Fundamental Conservation Principles and Assumptions

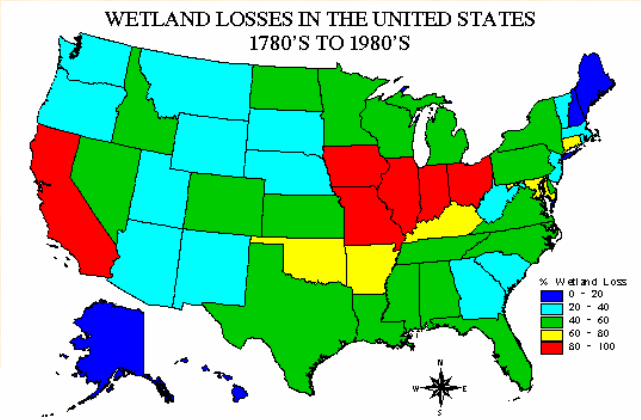
- Must conserve ecosystems and associated processes
- Watersheds are a fundamental conservation unit and define ecosystems for riverine systems
- Proactive protective measures are less costly and more likely to succeed than restoration actions
- Cannot directly manage ecological or evolutionary processes, but we can manage biotic and abiotic surrogates
- Conserving a diversity of biotic and abiotic targets is the best and most efficient approach to conservation
- More/bigger is better, connectivity is essential, redundancy is a safeguard, …
- Priorities should be established and conservation actions taken at multiple spatial scales
  - Species utilize the landscape or riverscape differently
- Populations, not species, are the fundamental conservation unit

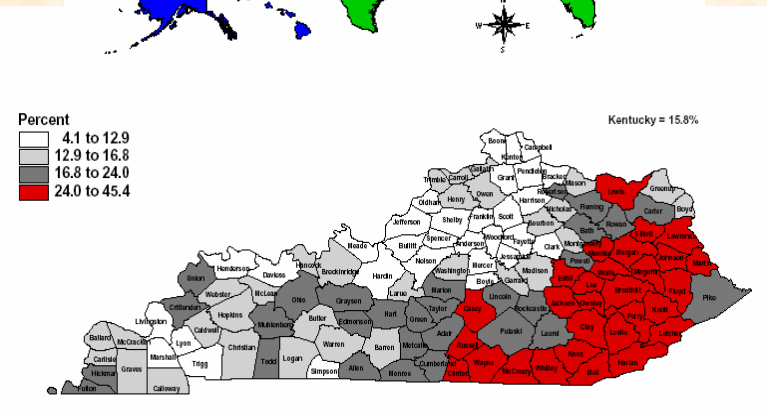
Planning Regions and Assessment Units

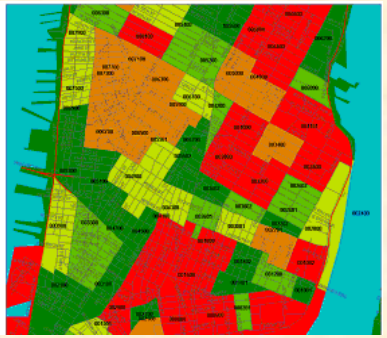
- Planning Unit/Region
  - Overall study area
  - Defines spatial extent
- Assessment Units
  - Spatial units within which assessment statistics are compiled and among which relative comparisons are made
  - Defines spatial grain

