AN AQUATIC GAP ANALYSIS OF RIVERINE ECOSYSTEMS THROUGHOUT THE MISSOURI RIVER BASIN

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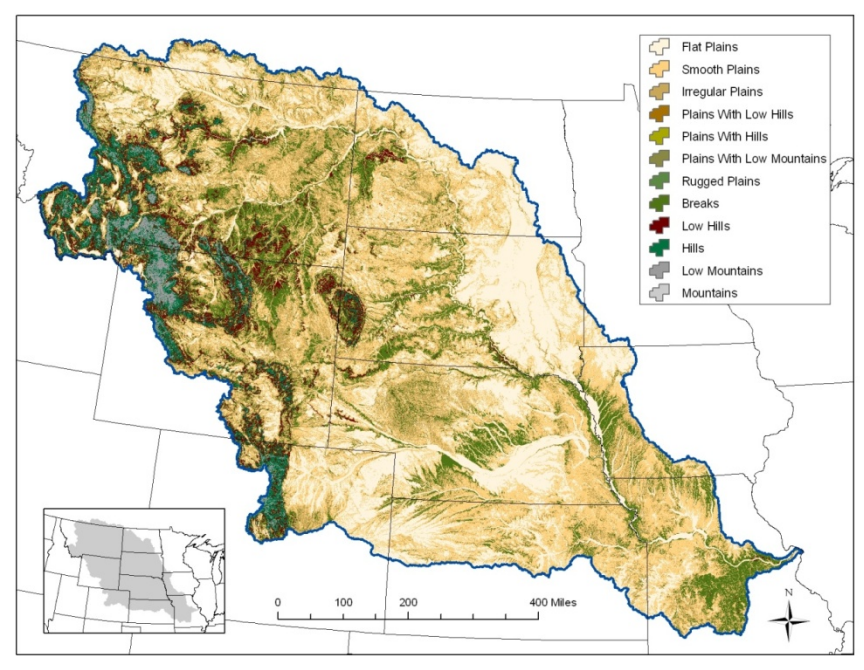
KEEPING COMMON SPECIES COMMON

OUTLINE

1. Background
2. Nested ecological classification framework
3. Fish predictive distribution modeling
4. Threat assessment
5. The Aquatic Gap Analysis
    a. Abiotic component
    b. Biotic component

MISSOURI RIVER BASIN



- 10 states
- 2 provinces
- 3 physiographic regions
- 1,348,785 km^2 (17% of country)
- 996,243 km of stream
- Climate, geologic composition, and topography vary widely
- 178 fish species

AQUATIC GAP – SOME BACKGROUND

- *The goal of the National Aquatic GAP is to evaluate aquatic biological diversity and aquatic habitats using spatial analysis and habitat suitability models to identify gaps in species distribution and work toward more effective conservation prioritization* (Aquatic Gap Program 2010).

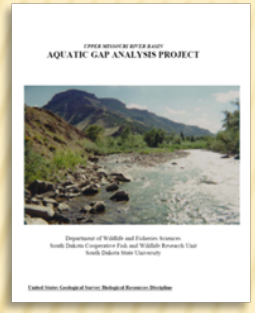
Photo courtesy of the Missouri Department of Conservation, Missouri Fish and Wildlife Information System

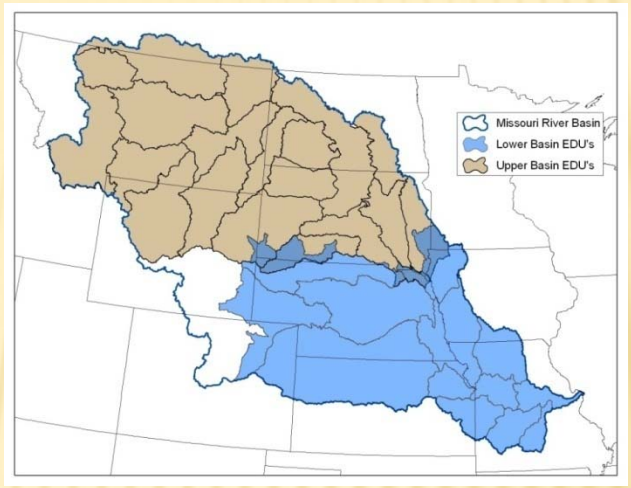
gap

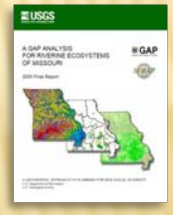
KEEPING COMMON SPECIES COMMON

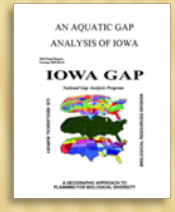
PROJECT BACKGROUND AND OBJECTIVES

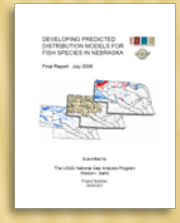
- Integration of two previous projects







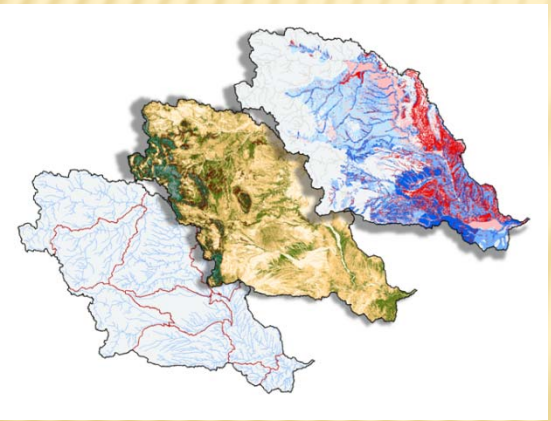




Specific Objectives:

- Seamless ecological classification
- Seamless fish predictive distribution models
- Seamless Gap Analysis

General Approach



Step 1 Classify riverine ecosystems at multiple spatial scales

Step 2 Predict biological potential of each valley segment

Step 3 Quantify public ownership/stewardship for each valley segment

Step 4 Quantify degree of human disturbance

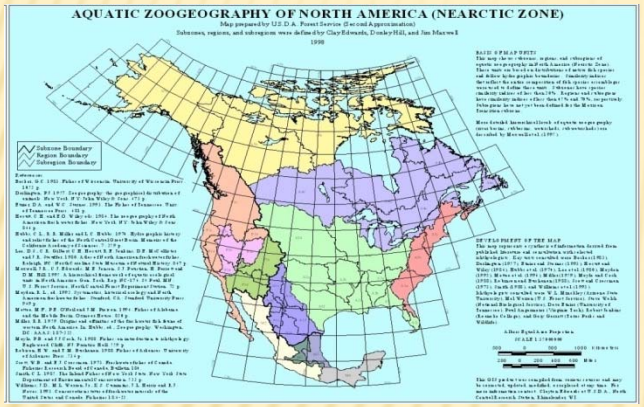
Step 5 Assess representation of stream types

Step 6 Assess representation of watershed types

Step 7 Assess representation of species

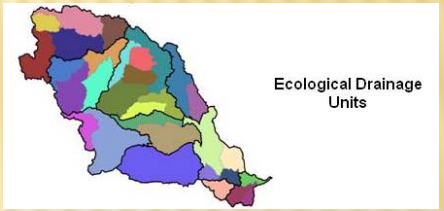
NESTED ECOLOGICAL CLASSIFICATION HIERARCHY

