



Overview of “Conservation Assessments”

NPS Meeting, Columbia, MO
Sept 5, 2006

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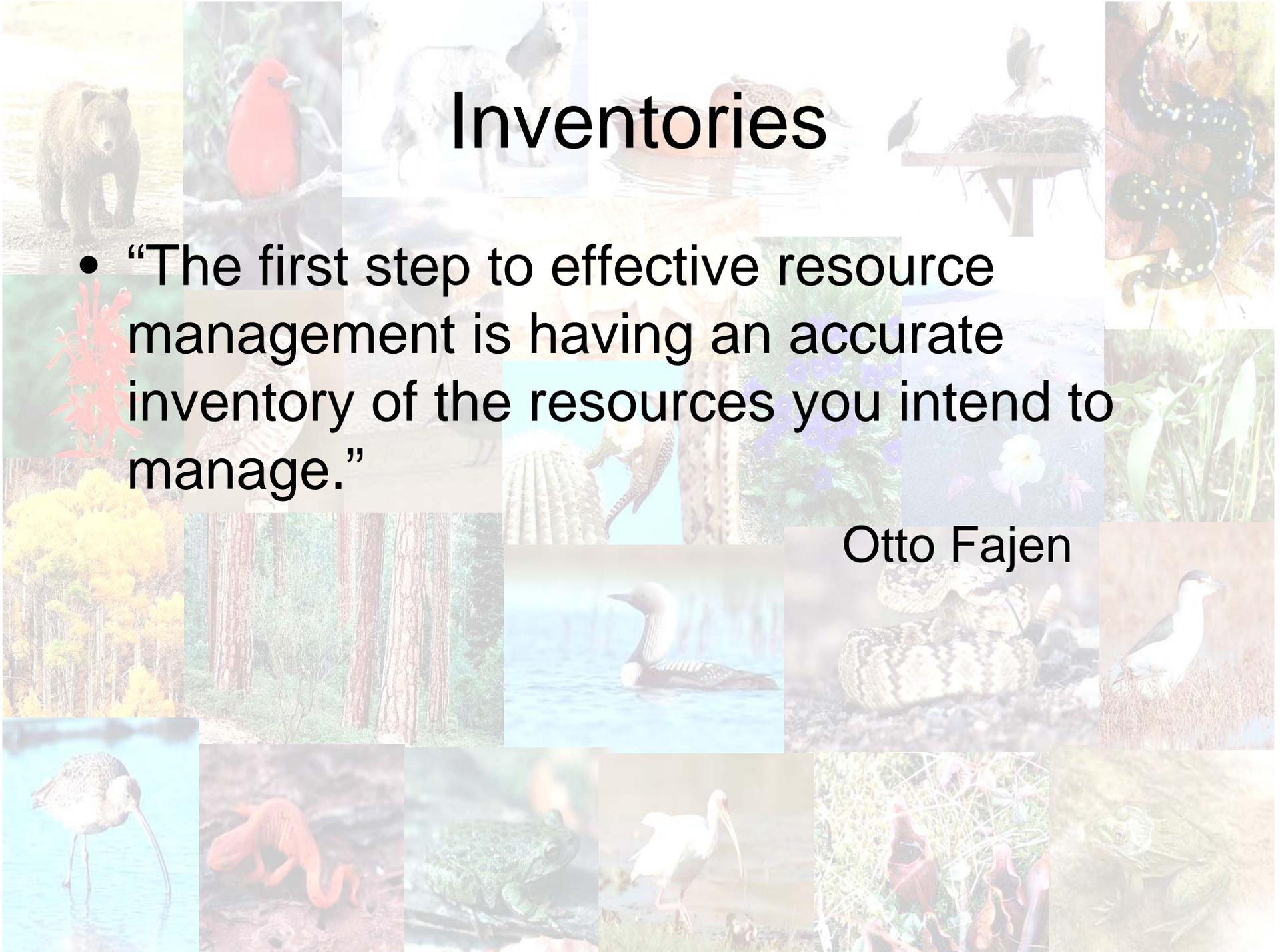
Inventory, Assessment, Planning