Planning Regions and Assessment Units

Political/Administrative







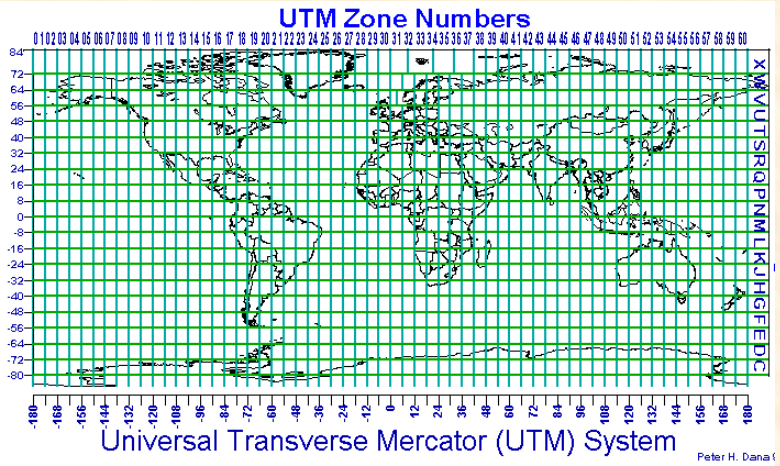
Larger

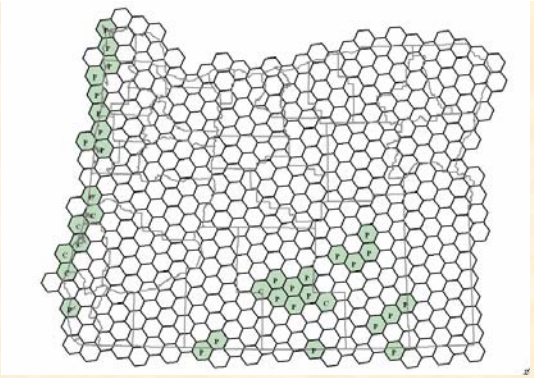
Spatial Extent

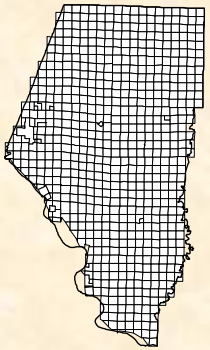
And Grain

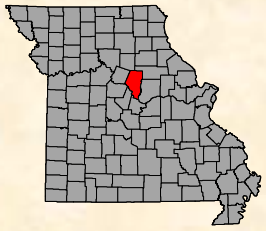
Smaller

Political/Regular Grid





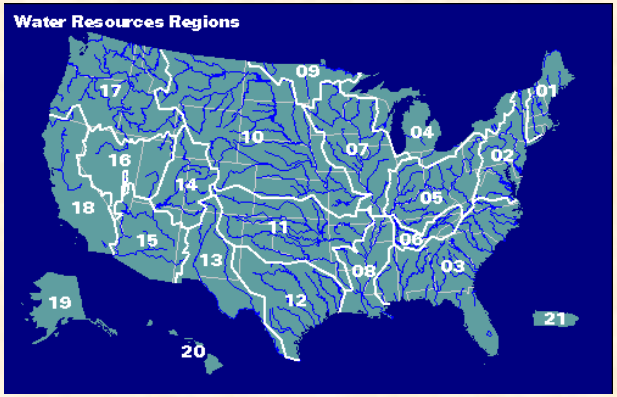


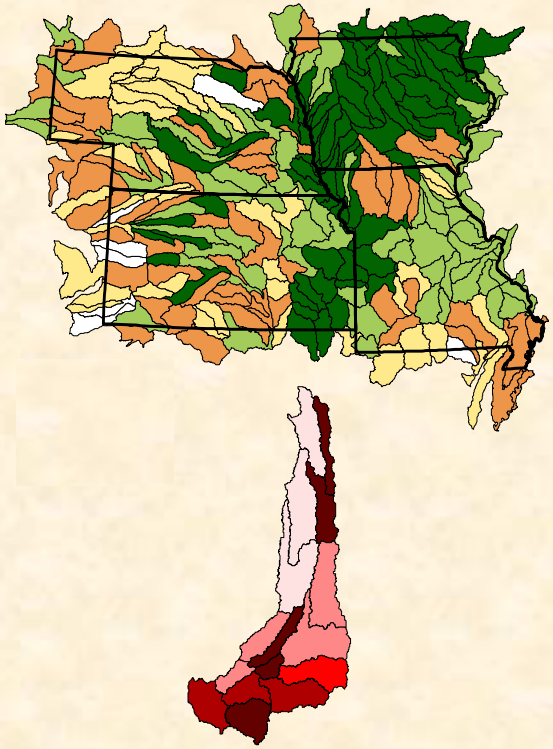


Planning Regions and Assessment Units

Watersheds/Hydrologic Units

Ecologically-Based

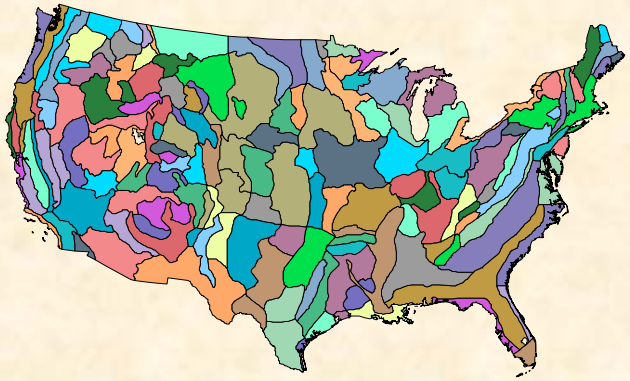


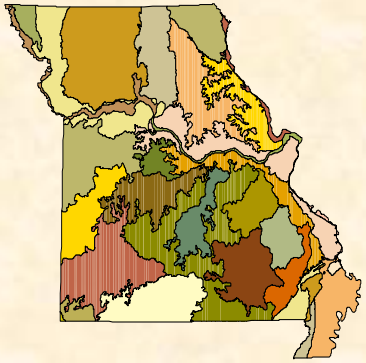


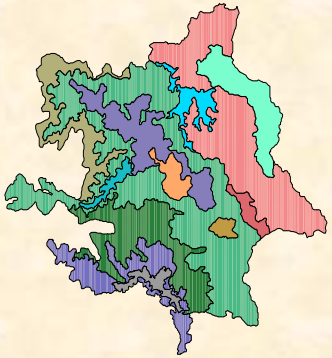
Coarse

Spatial Extent And Grain

Fine

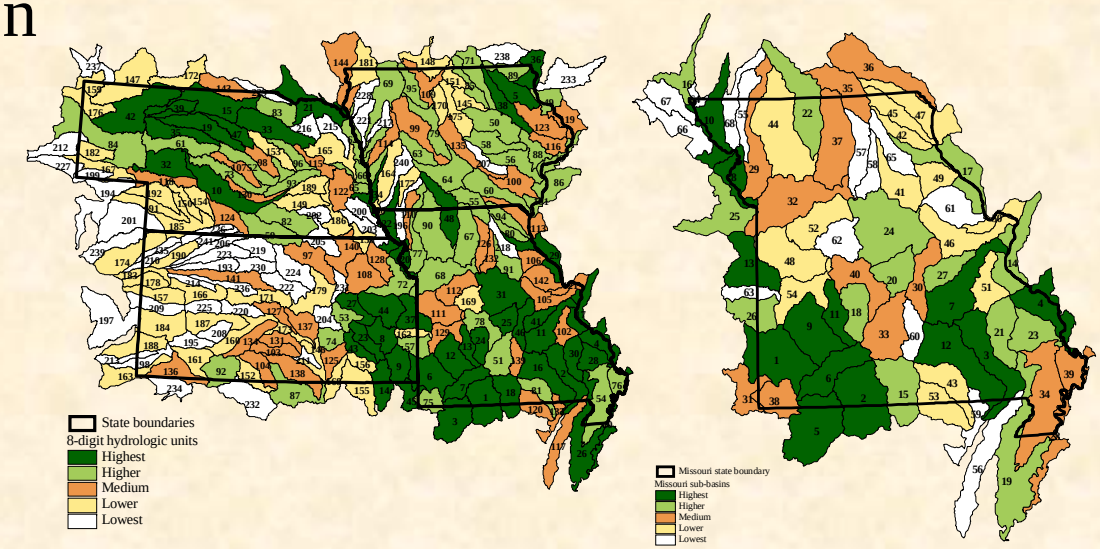






Planning Regions and Assessment Units Must be Carefully Selected

- Comparisons among your assessment units is relative to your planning region



- Should be ecologically-based and hierarchically nested
  - Define ecosystems
  - Provide ecological context
  - Meet a variety of conservation objectives
  - Finest level of hierarchy should be at a resolution suited to local planning and management

Ecoregions Generally Account for Structural and Functional Variation in Freshwater Ecosystems

DO NOT:

- Account for species-level compositional variation
- Define interacting systems

Ecoregional Subsections

Ozark/Central Plateau

Ecological Drainage Units

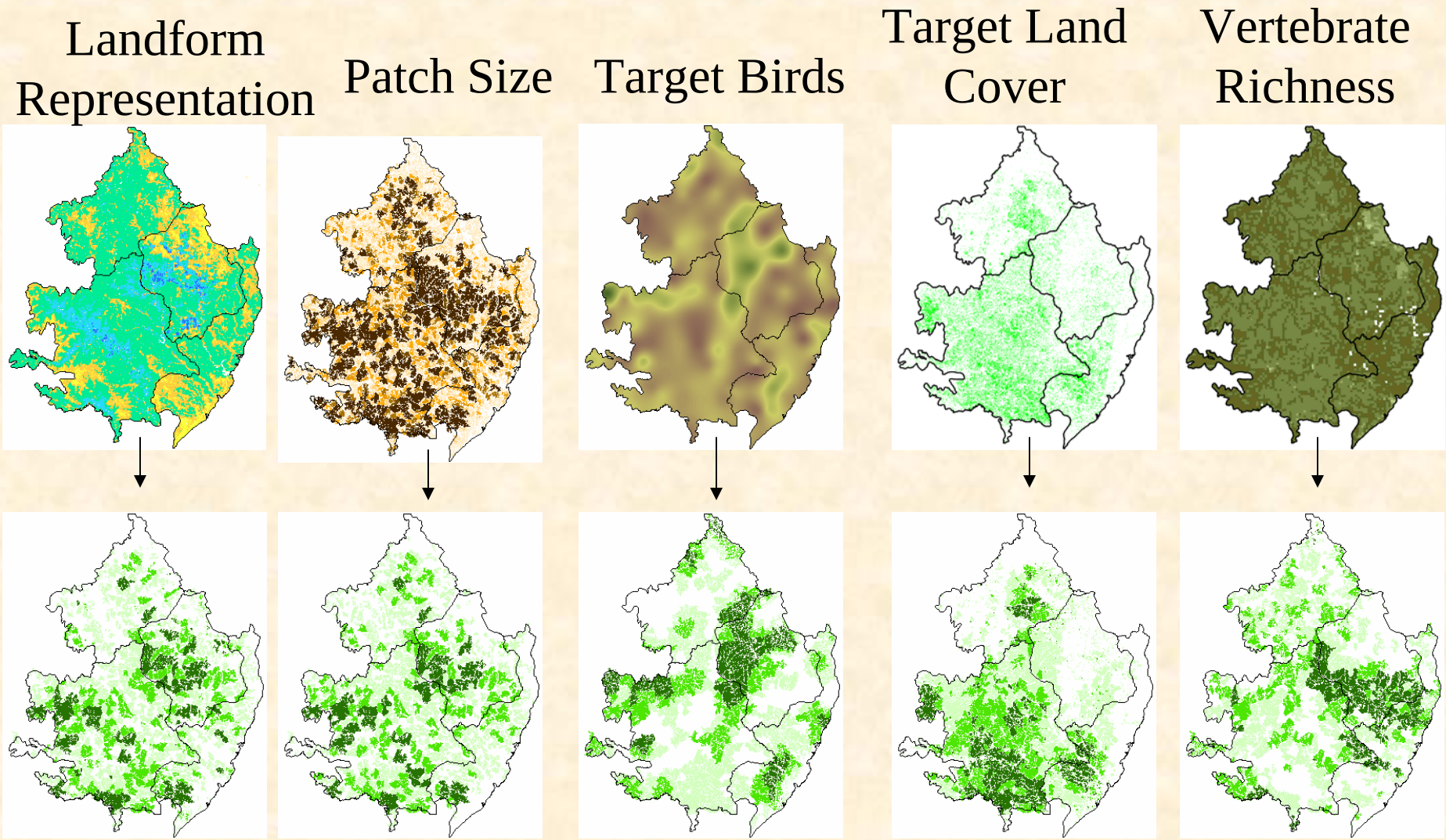
Why We Must Use Surrogate Conservation Targets