- Levels 1-3 of hierarchy

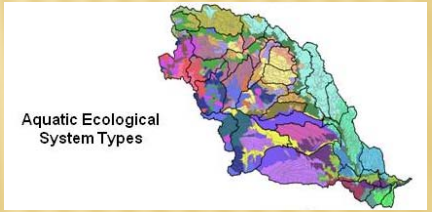


Level 4

Level 5



Level 6



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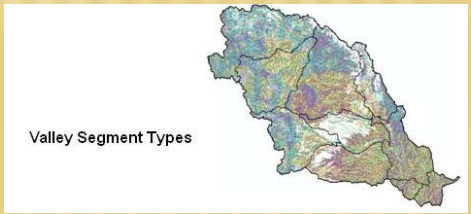
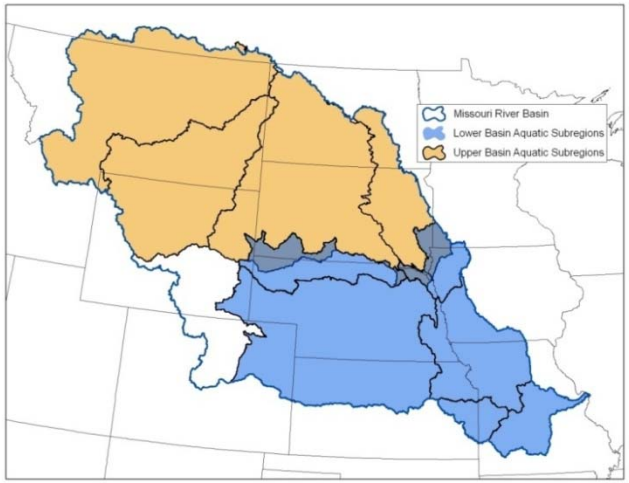
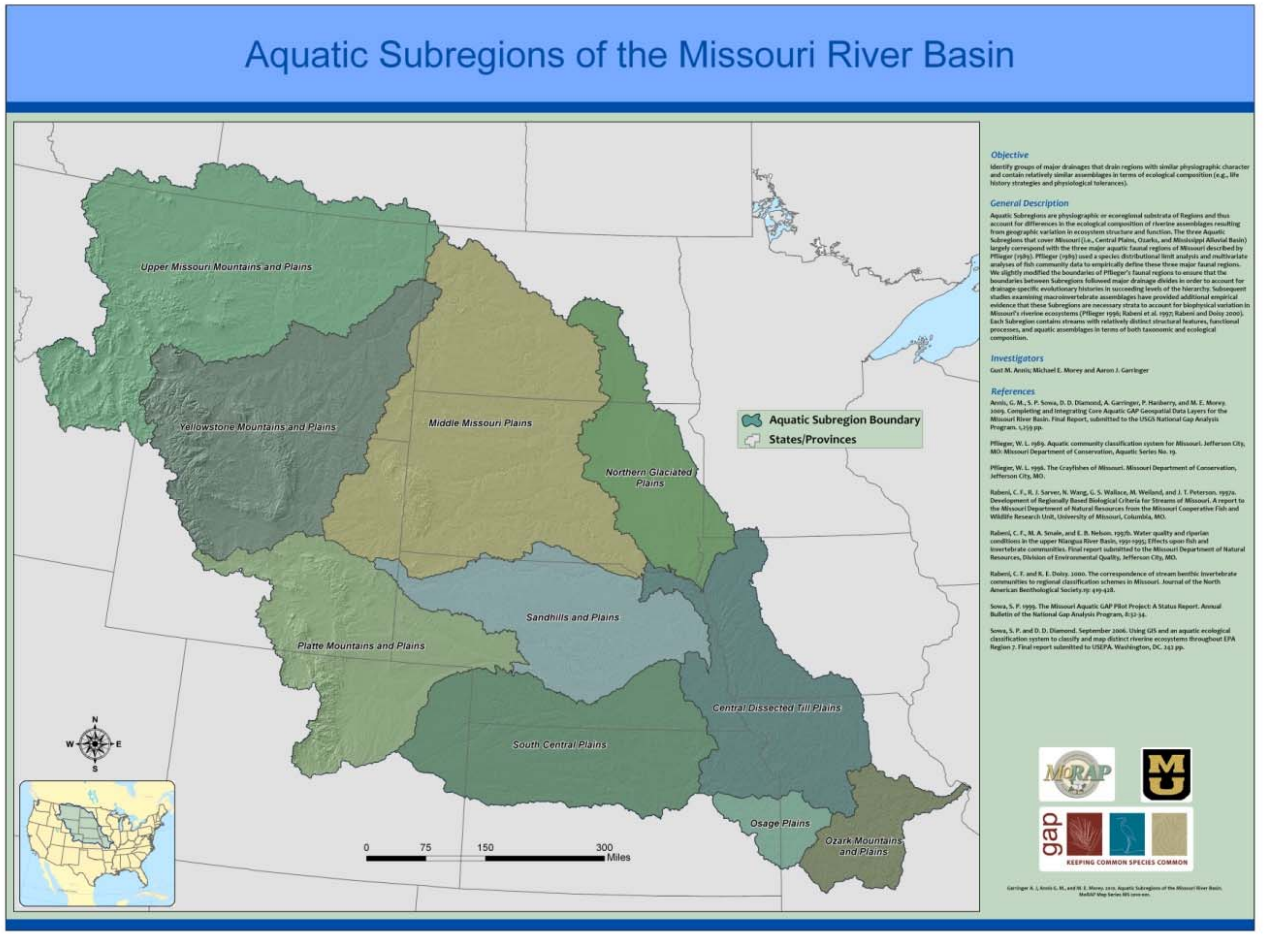


- Aquatic Subregions
- Ecological Drainage Units
- Aquatic Ecological System Types
- Stream Valley Segment Types

AQUATIC SUBREGIONS

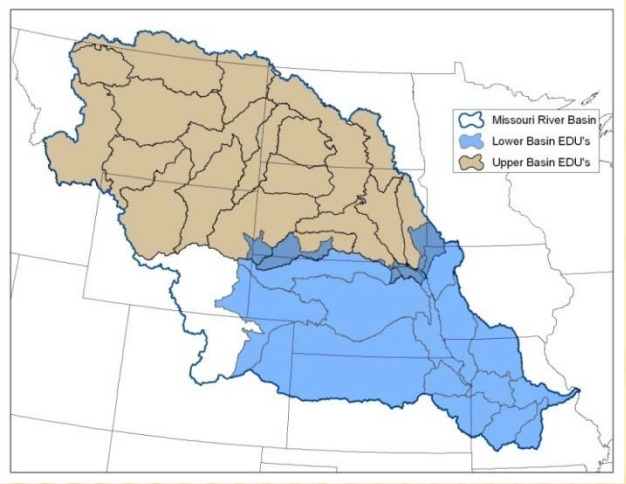


Pre-integration Data

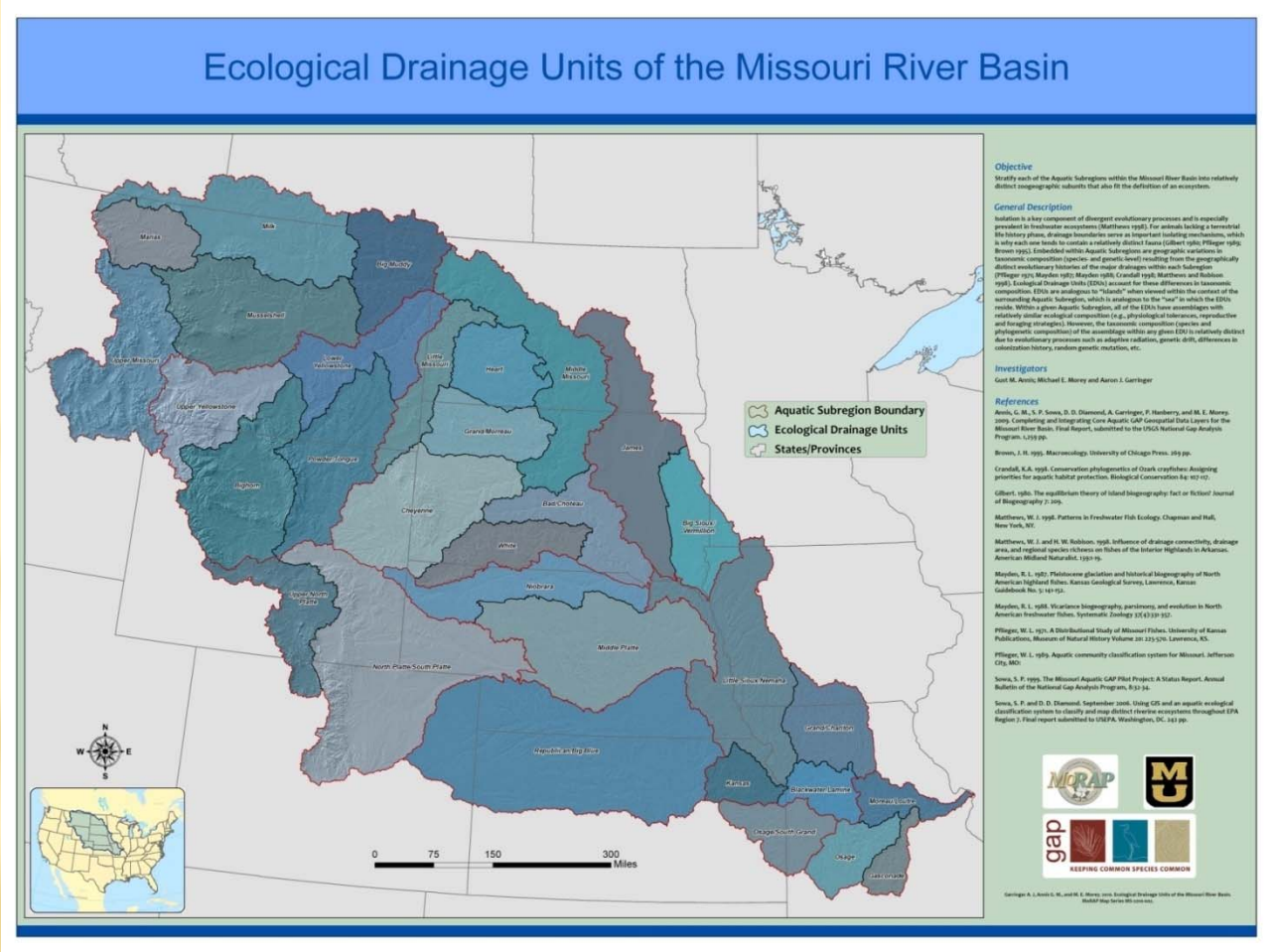


- Groups of major drainages that drain regions with similar physiographic character

ECOLOGICAL DRAINAGE UNITS (EDU)