- **Inventory:** To create an itemized list of goods, property, resources, etc.
- **Assessment:** To estimate or determine the significance, importance, or value of something (both good things and bad things)
- **Planning:** The process of setting goals, developing strategies, and outlining tasks and schedules to accomplish the goals

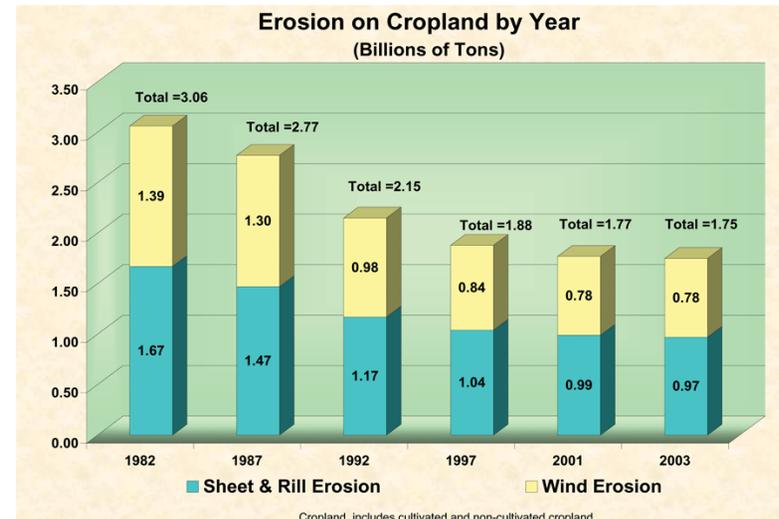
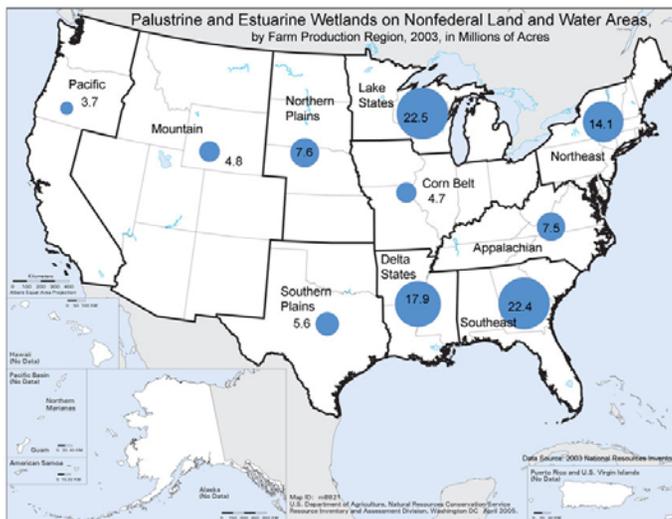
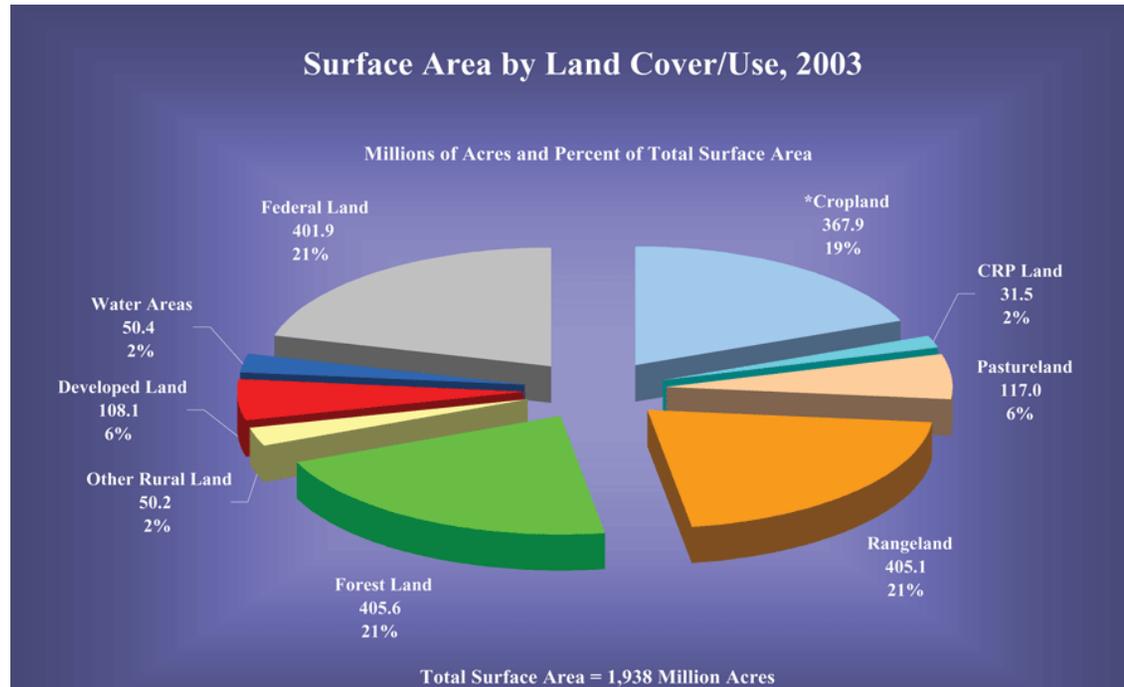
Inventories

