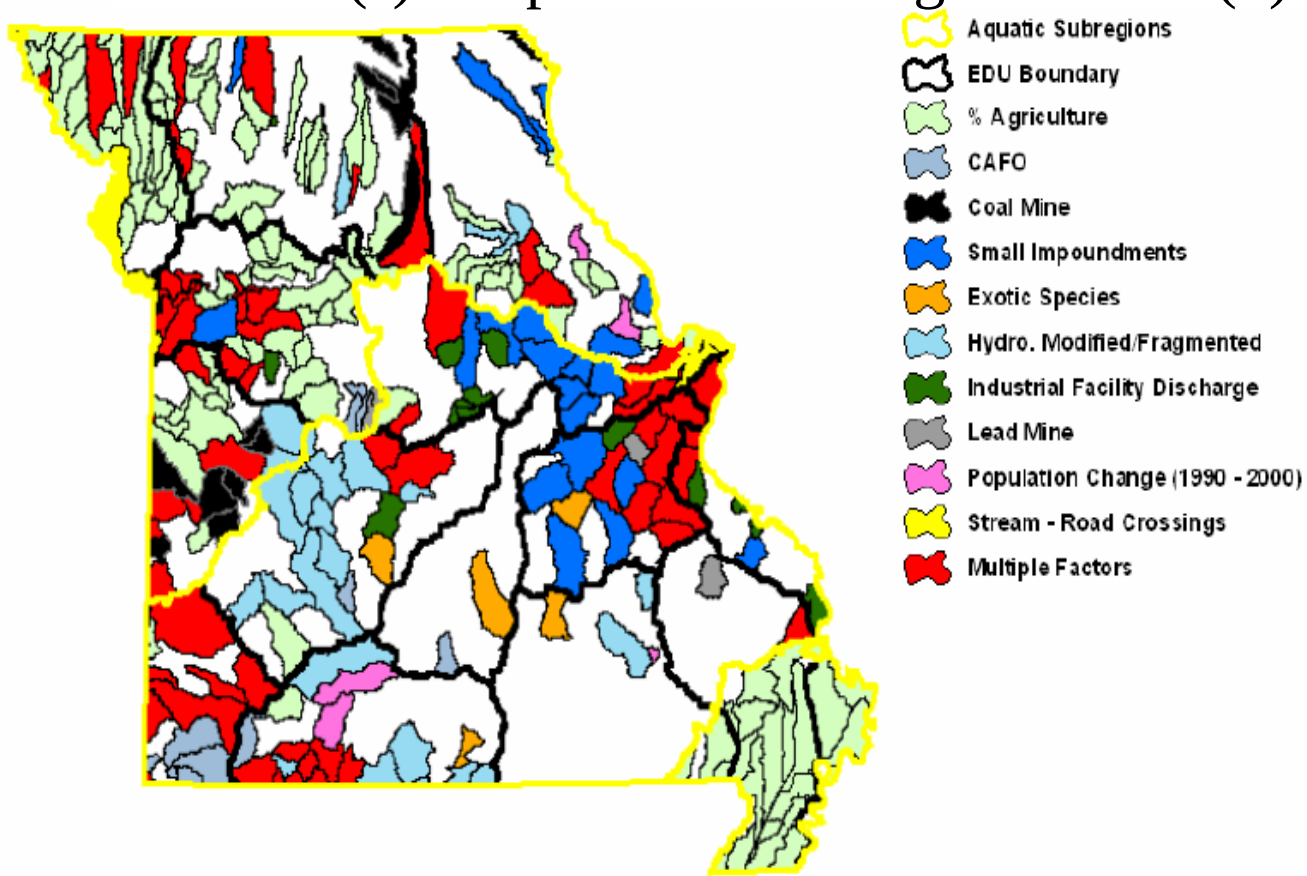


Utility:
Coarse Screening Tool



First HSI Value

Stressor(s) Responsible for Highest Rank (4)