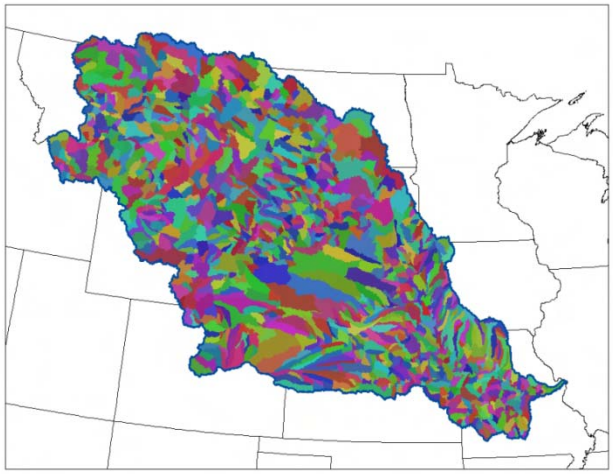


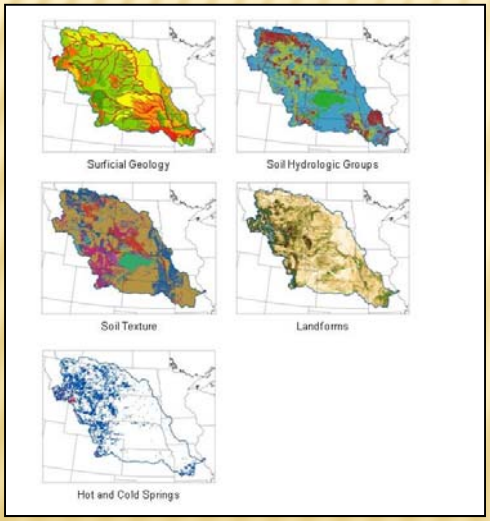
Pre-integration Data

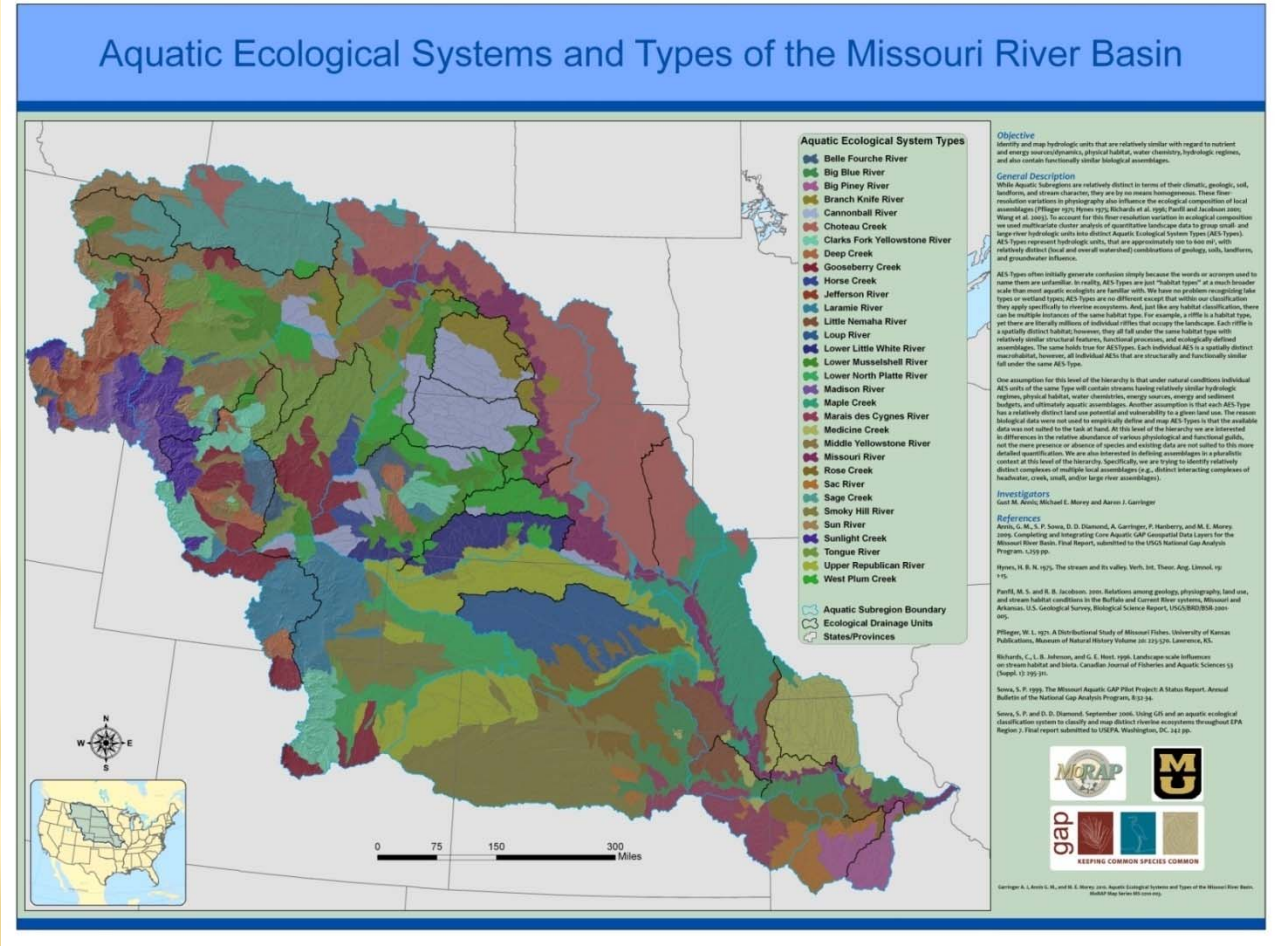


- Evolutionarily distinct units
- “Islands” in the landscape

AQUATIC ECOLOGICAL SYSTEM TYPES (AES-TYPES)



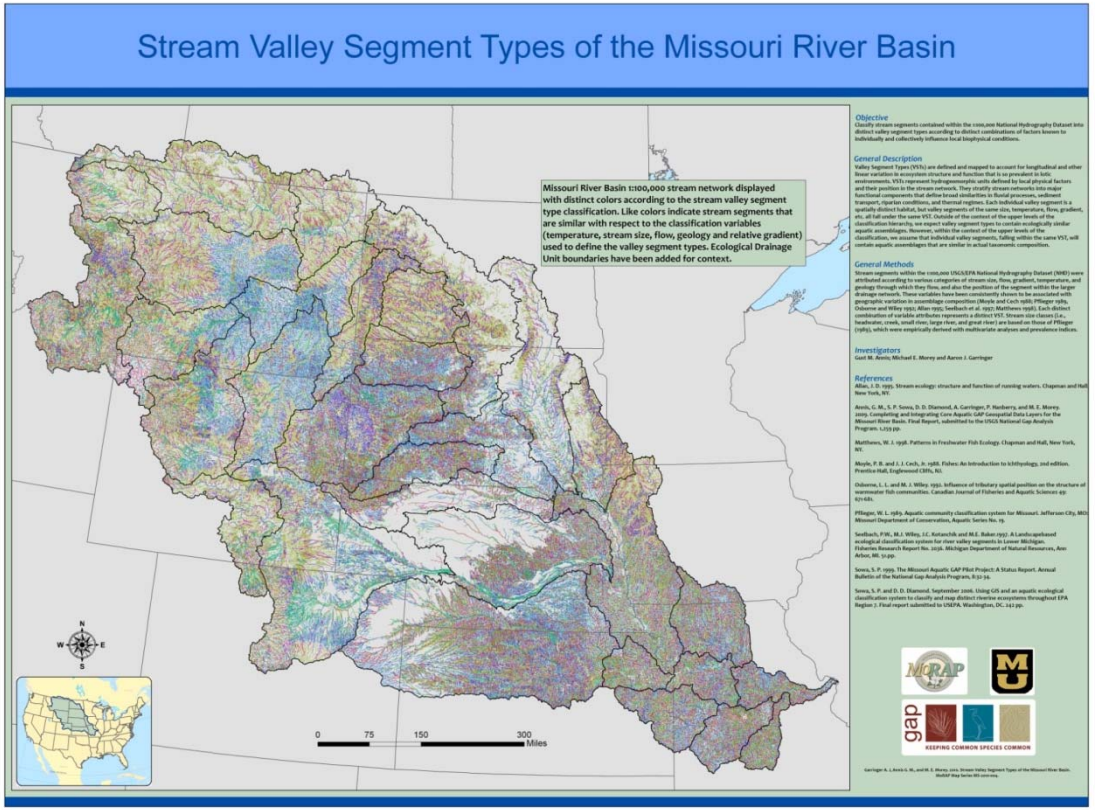




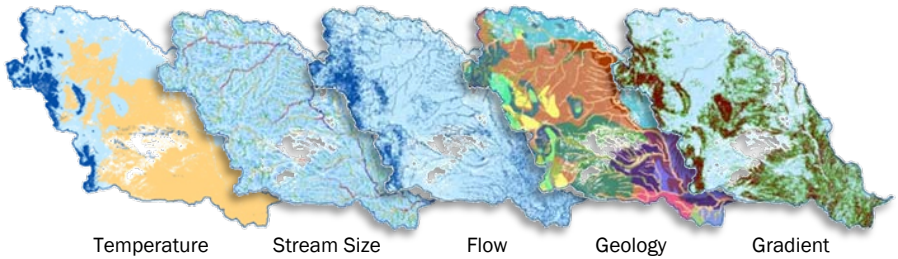
- Watershed Types
- Ecological neighborhoods
  (similar combinations of stream types)

STREAM VALLEY SEGMENT TYPES (VST)

- 1:100,000 stream networks
- Each segment classified
- Used to identify dominant stream types