Taxon	Identified	Estimated	% Identified
Bacteria	4,000	1,000,000	0.4
Viruses	4,000	400,000	1
Fungi	72,000	1,500,000	5
Nematodes	25,000	400,000	6
Algae	40,000	400,000	10
Arachnids	75,000	750,000	10
Insects	950,000	8,000,000	12
Protozoa	40,000	200,000	20
Crustaceans	40,000	150,000	27
Mollusks	70,000	200,000	**35**
Others	115,000	250,000	**46**
Plants	270,000	320,000	**84**
Vertebrates	45,000	50,000	**90**
Total	1,750,000	13,620,000	**13**

Surrogates for Biodiversity

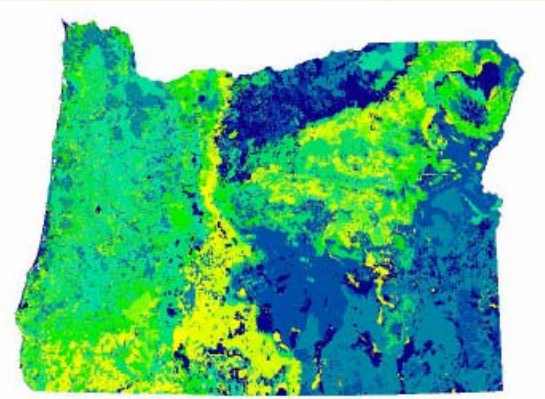
Type of Surrogate	Cost and Precision	Biodiversity Surrogate	Ability to account for critical processes
Abiotic/Biotic	LOW	Ecosystem types	HIGH
Abiotic/Biotic	↓	Landscape types	⇧
Abiotic	↓	Climate classes	⇧
Abiotic	↓	Landform classes	⇧
Abiotic	↓	Geology, Soil, Substrate classes	⇧
Abiotic/Biotic	↓	Habitat types	⇧
Biotic	↓	"Community" types	⇧
Biotic	↓	Vegetation types	⇧
Biotic	↓	Select Higher Taxa	⇧
Biotic	↓	Select Species/subspecies	⇧
Biotic	HIGH	Select Populations/ Phylogenies	LOW

Conservation Targets Matter

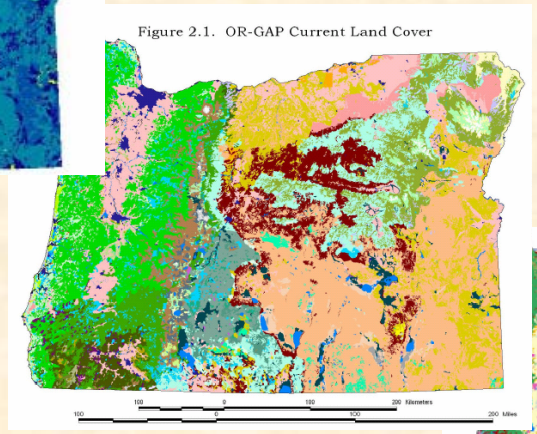


Potential Targets for Terrestrial Ecosystems

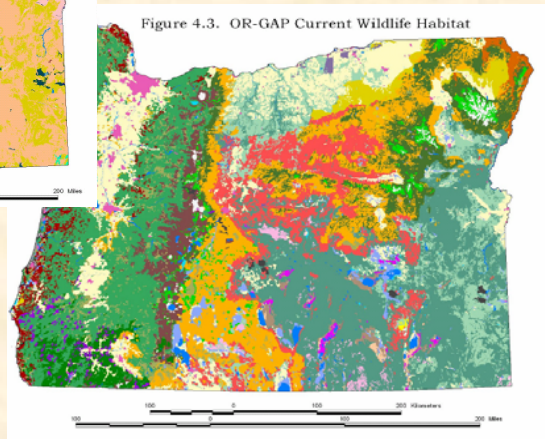
Species



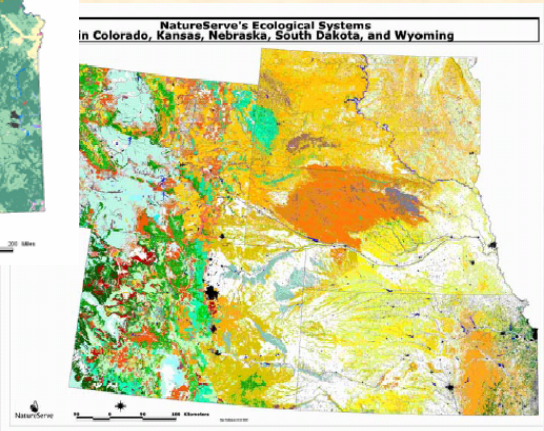
Vegetation Types



Habitat Types



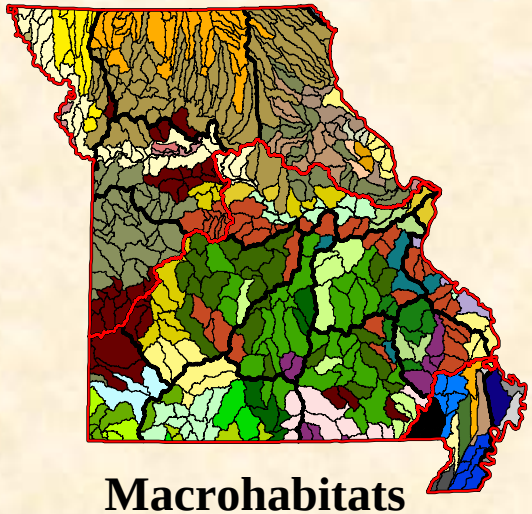
Ecological Systems



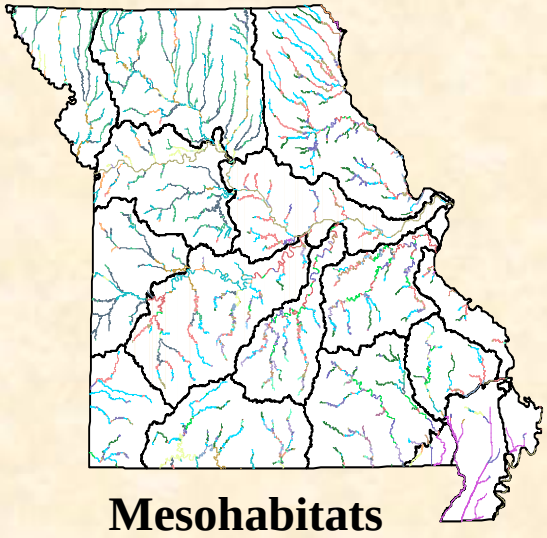
Potential Targets for Riverine Ecosystems