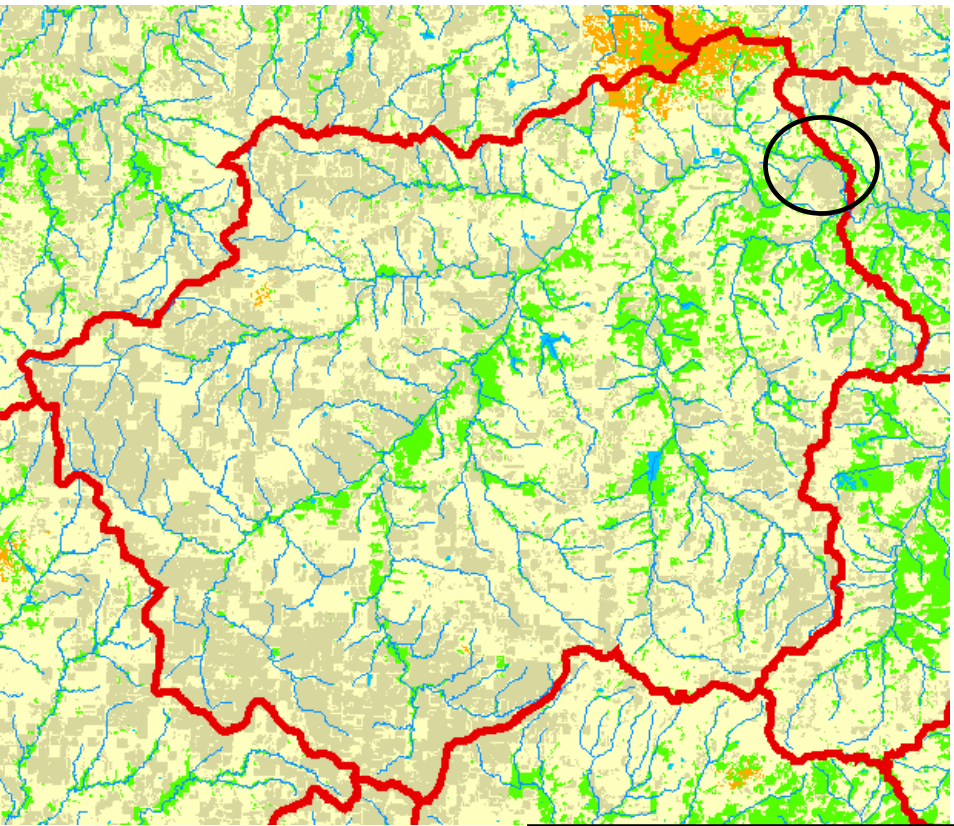
Problems with HSI

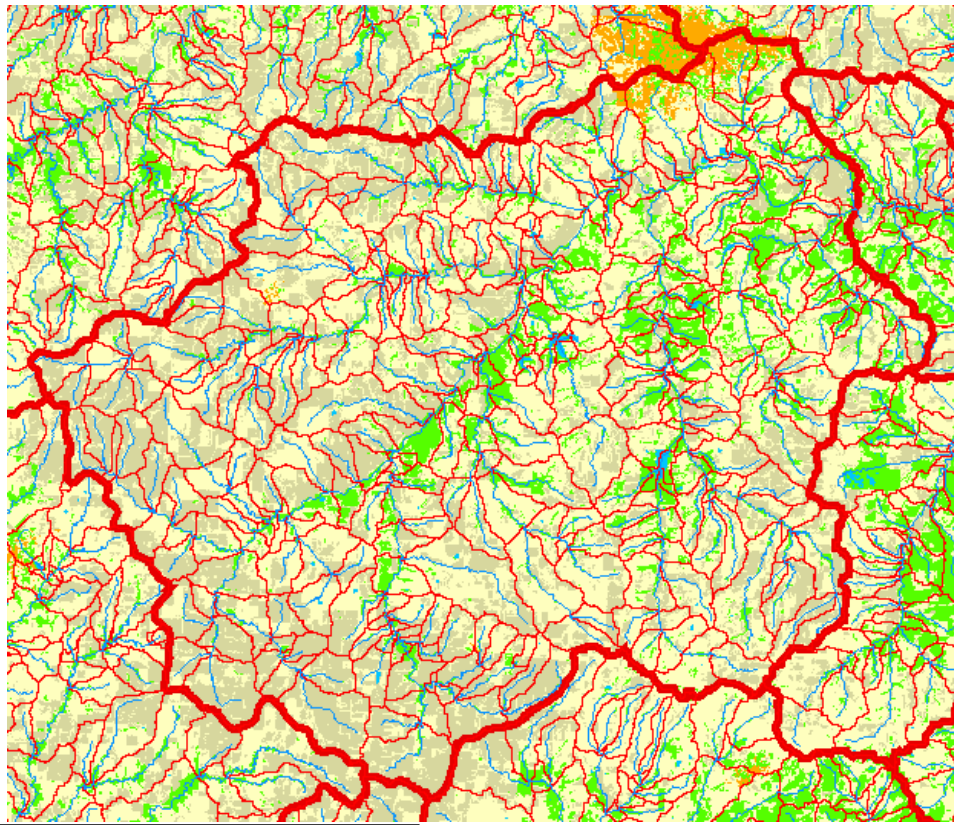
- Only accurately quantifies conditions at outlet
- Data availability and quality
- Treats all stressors equally
  - Weighting (ex., 3xUrban vs. 1xAg)
- Does not account for principal ecological effects
  - Develop separate stressor indices (Physical habitat, water quality, flow regime, energy/nutrient dynamics, biotic interactions)
- Does not account for spatial considerations

Problem:
Only Quantifies Conditions at Outlet

Problem: Only accurately quantifies conditions at outlet

Solution: Utilize higher resolution assessment unit (segment shed)