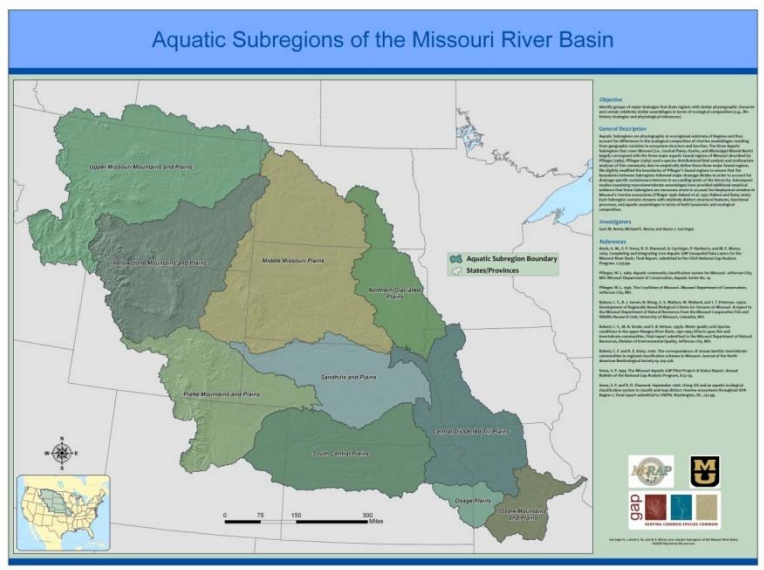


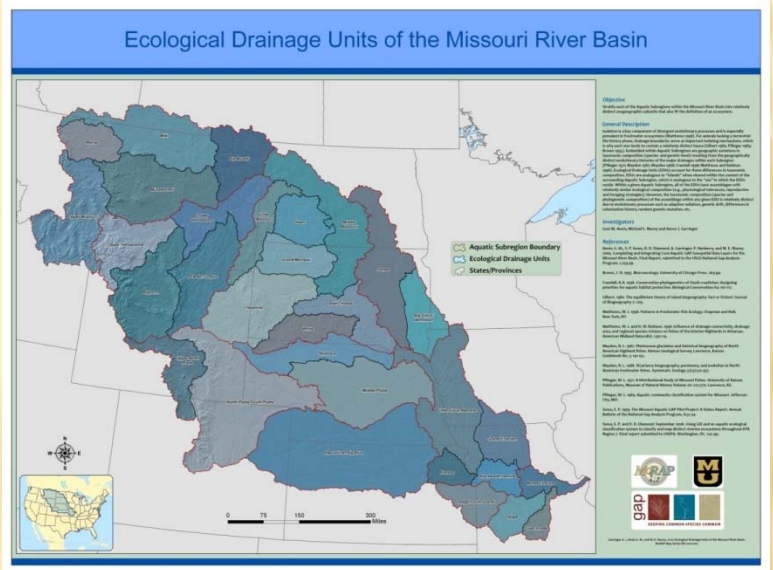
Unique Valley Segment Types

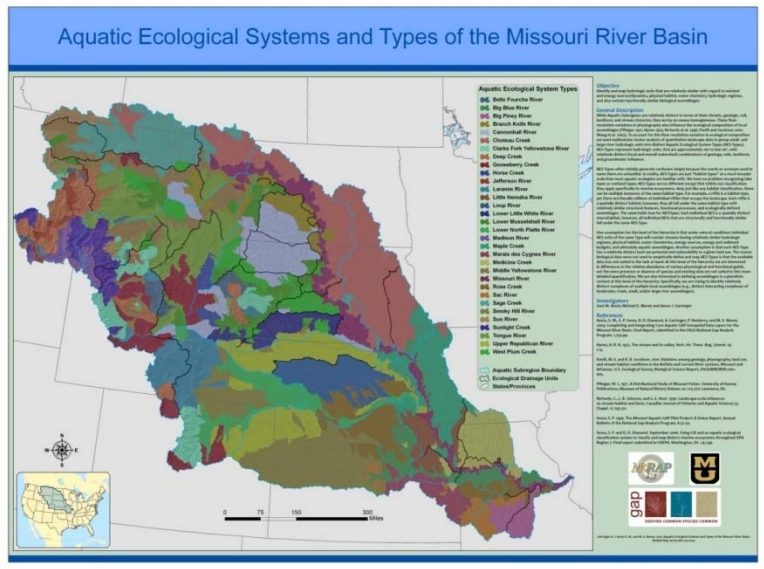


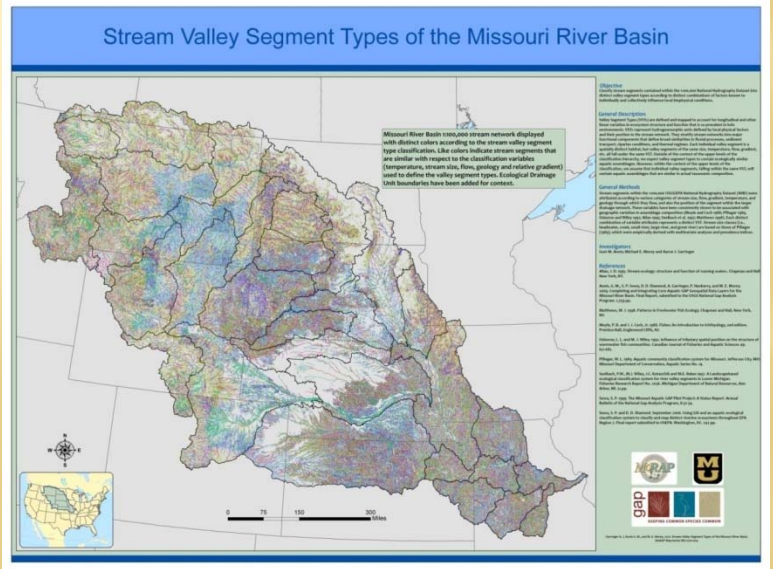
Individual Variables

NESTED ECOLOGICAL CLASSIFICATION USED FOR AQUATIC GAP ANALYSIS



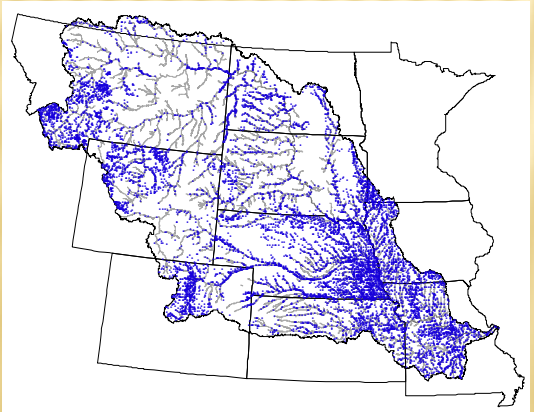






FISH PREDICTIVE DISTRIBUTION MODELING WHY?

- We cannot directly measure or map biodiversity
  - Species or assemblages serve as surrogate targets for assessing gaps in biodiversity conservation
- We cannot sample everywhere and most sampling data is spatially and temporally biased
  - Provide spatially comprehensive coverage of biological data at the finest resolution of our assessment of conservation gaps (i.e., valley segment scale)
    - A scale at which managers can comprehend and which effective conservation action can take place



~2% of basin stream segments have been sampled

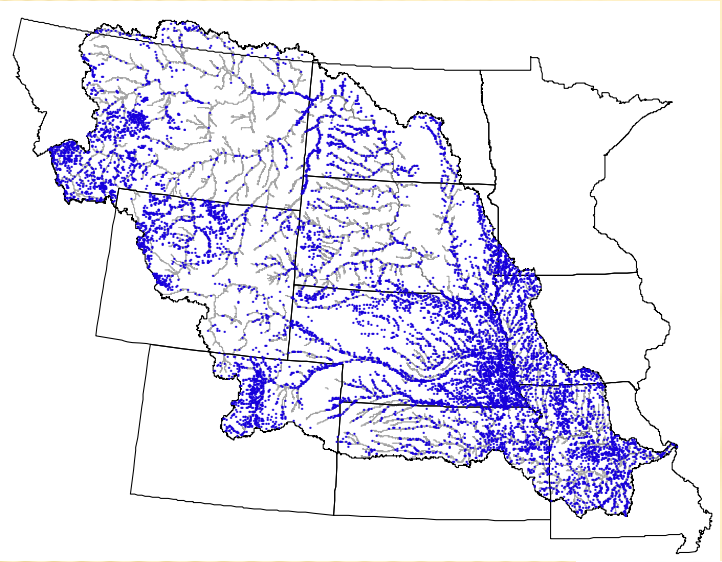
FISH PREDICTIVE DISTRIBUTION MODELING

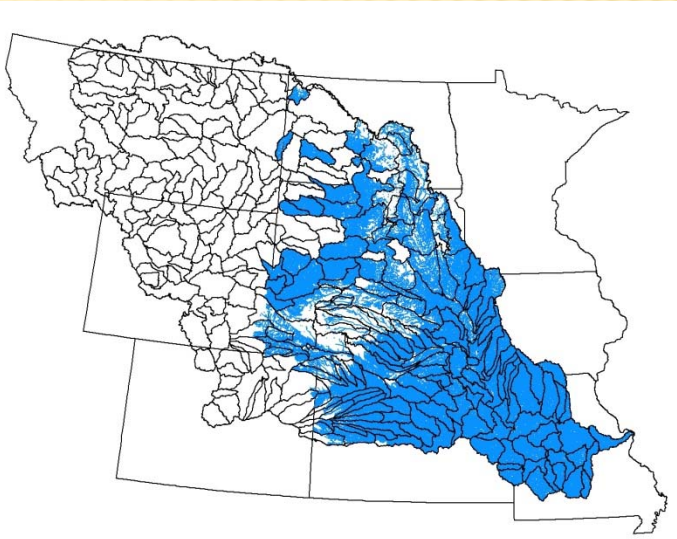
- Local and watershed predictors
- Local Predictors:
  - Stream size, stream temperature, flow, size discrepancy, gradient, geology
- Watershed Predictors:
  - Geology, Soils, Landform, Annual rainfall, Annual air temperature

FISH PREDICTIVE DISTRIBUTION MODELING

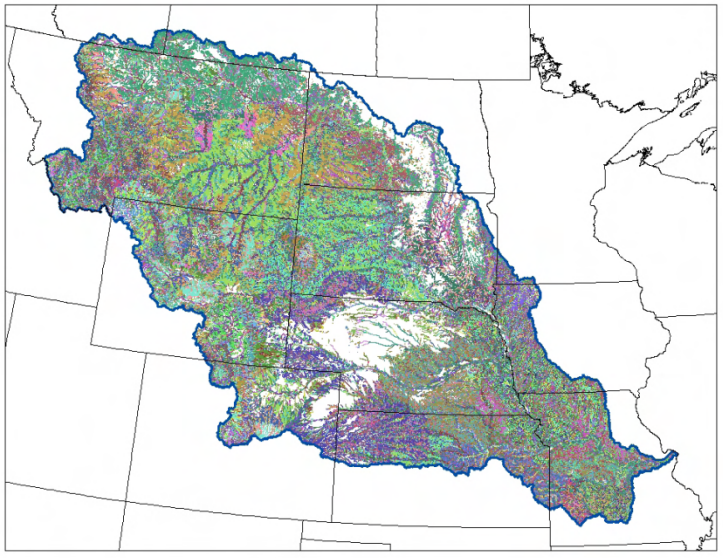
- 178 fish species excluding subspecies
- 22,693 fish community collections
  - 146,240 individual species occurrence records
  - 11,209 stream segments
- Species ranges
- SPSS Version 14
  - Classification Tree Add-on