Biotic

Abiotic



Macrohabitats

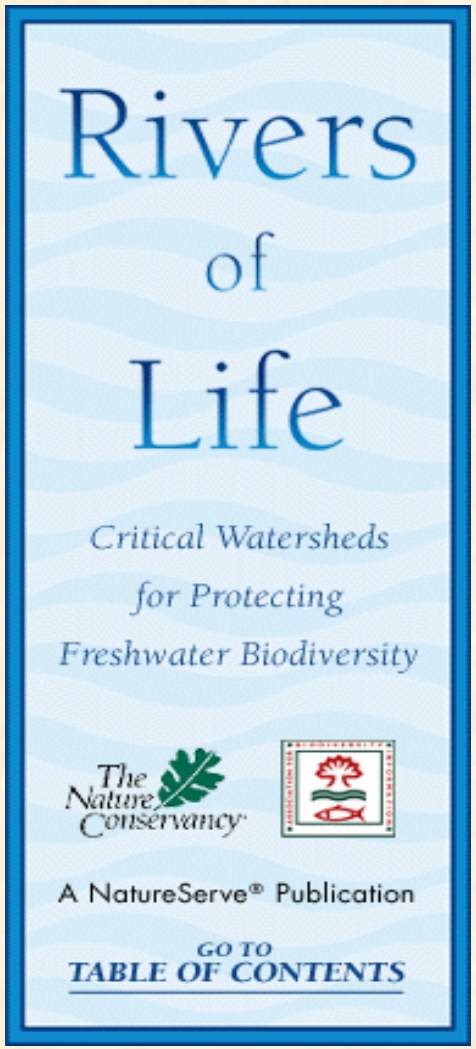


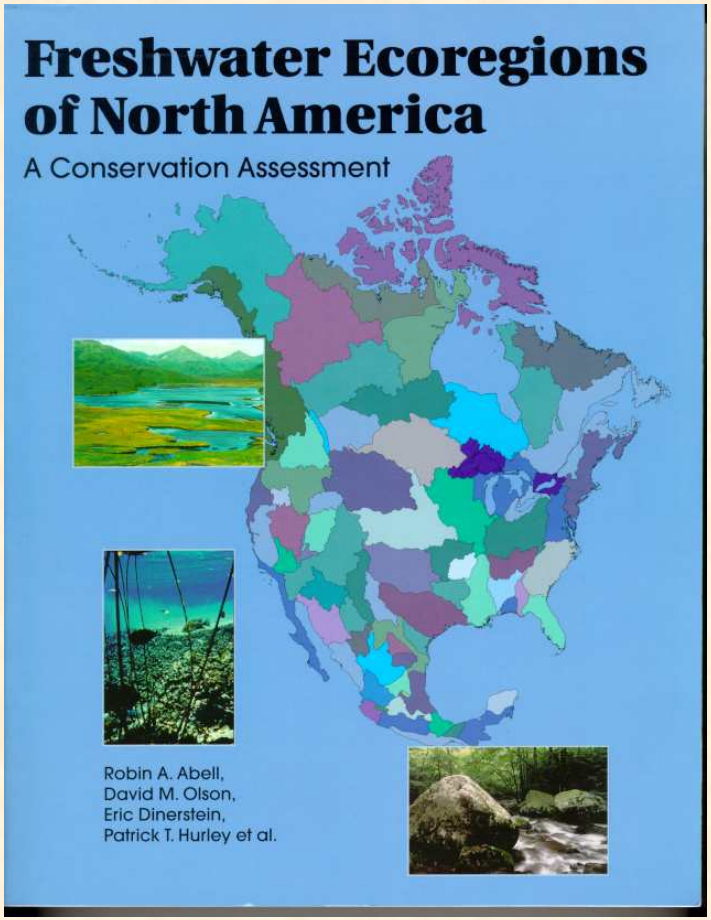
Mesohabitats

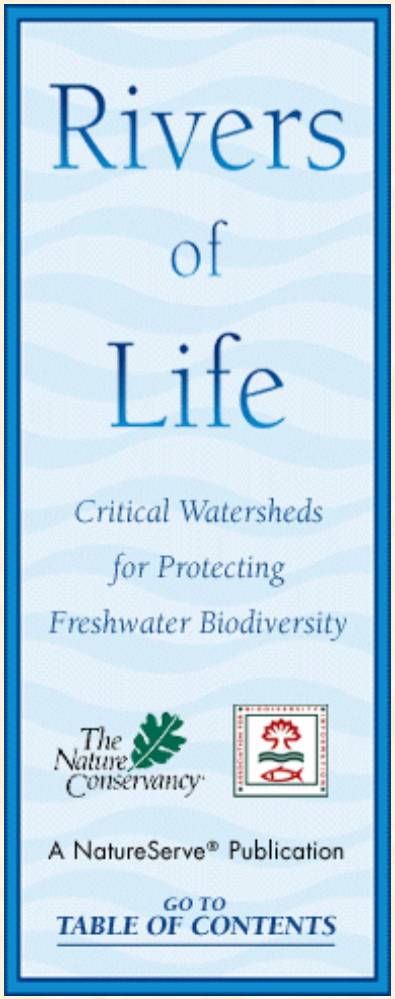
Specify Qualitative or Quantitative Assessment Criteria

- How many occurrences of each target?
- How much area or length?
- Should they be connected?
- If given a choice should conservation efforts:
  - focus on public land?
  - focus on the highest quality locations remaining
- What specific measures will you use to compare and prioritize assessment units?
  - Significance: Richness, # of endemics, …
  - Condition: Quantitative or qualitative measure
  - Threats: Population change, potential for future extractive uses
  - Costs: For restoration, acquisition,…
  - Opportunities: Cooperation/Leveraging, willing landowners

General Examples







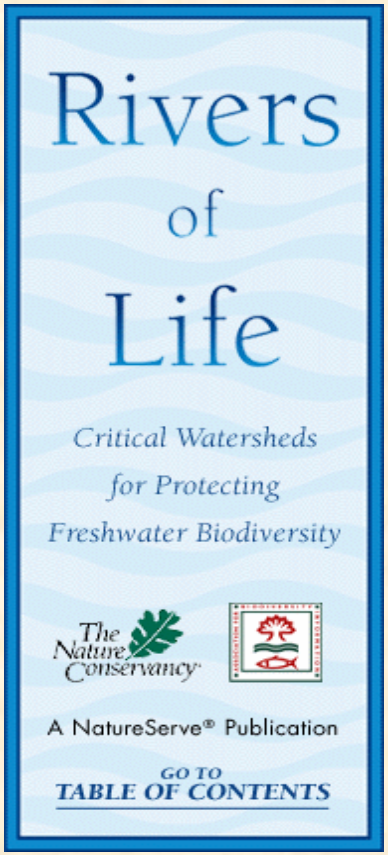
- Planning Region: Conterminous United States
- Assessment units: USGS 8-digit Hydrologic Units
- Conservation Targets:

  Biotic: Vulnerable and imperiled fish and mussel species

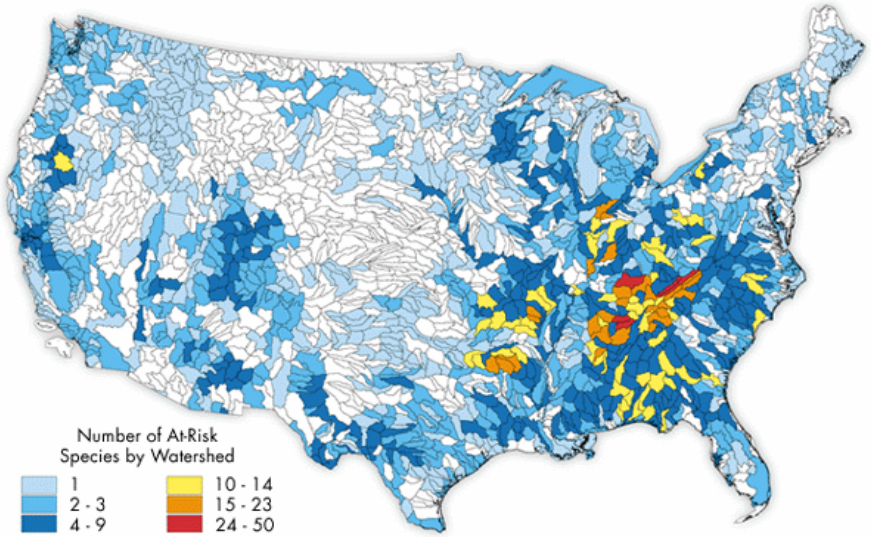
  Abiotic: None
- Assessment Criteria:

  Biological: Richness and Rarity index

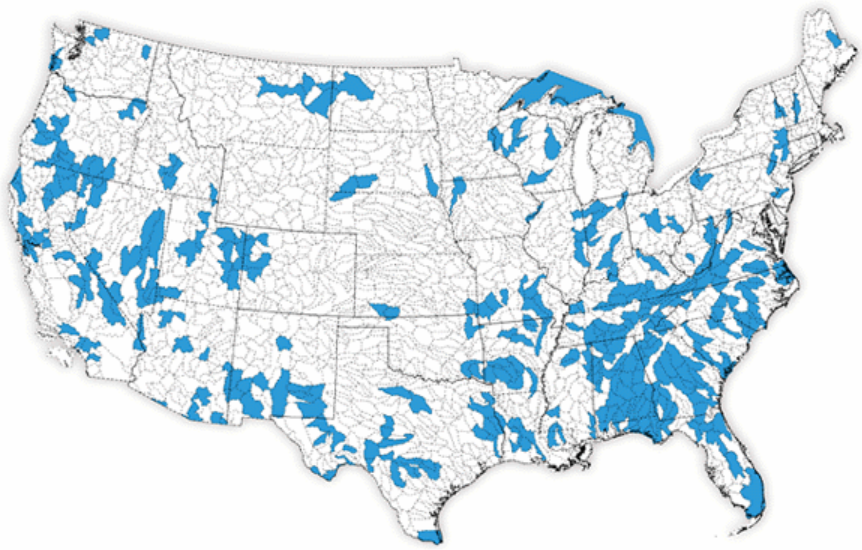
  Stressors: None

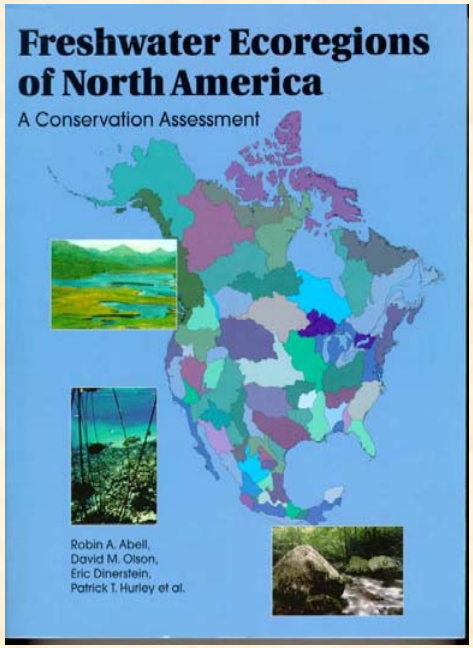


Hot Spots for At-Risk Fish and Mussel Species



Critical Watersheds to Conserve Fish and Mussel Species





- Planning Region: North America
- Assessment units: Freshwater ecoregions
- Conservation Targets:

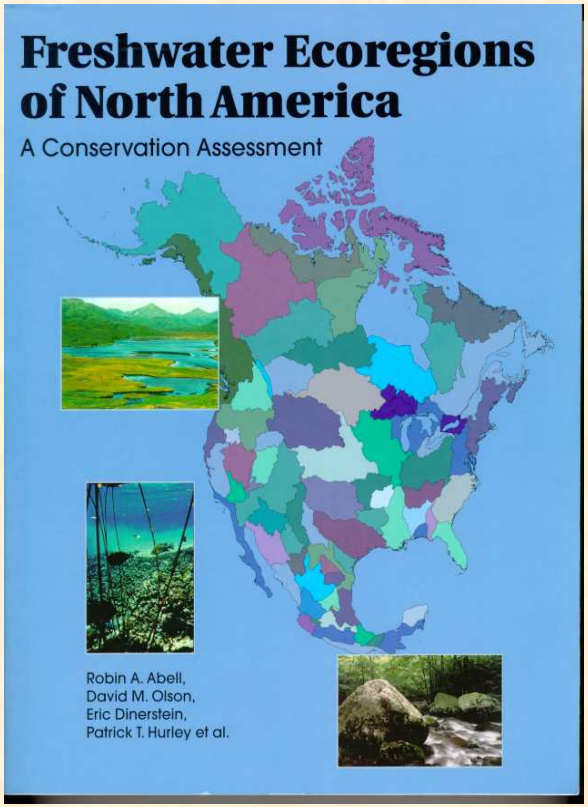
  Biotic: All fish, crayfish, unionid mussels, aquatic amphibians and aquatic and semiaquatic reptiles