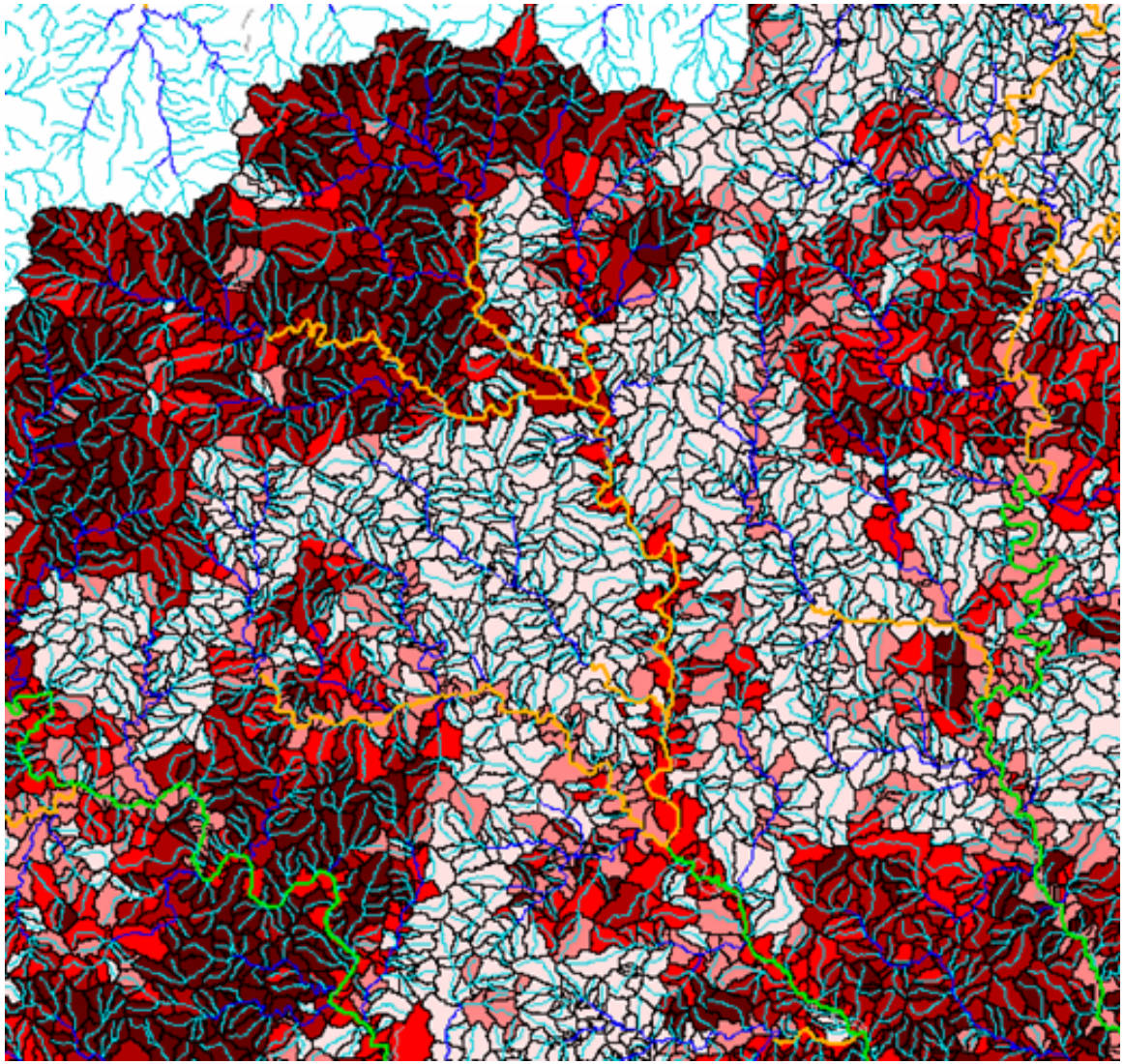


Streams
Assessment Polygon

Urban
Row and Close Grown Crop
Grassland
Forest and Woodland
Swamp and Marsh
Open Water