FISH PREDICTIVE DISTRIBUTION MODELING





Species collections

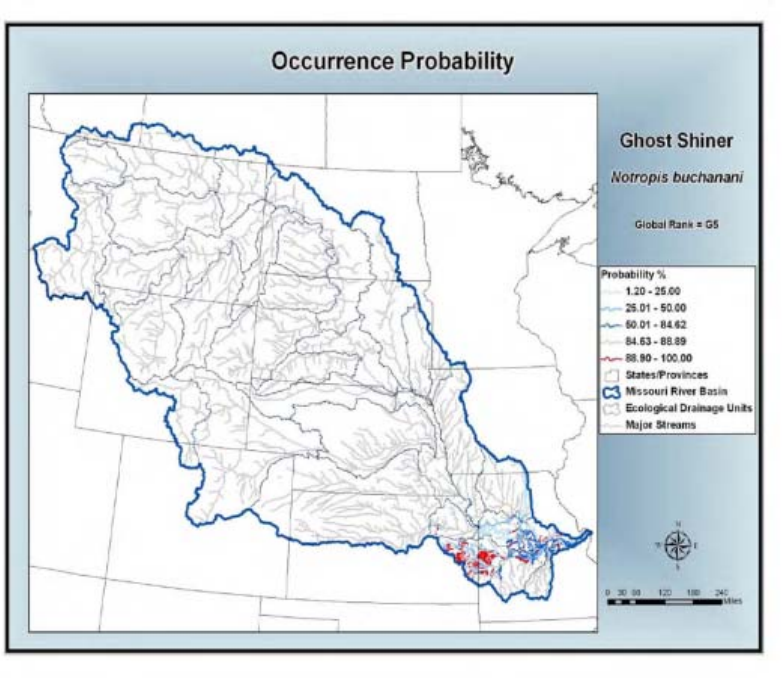


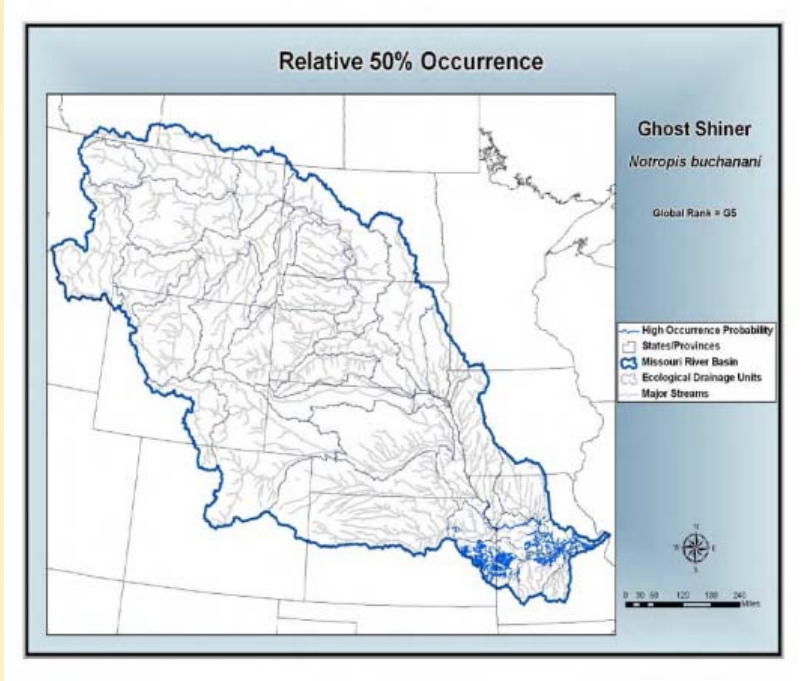
Professionally Reviewed Species Ranges

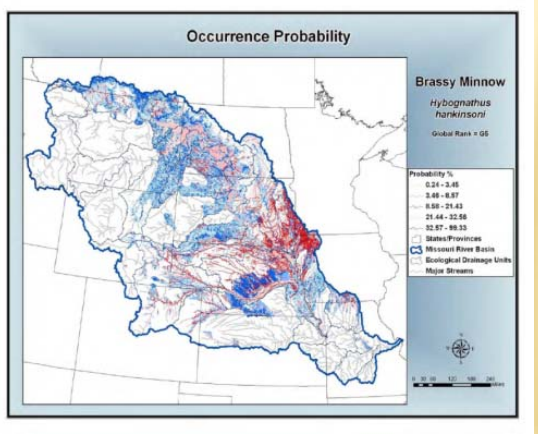
Streams attributed with predictor variables

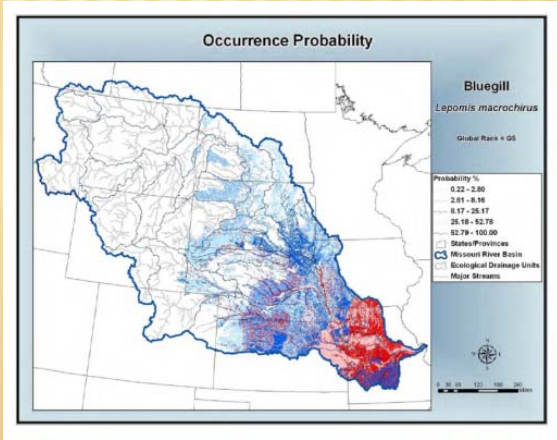
FISH PREDICTIVE DISTRIBUTION MODELING

RESULTS

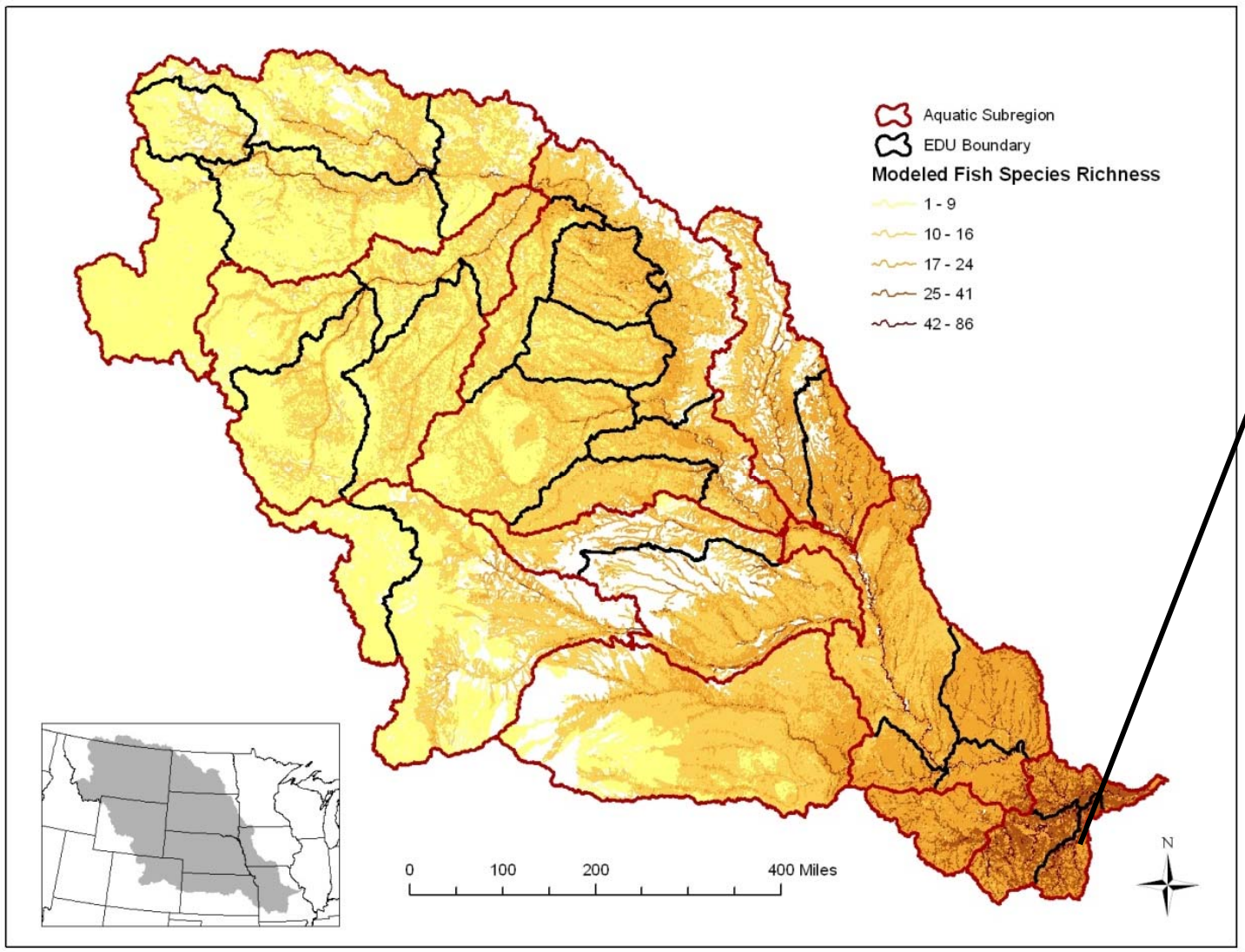








FISH PREDICTIVE DISTRIBUTION MODELING
UTILITY



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

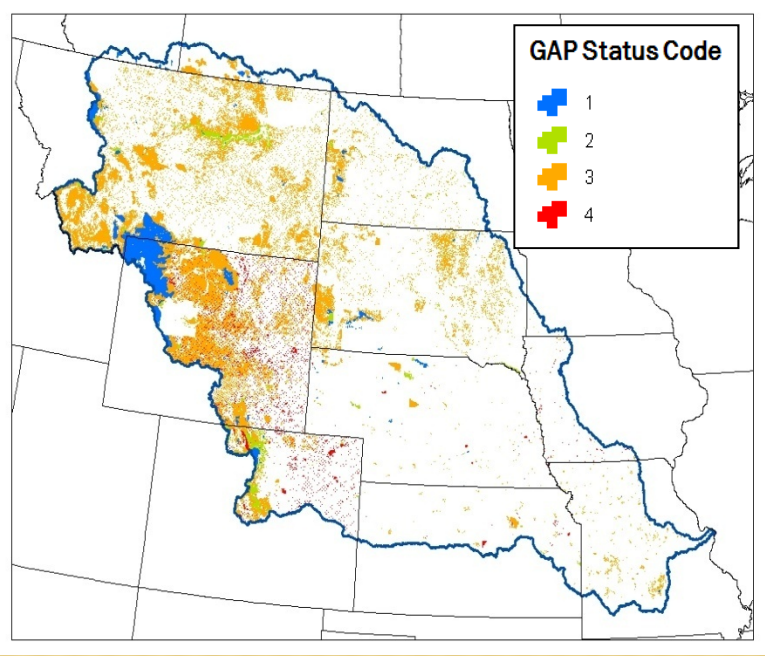
PUBLIC LAND STEWARDSHIP

Status 1: Permanent protection from conversion of natural land cover and a mandated management plan to maintain a natural state in which natural disturbance events are allowed to proceed. (e.g. Research natural areas)

Status 2: Permanent protection from conversion of natural land cover and a mandated management plan to maintain a primarily natural state, but which may receive use or management practices that degrade the quality of existing natural communities. (e.g. Wilderness areas)