- “The first step to effective resource management is having an accurate inventory of the resources you intend to manage.”

Otto Fajen

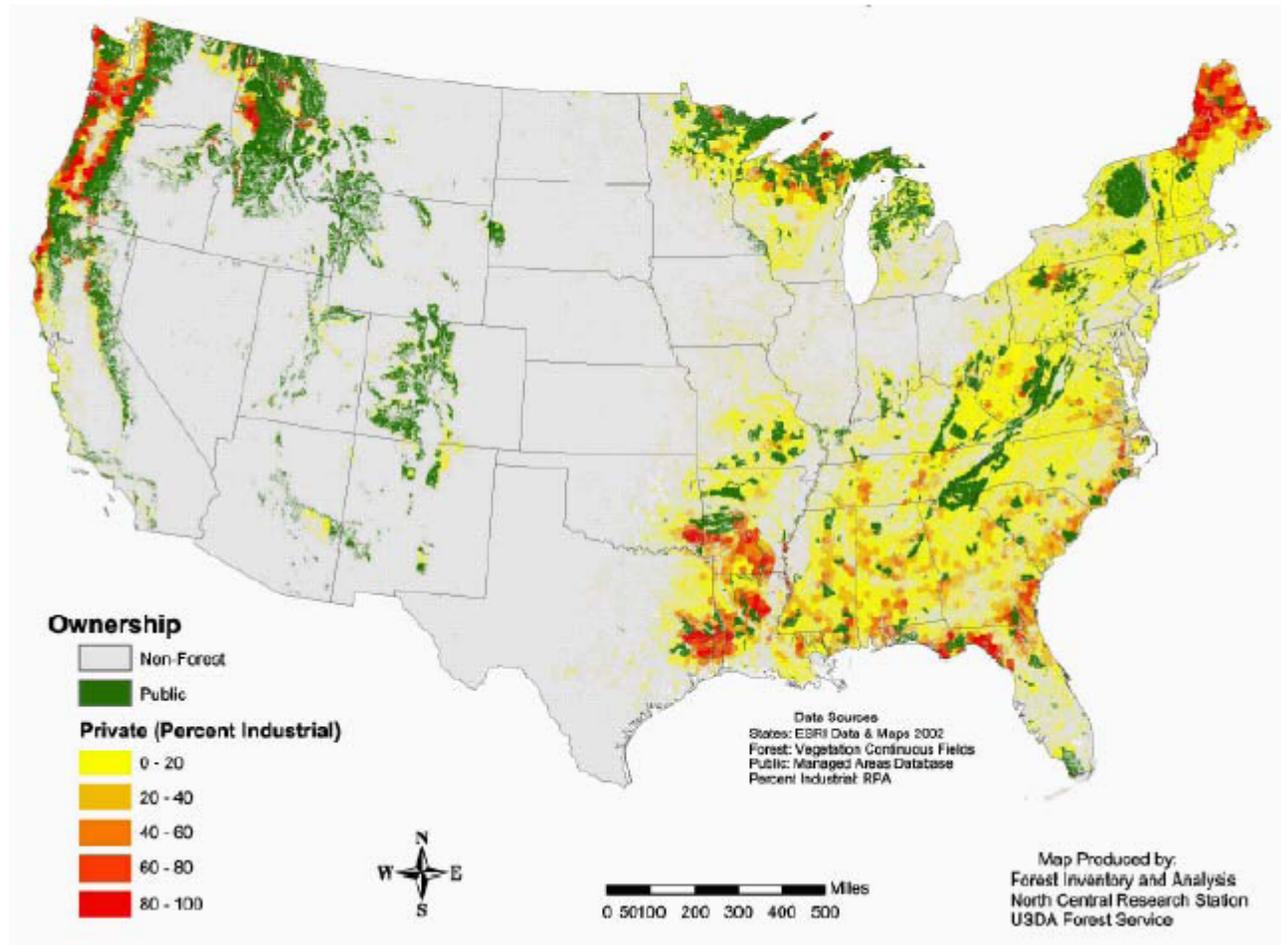


Inventories: NRCSs NRI



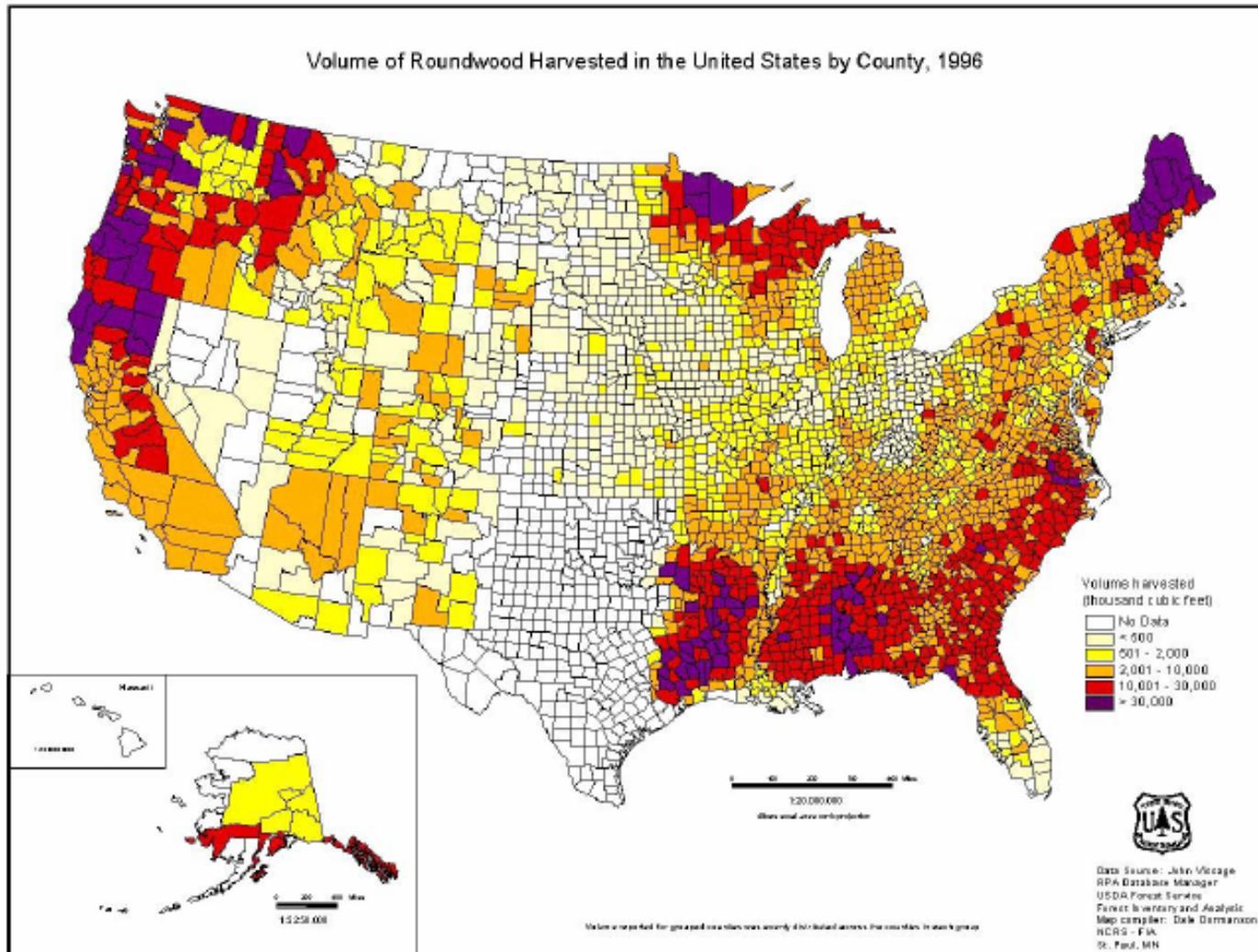
Inventories: USFS FIA

Forest ownership



Inventories: USFS FIA

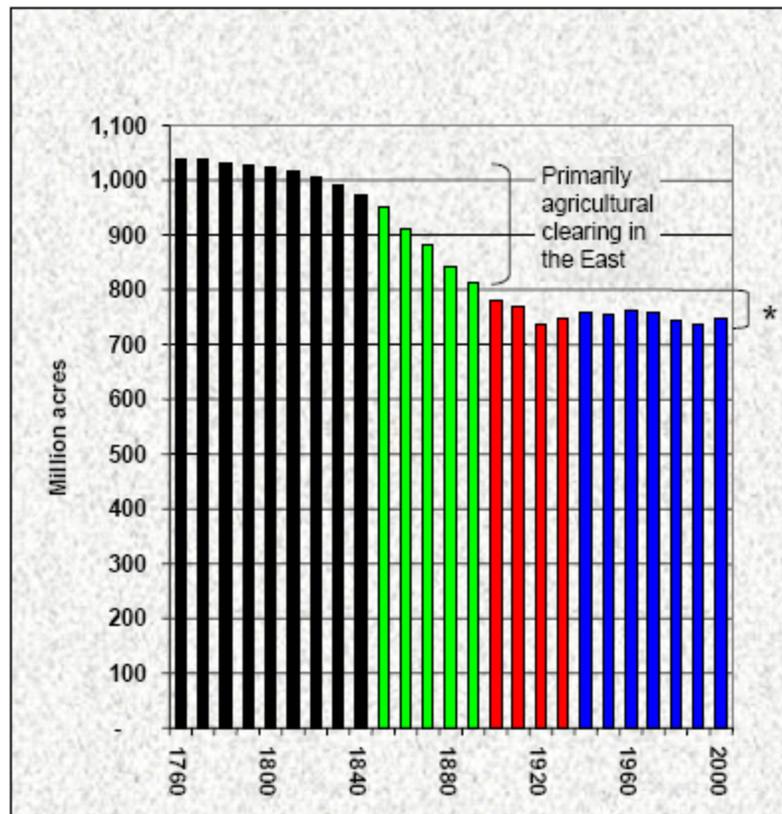
Timber harvest by county



Inventories: USFS FIA



Forest area, 1760-2000



Bars include area in all 50 current States.

* Since 1900, forest area in the U.S. has remained statistically within 745 million acres +/-5% with the lowest point in 1920 of 735 million acres. U.S. forest area in 2000 was about 749 million acres.