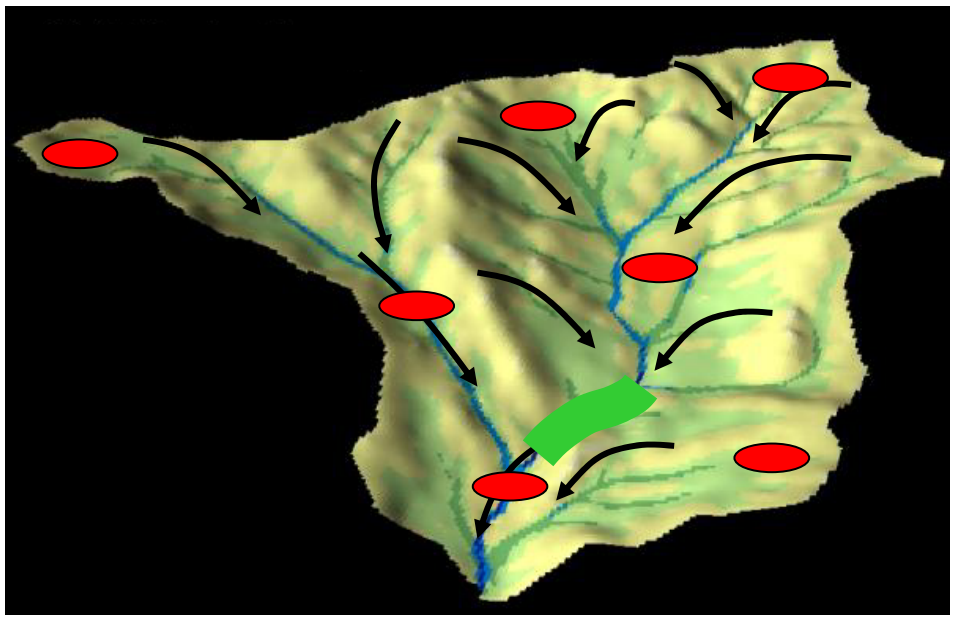
Streams
Assessment Polygon

Account for Local and Watershed Conditions

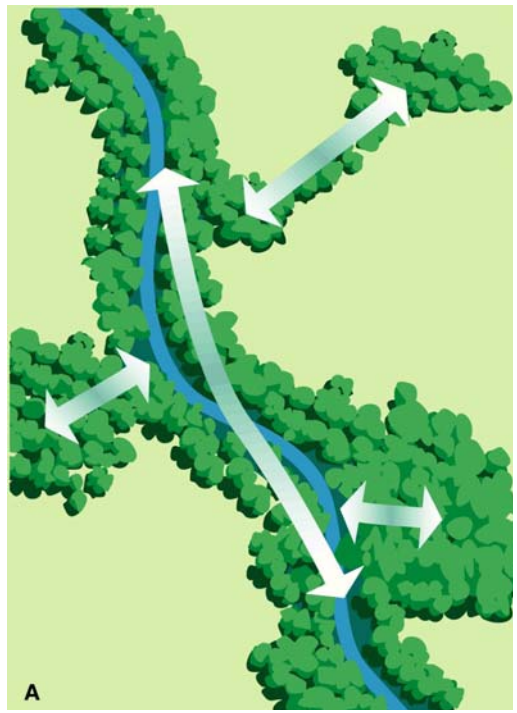


Spatial Considerations

- Distance to stressor