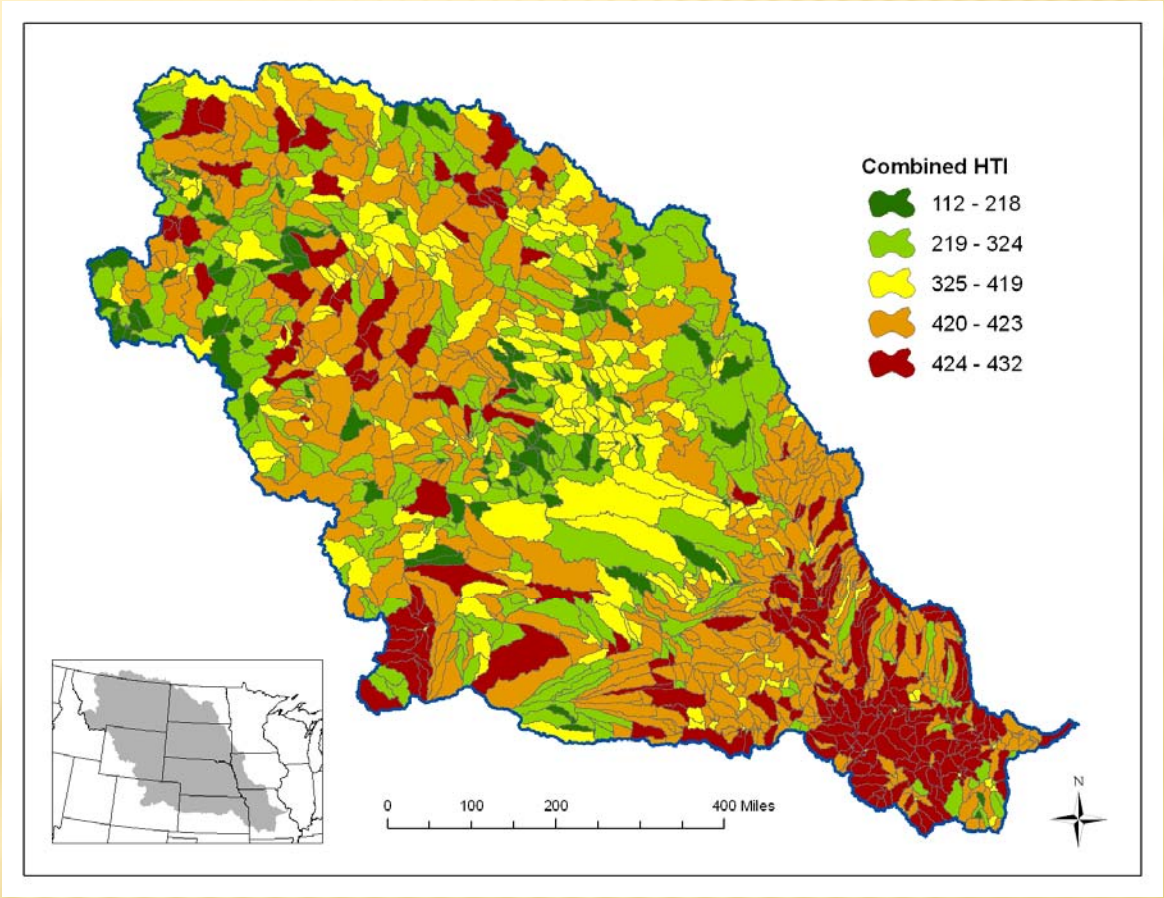
Status 3: Permanent protection from conversion of natural land cover for the majority of the area, but may be subject to extractive or intensive uses. (e.g., national forests).

Status 4: No easement or mandate to prevent conversion of natural habitat types. Allows for intensive use throughout the tract.



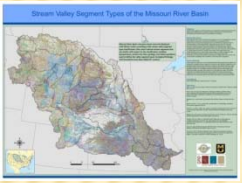
HUMAN THREAT INDEX

- Introduced Fish Species
- Impervious
- Cropland
- Pasture
- Road-Stream Crossings
- Population Change
- Major Hydrologic Modification
- Dams
- Coal Mines
- Lead Mines
- Permitted Discharges
- Oil & gas Wells

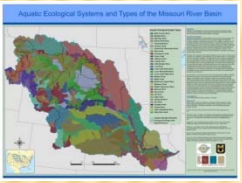


THE AQUATIC GAP ANALYSIS

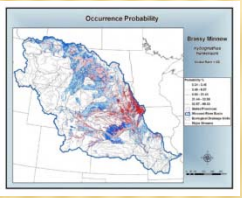
- Abiotic Surrogates
  - How well are the various stream types (VSTs) represented in the matrix of public lands set aside for long term maintenance of biodiversity (Status 1 or 2 lands)?



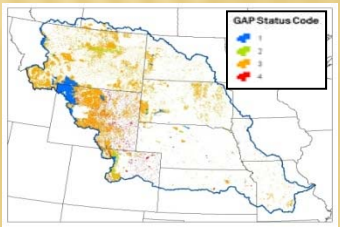
  - How well are the various watershed types (AES-Types) represented in the existing matrix of public lands?



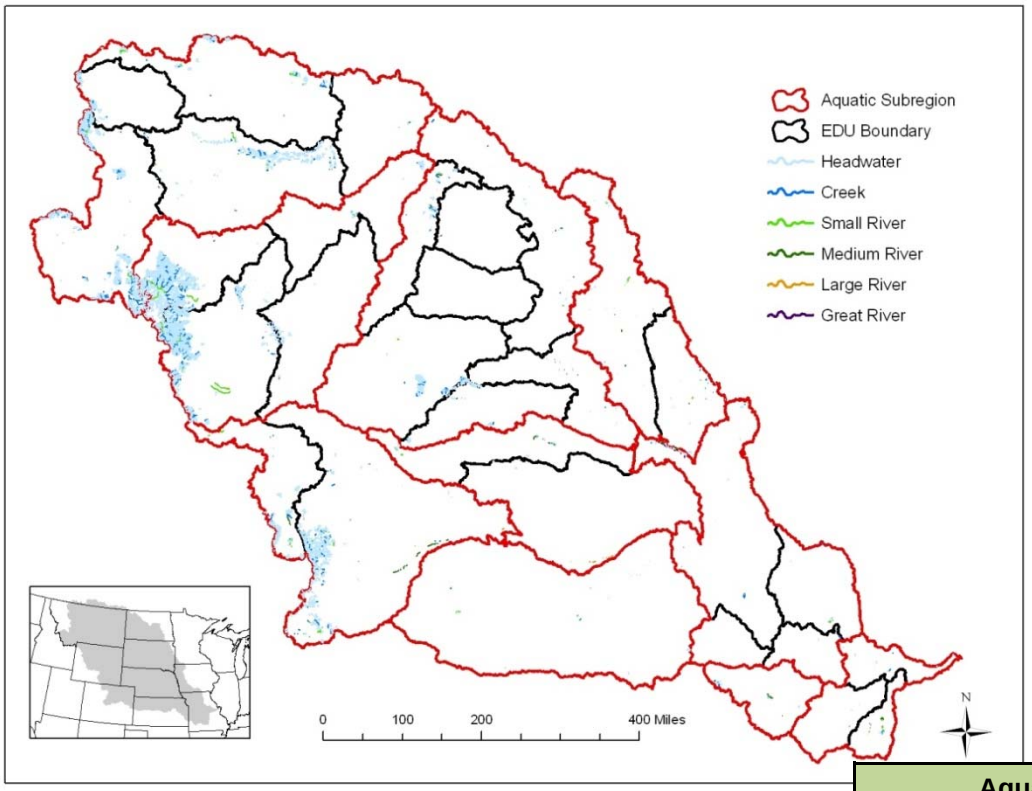
- Biotic Surrogates
  - How well are the aquatic biota (fish) represented in the existing matrix of public lands?