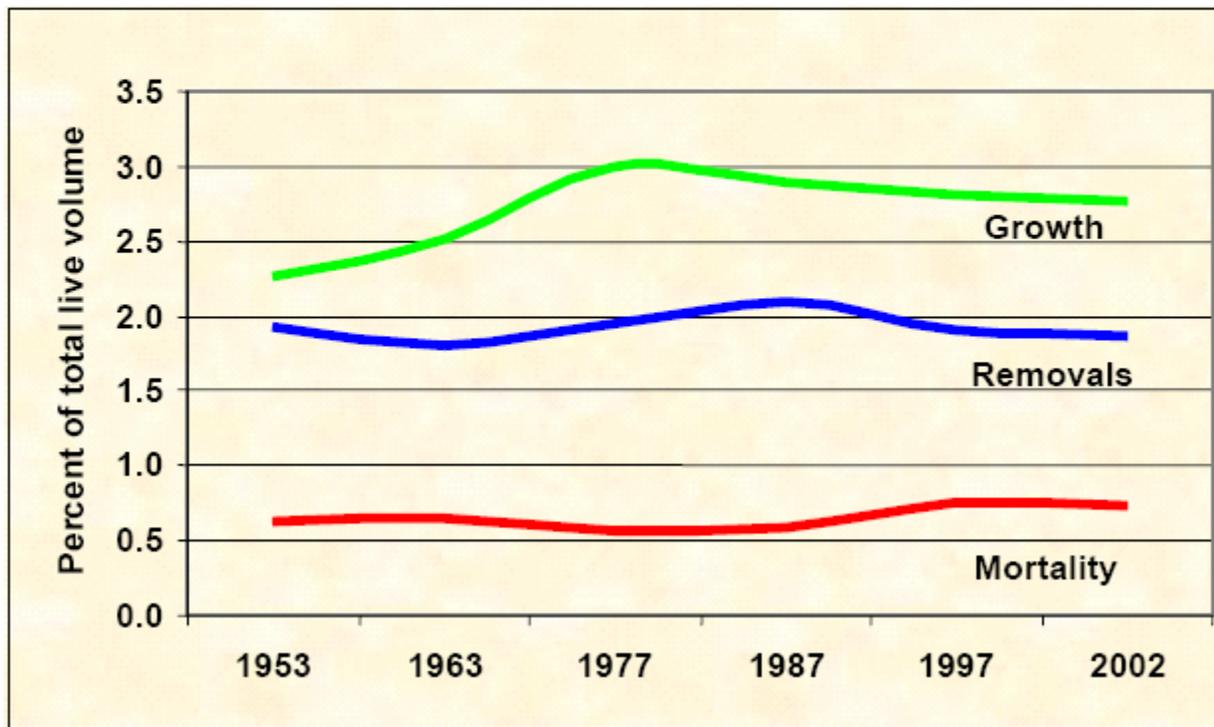
Basis for chart data:

- FIA Field Inventory Reports
- Forest Service report estimates prior to FIA field inventories.
- Based on Bureau of the Census land clearing statistics.
- Based on estimates of forest clearing proportional to population growth.



Inventories: USFS FIA

Rates of growing stock growth, removals, and mortality on productive unreserved forest, 1953-2002