- Is stressor upstream, downstream or local

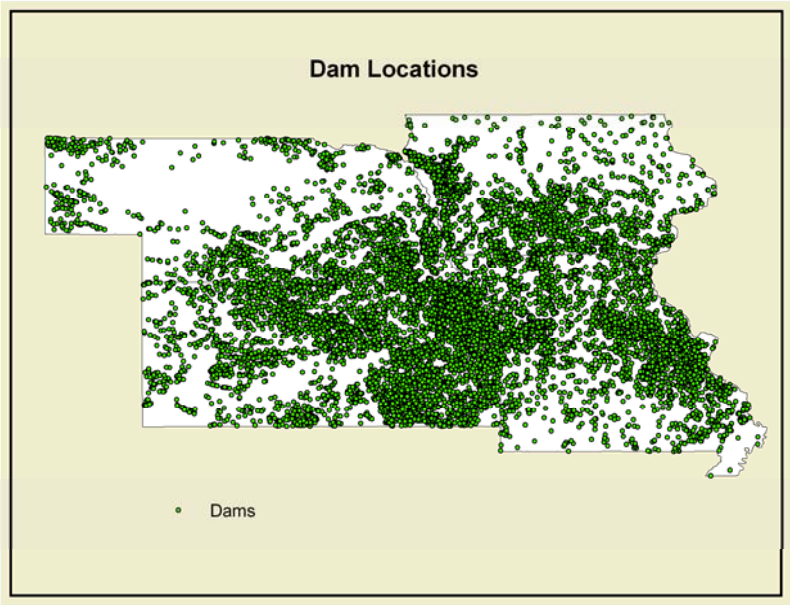


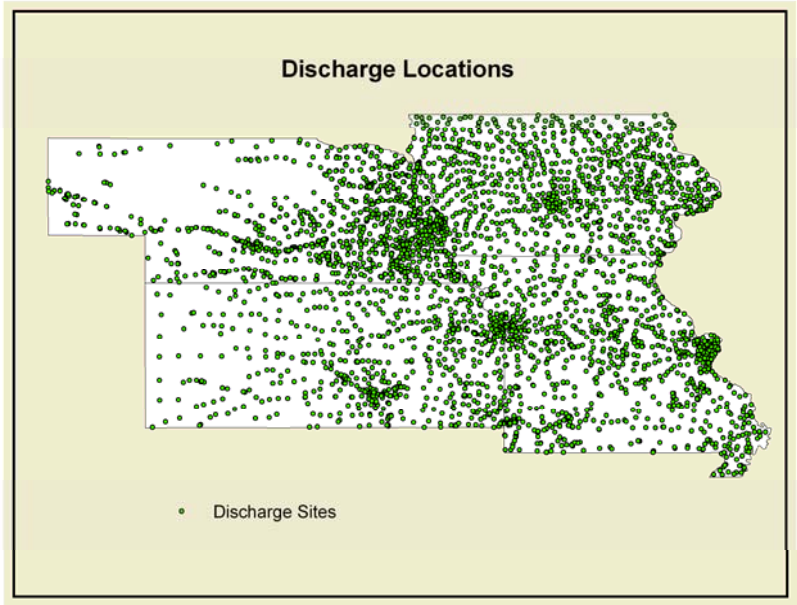
Ecological Integrity of Riverine Ecosystems is Dependent Upon Integrity of the Entire Watershed