- Focused on local stewardship



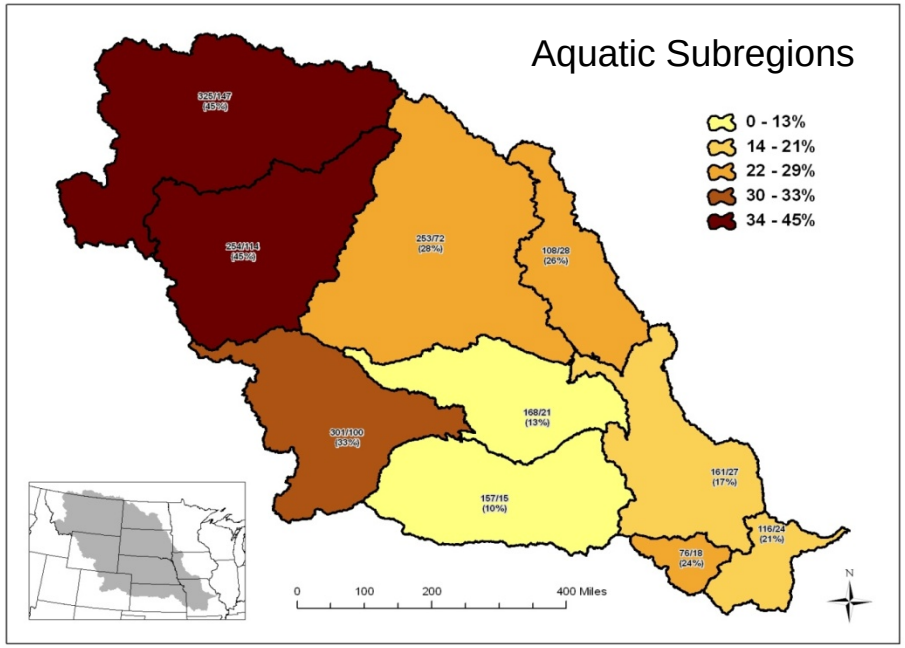
AQUATIC GAP ANALYSIS (ABIOTIC) STREAMS

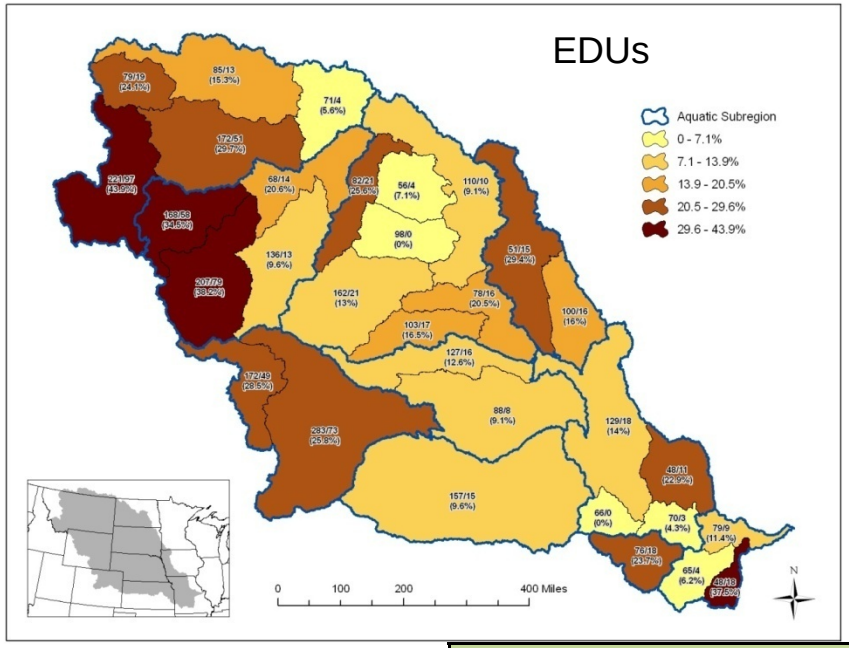


- Only ~2.2% of stream length is contained in Status 1 or 2 lands

		Status 1 or 2	
Aquatic Subregion	**Total Km**	**Kilometers**	**Percent**
Yellowstone Mountains and Plains	144,238	9,478	6.57
Upper Missouri Mountains and Plains	171,970	6,763	3.93
Platte Mountains and Plains	91,409	3,377	3.69
Middle Missouri Plains	228,066	1,788	0.78
Osage Plains	21,414	140	0.65
Northern Glaciated Plains	45,495	215	0.47
Ozark Mountains and Plains	39,566	156	0.39
Sandhills and Plains	66,572	206	0.31
Central Dissected Till Plains	113,780	220	0.19
South Central Plains	124,329	126	0.10

AQUATIC GAP ANALYSIS (ABIOTIC) STREAM TYPES (VSTs)





Basin / Aquatic Subregion	Total VSTs	Status 1 or 2	
		Number	Percent
Missouri River Basin	*607*	*322*	*53%*
Yellowstone Mountains and Plains	254	114	45%
Upper Missouri Mountains and Plains	325	147	45%
Platte Mountains and Plains	301	100	33%
Middle Missouri Plains	253	72	28%
Northern Glaciated Plains	108	28	26%
Osage Plains	76	18	24%
Ozark Mountains and Plains	116	24	21%
Central Dissected Till Plains	161	27	17%
Sandhills and Plains	168	21	13%
South Central Plains	157	15	10%

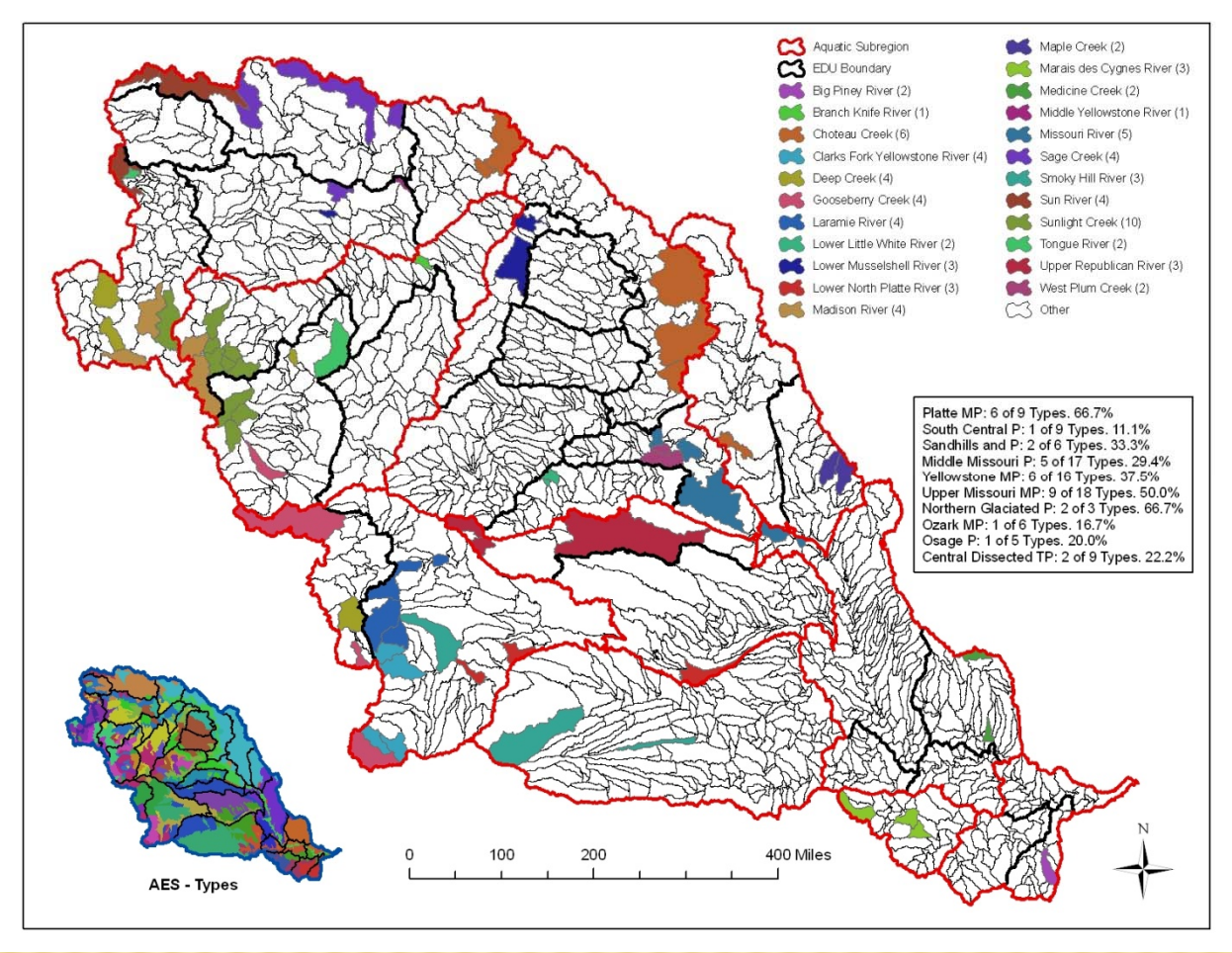
AQUATIC GAP ANALYSIS (ABIOTIC – STREAMS) BREAKDOWN BY ENVIRONMENTAL FACTORS

Stream Size	Total Length (km)	Length in Status 1 or 2	Percent in Status 1 or 2
Headwater	783,466.3	18,092.5	2.31%
Creek	141,403.0	2,539.0	1.80%
Small River	48,176.9	760.6	1.58%
Medium River	16,827.9	218.4	1.30%
Large River	4,075.6	20.2	0.49%
Great River	2,294.0	36.8	1.61%

Temperature	Total Length (km)	Km in Status 1 or 2	Percent in Status 1 or 2
Cold	67,726.8	14,768.0	21.81%
Cool	332,501.9	4,464.1	1.34%
Warm	577,883.3	2,435.5	0.42%

Relative Gradient	Total Length (km)	Length in Status 1 or 2	Percent in Status 1 or 2
Low	565,091.9	5,747.8	1.02%
Moderate	234,179.8	3,949.7	1.69%
High	196,972.0	11,970.0	6.08%