As the nation's forests continue to increase in average age and decline in trees per acre, the rate of net growth is declining.

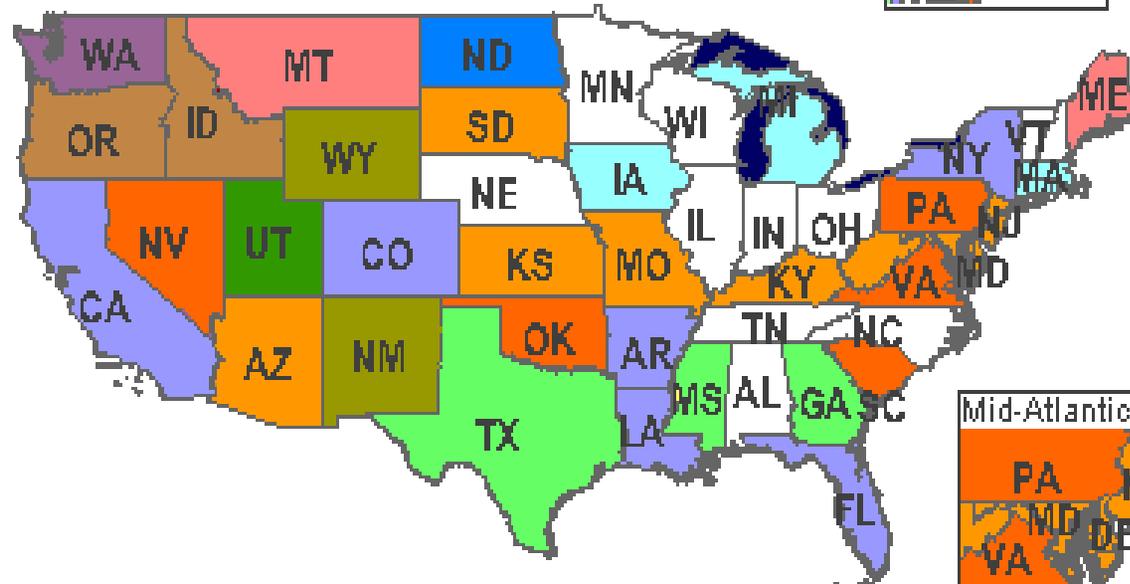
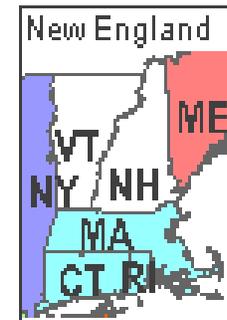
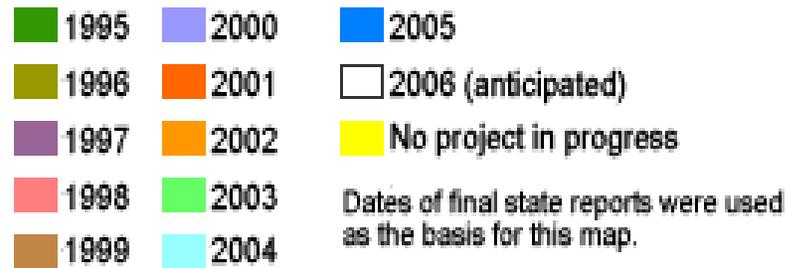
The removals rate has declined slightly but imports are on the rise.