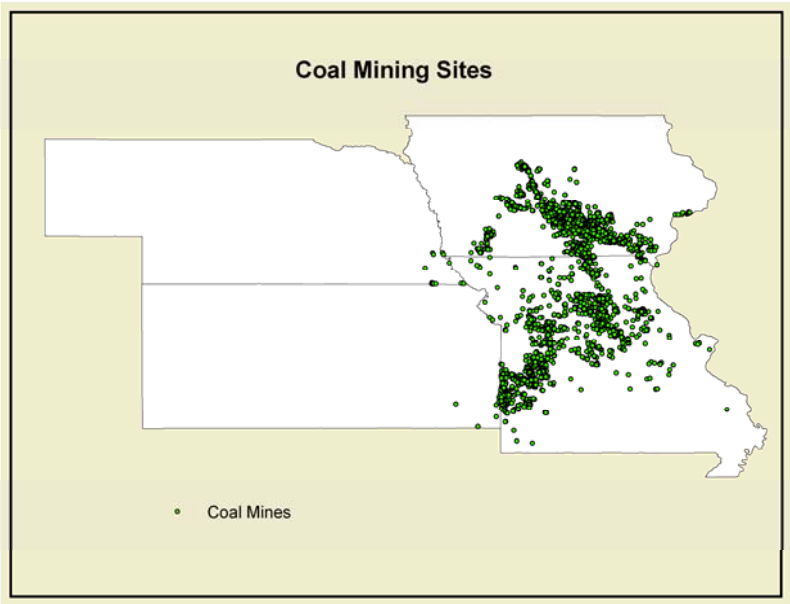


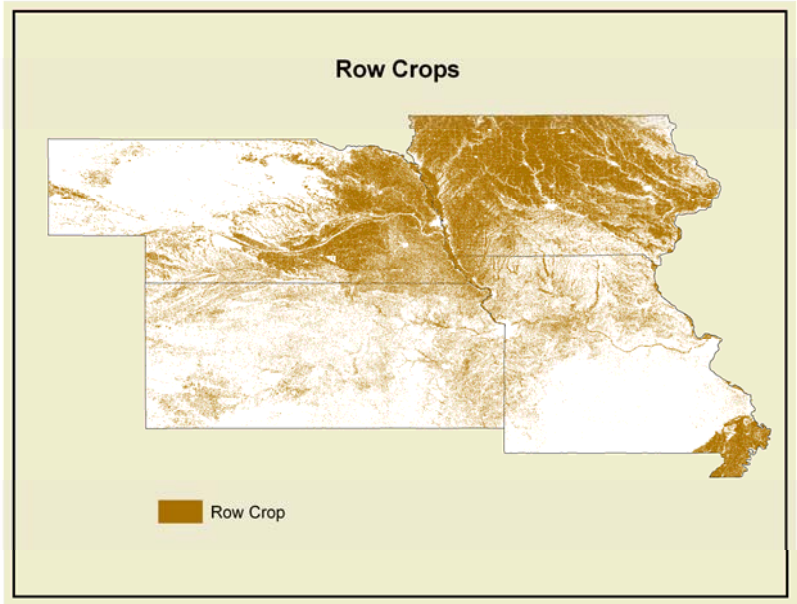
Accounting for Connectivity

Gathering Threats Data









A New Methodology: How is it different from what we have done in Missouri?

- All of EPA Region 7
- Use segment-sheds (reach specific drainage)
- Work with committee to locate all available data
- Weight threats
- If possible, account for principal ecological effects separately
- Account for spatial considerations