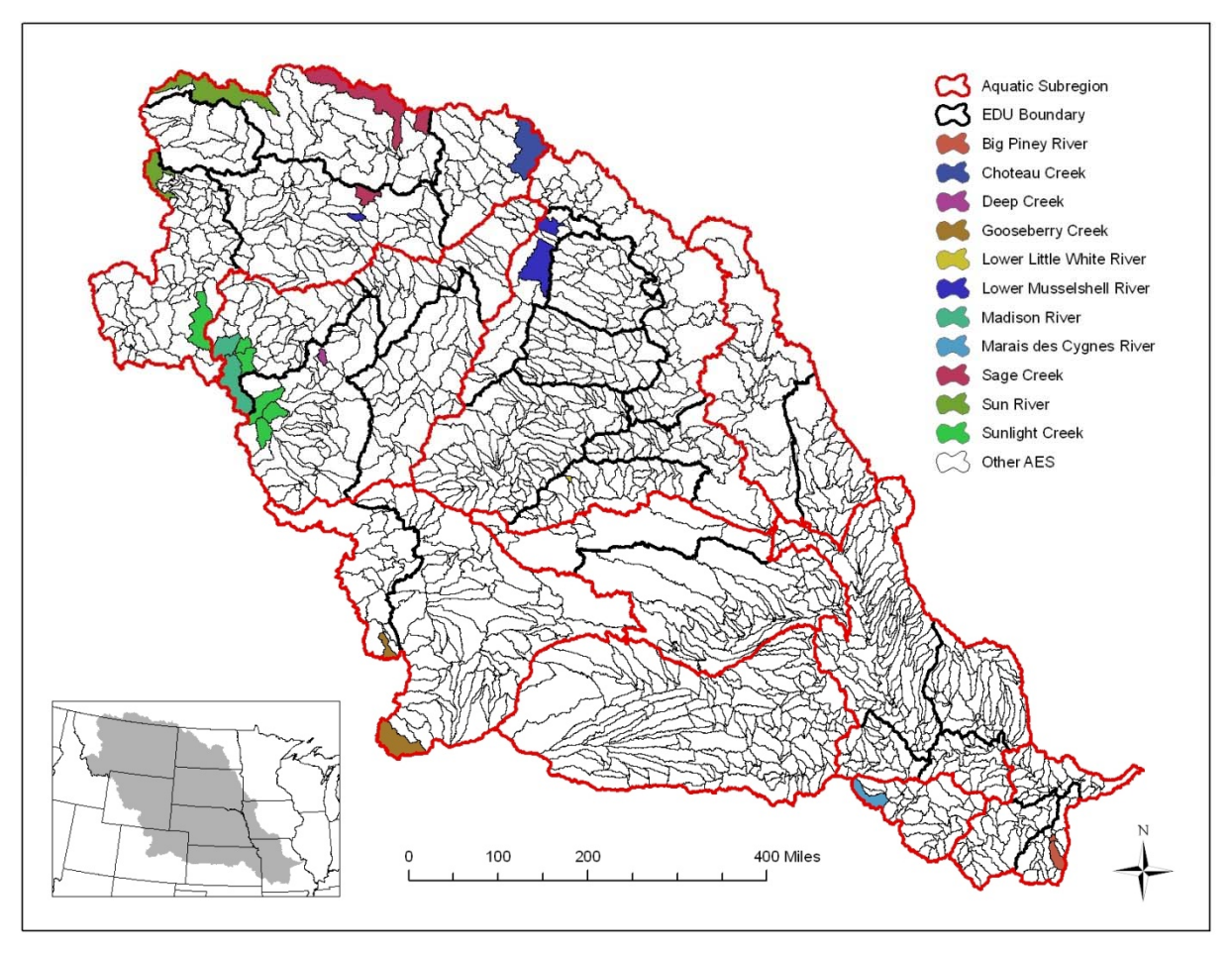
AQUATIC GAP ANALYSIS (ABIOTIC) AES



78 of 1562 (5%) Individual AES Polygons Represented

- Aquatic Ecological Systems (AESs) that have all stream size classes represented in Status 1 or 2 lands

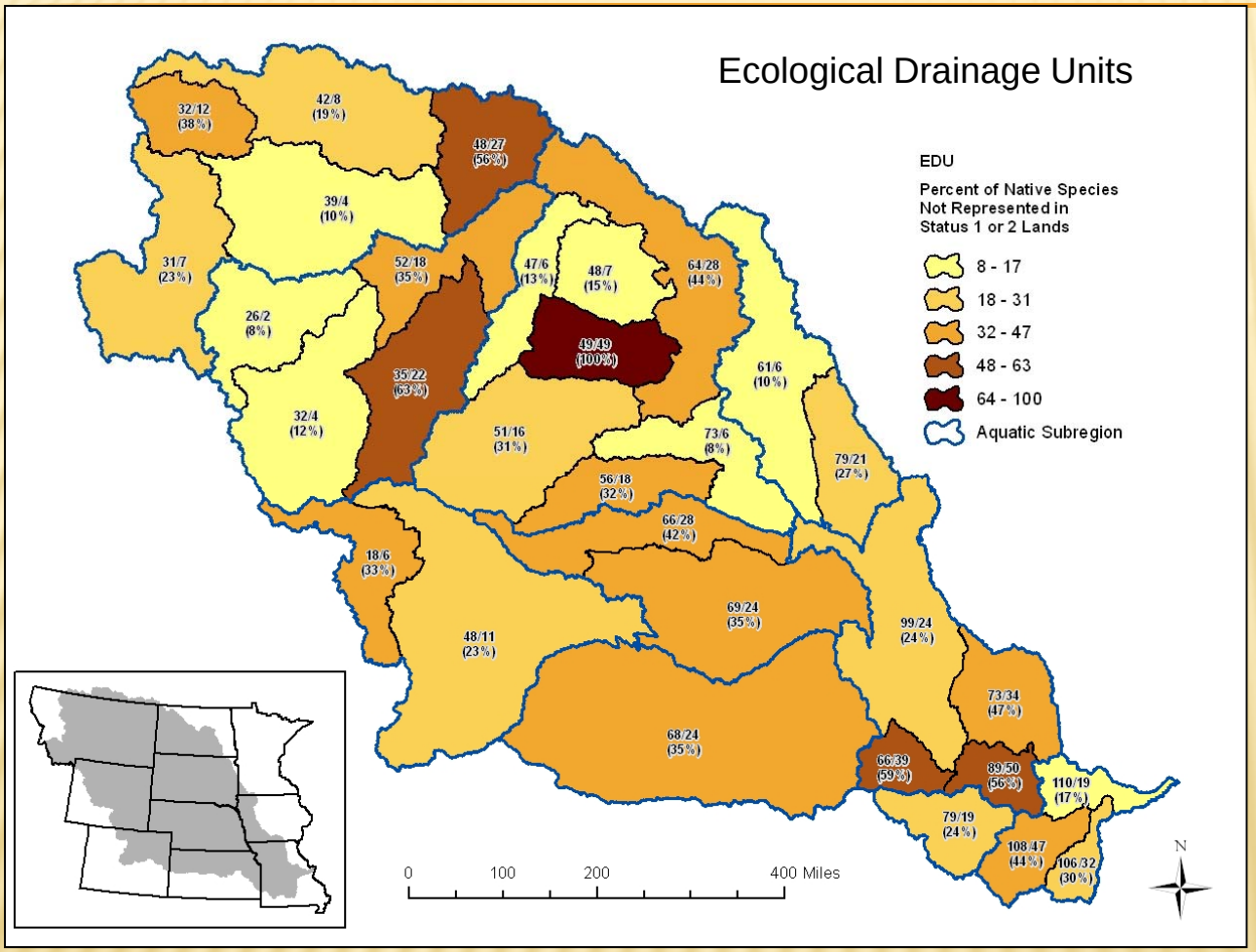
AQUATIC GAP ANALYSIS (ABIOTIC)
AES - MORE STRINGENT (CONNECTIVITY)



11 of 1562 (0.7%) Individual AES Polygons Represented

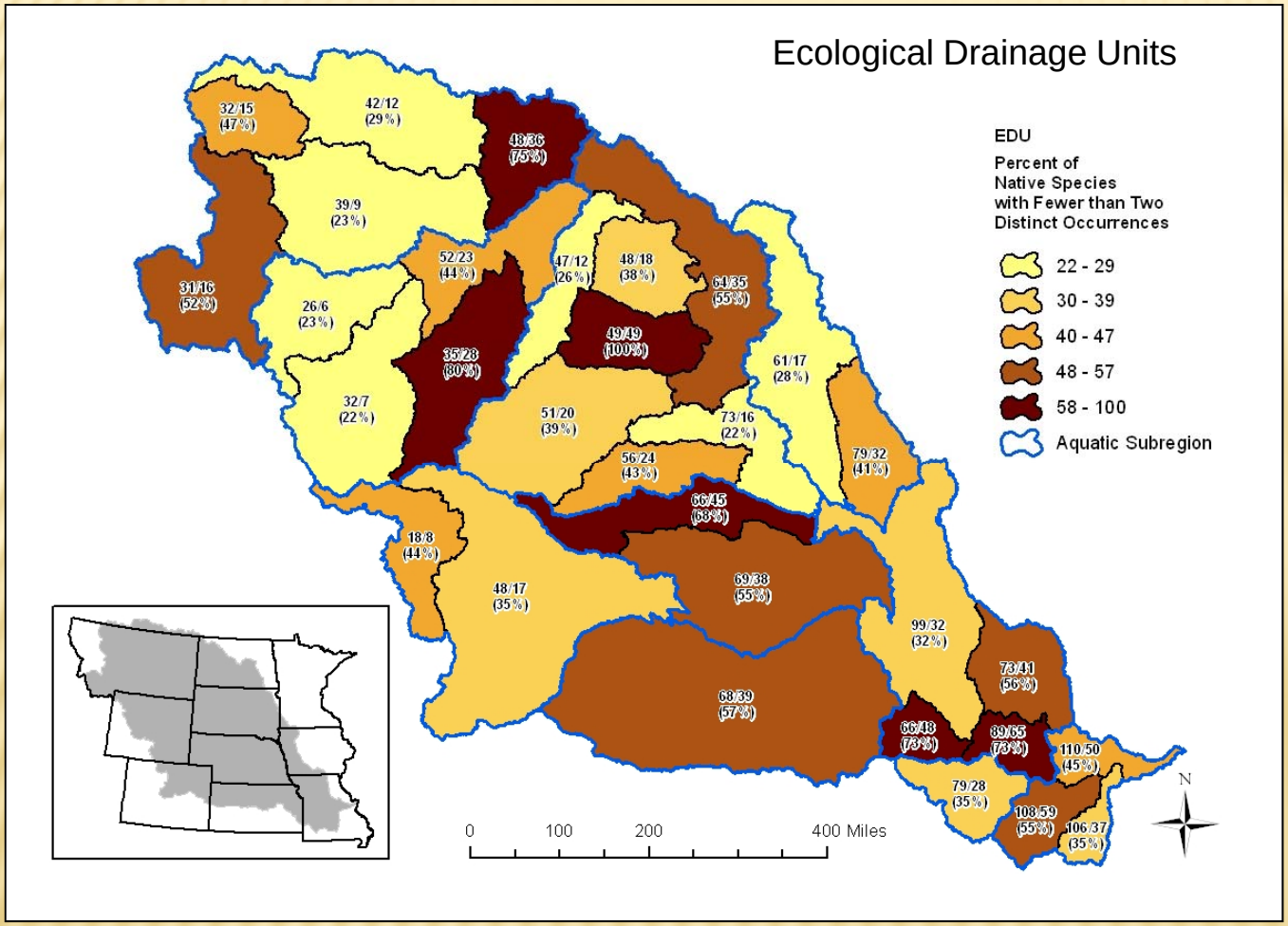
- Individual AESs with all stream size classes captured as interconnected complex in Status 1 or 2 lands

AQUATIC GAP ANALYSIS (BIOTIC) FISH PERCENT REPRESENTATION



- Percent of native species not represented in Status 1 or 2 lands

AQUATIC GAP ANALYSIS (BIOTIC) FISH POPULATION REPRESENTATION



- Percent of native species with fewer than two distinct occurrences

FINAL POINTS

- Many gaps and disparities across basin
- Doing a better job of conserving . . .
  - Cold water
  - High gradient streams
- Need to look at other taxa
- Resulting data suite is useful for conducting conservation planning

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END