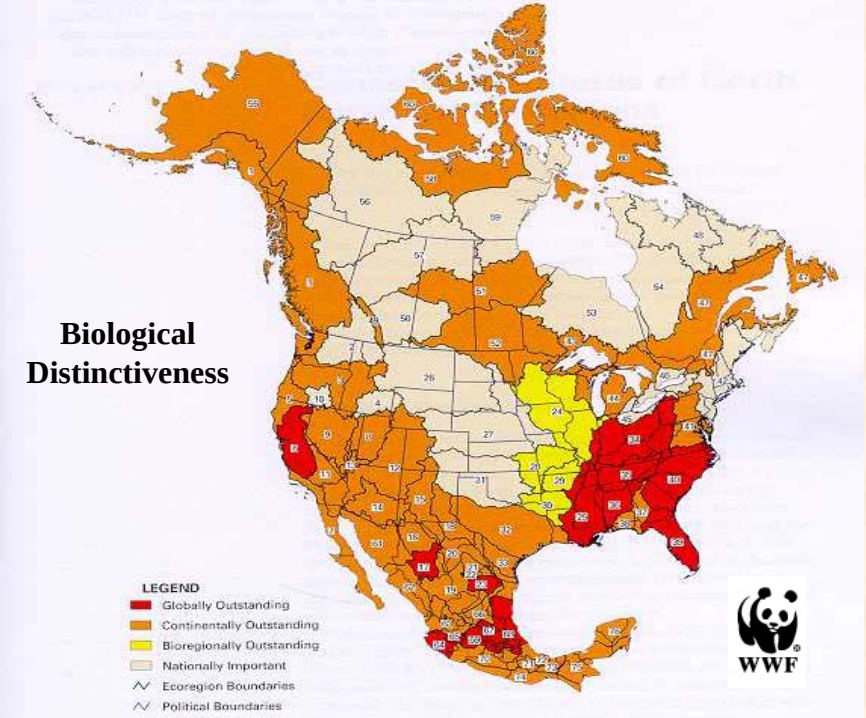
  Abiotic: Rare ecological/evolutionary phenomena and rare habitats

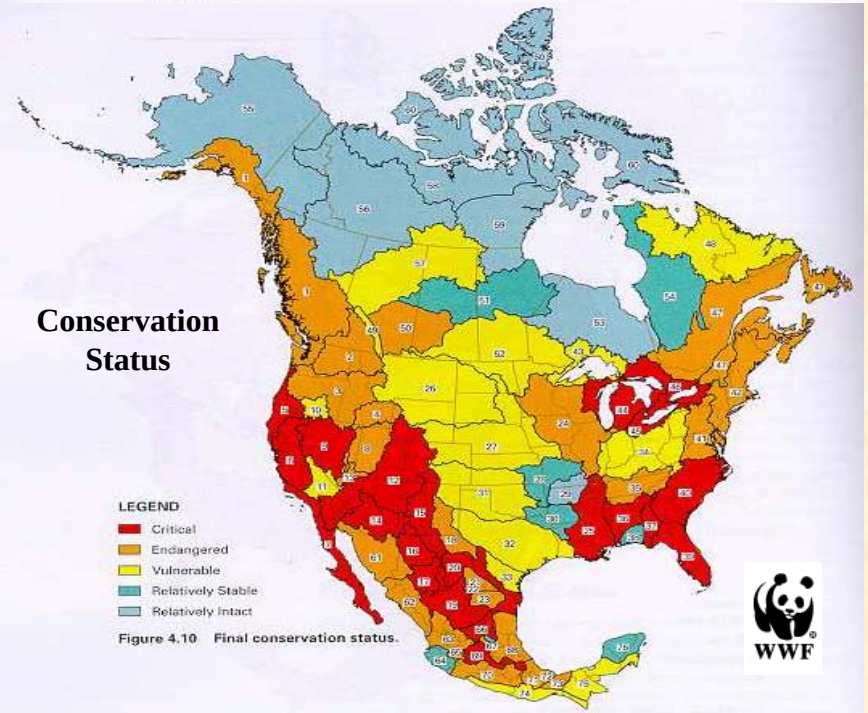
- Assessment Criteria:

  Biological: Richness, total and % endemism, presence of rare ecological/evolutionary phenomena or habitat

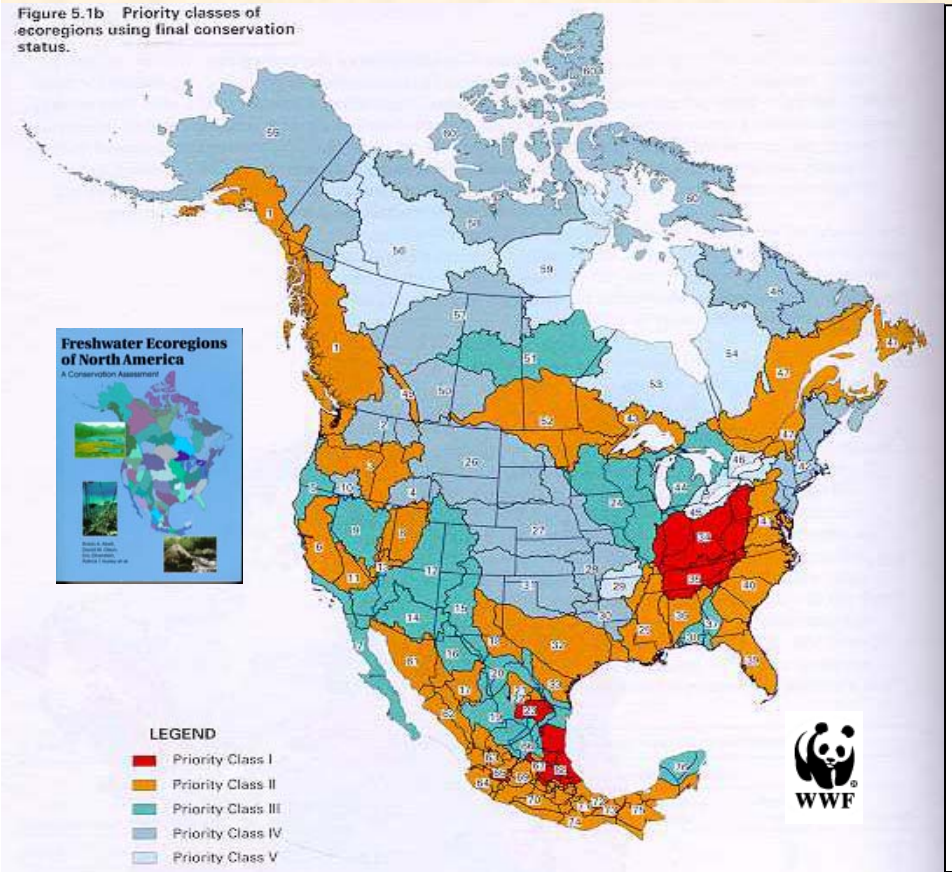
  Stressors: Expert opinion of the relative severity of human stressors

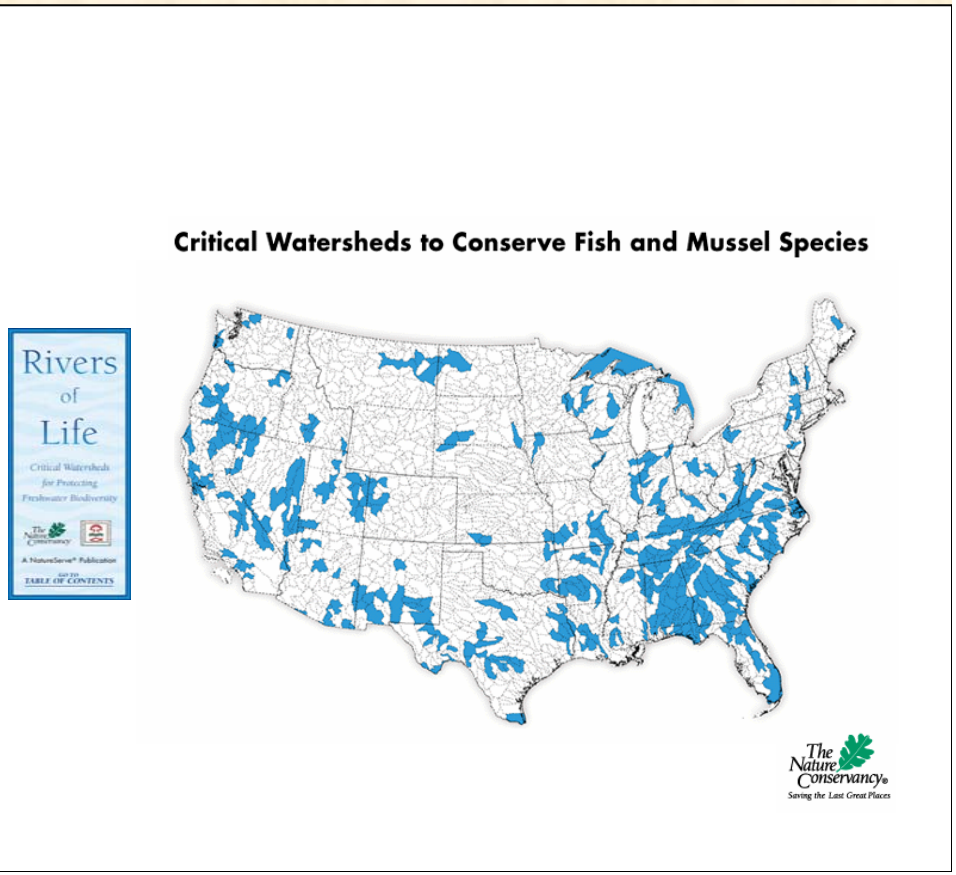

Freshwater Ecoregions of North America
A Conservation Assessment
Robin A. Abell,
David M. Olson,
Eric Dinerstein,
Patrick T. Hurley et al.


Biological Distinctiveness
LEGEND
Globally Outstanding
Continentally Outstanding
Bioregionally Outstanding
Nationally Important
Ecoregion Boundaries
Political Boundaries
WWF


Conservation Status
LEGEND
Critical
Endangered
Vulnerable
Relatively Stable
Relatively Intact
Figure 4.10 Final conservation status.
WWF

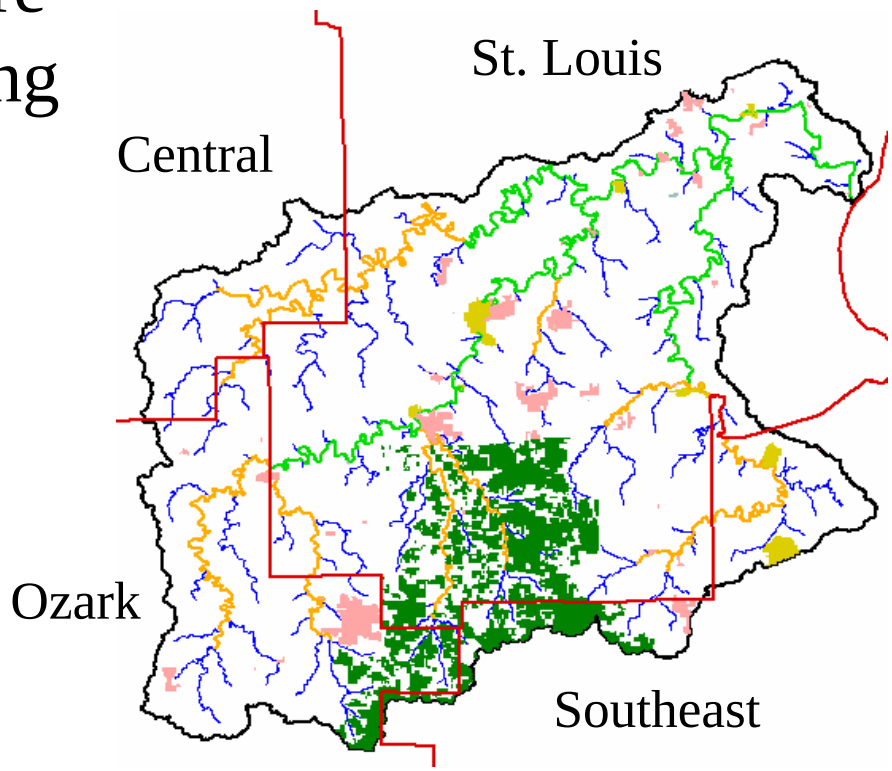
Different Approaches
Yet Similar Results





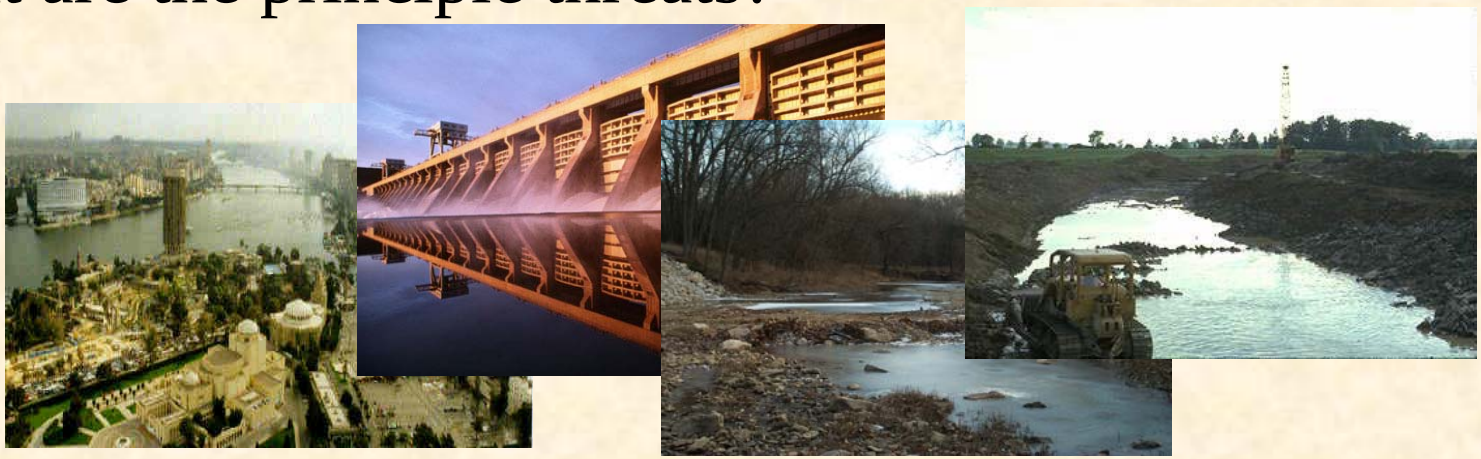
Who, What, How, When?

- Who?
  - Who owns the land/stream under consideration?
  - Who has jurisdiction?
  - Which specific people are in charge of implementing management activities

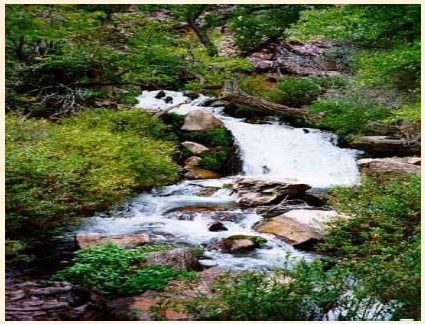


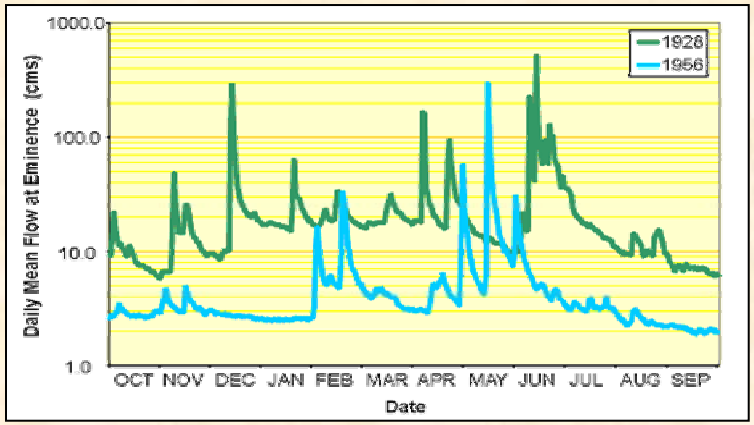
Who, What, How, When?

- What?
  - What are the principle threats?



  - What are the critical habitats and ecological processes?





Who, What, How, When?

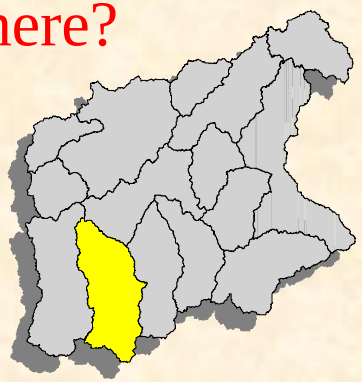
- How?
  - How do we propose to minimize threats and protect or restore these factors and processes?
    - General:
      - local vs. watershed, land acquisition or private land management, regulations, special designations, incentive programs, restoration, mitigation banking, etc…
    - Specific:
      - bank stabilization, plant riparian buffers, educate landowners, harvest regulations, stormwater detention basins, monitor permitted discharges, alternative livestock watering, etc…

Who, What, How, When?

- When?
  - How long do we have?
    - Urban vs. rural
  - What is the temporal sequence of all necessary management activities
    - Must prioritize activities to avoid wasted effort
  - Are there any seasonal considerations for our management activities?

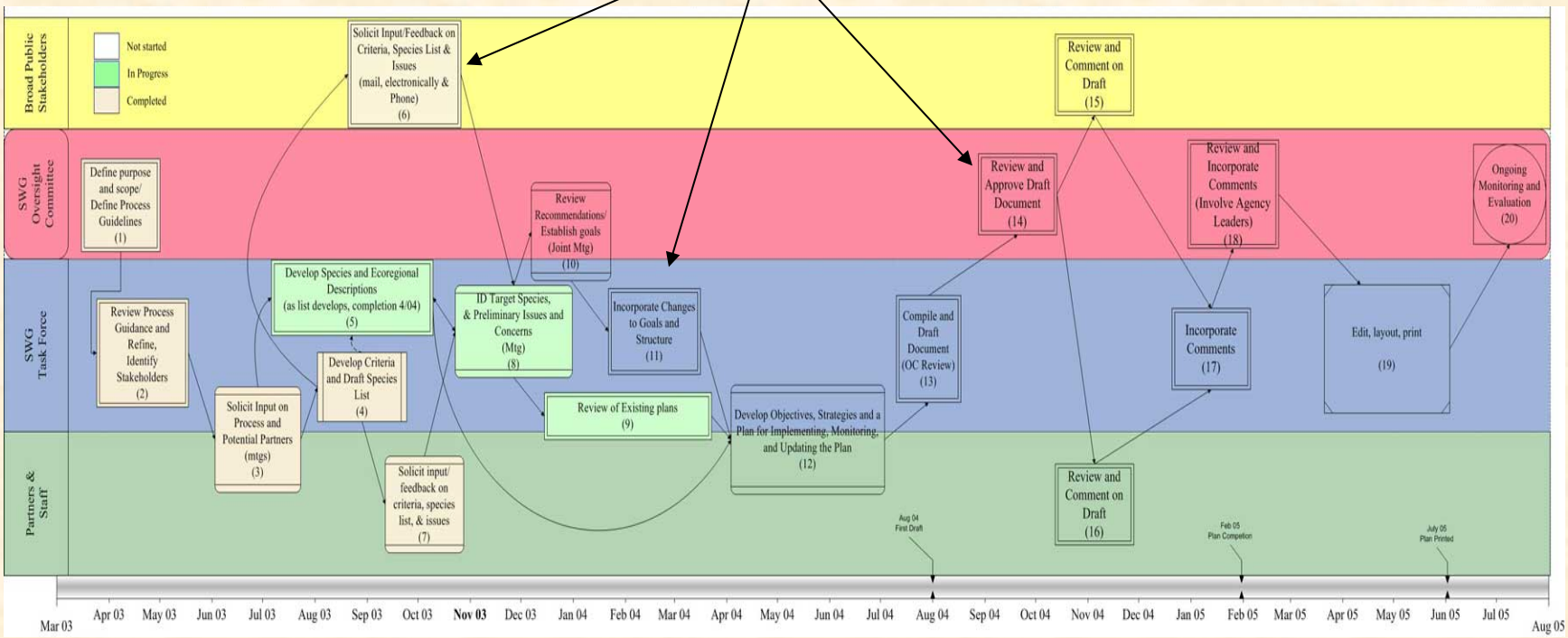
Putting it All Together

Where?



What and How?

Who?



When?

Our Objectives

- Formulate general conservation goal(s)
- Identify fundamental conservation principles or assumptions that must be considered in order to meet these goals
- Select Planning Regions and Assessment Units
- Select conservation targets
- Specify qualitative or quantitative assessment criteria
- Establish geographic conservation priorities
- Specify spatially explicit conservation actions for each priority species, community, or site

- Implement spatially explicit conservation actions for each priority species, community, or site
- Monitor key indicators to evaluate success of conservation actions

Conservation Planning is a Spatial Exercise

- Thus, we need to develop spatially-explicit data for:
  - Planning regions and assessment units
  - Conservation targets
  - Existing conservation lands and how they are managed
  - Representation of targets
  - Factors that constrain to assist us from meeting our goal
    - Human stressors, potential future threats, socioeconomic factors, environmental laws, regulations, and management/incentive programs
  - Conservation priorities
    - What specific conservation actions are needed at each priority site

Comparing Terrestrial and Aquatic Components

- Same Philosophy/Assumption
  - Protected Areas are critical to the protection of biodiversity
- Same Goal
  - Conserve the **ecological and evolutionary processes that generate and sustain biodiversity**
- Same General Conservation Strategy
  - **Represent** the **spatial patterns** of **surrogate conservation targets** within a **matrix of protected areas** that ensures the long-term **persistence** of these targets by minimizing **threats** from anthropogenic stressors
- Same Specific Objective
  - Assess how well the spatial patterns of surrogate targets are represented in the current matrix of protected areas