While total mortality is up, the rate of mortality as percent of live volume is relatively stable.

“Conservation Assessment” is a General Term - Questions Asked Include:

- Where do we focus our efforts? (in the world? County? Park? To conserve what?)
- What is the status of our resources? (compared to what? What resources?)
- Size of the planning region (world, state, park), assessment unit (watershed, stream reach, pixel), and targets (biotic, abiotic) **always** matter.
- Focus on NPS needs later in the day (park manager needs, GPRA, OMB-PART

Gap Analysis Program: The only current, government-sponsored, nationwide biodiversity inventory/assessment



PR

Identifying Conservation Gaps

Table 14: Conservation Status of steppe zones (percent).

Steppe zone	Status 1	Status 2	Status 3	Status 4
Blue Mountains Steppe	0.00	5.91	14.30	79.79
Palouse	0.00	0.09	2.74	97.17
Three-tip Sage	0.00	1.27	12.10	86.64
Klickitat Meadow Steppe	0.00	0.38	6.49	93.13
Bitterbrush	0.00	0.00	6.93	93.07
Central Arid Steppe	0.00	5.91	9.16	84.93
Wheatgrass/Fescue	0.34	0.42	6.01	93.23
Canyon Grassland	0.00	0.59	5.19	94.22
Big Sage/Fescue	0.00	0.06	3.98	95.96
All steppe zones	0.05	3.38	8.45	88.12

Washington State

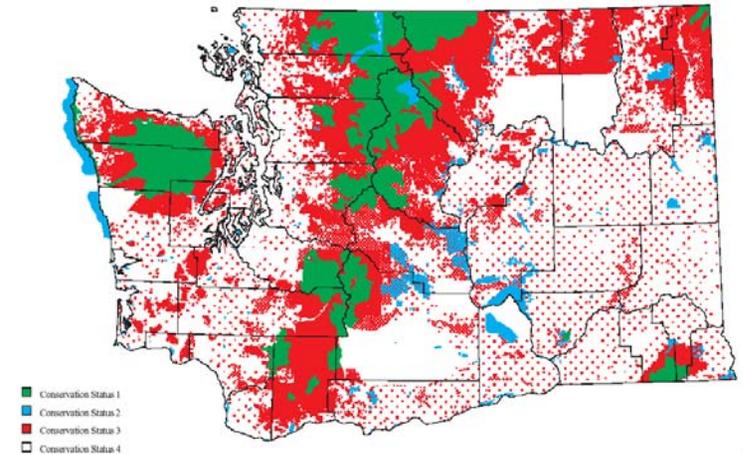
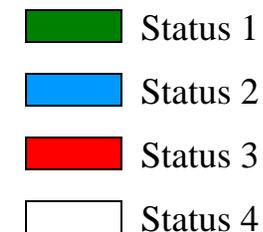
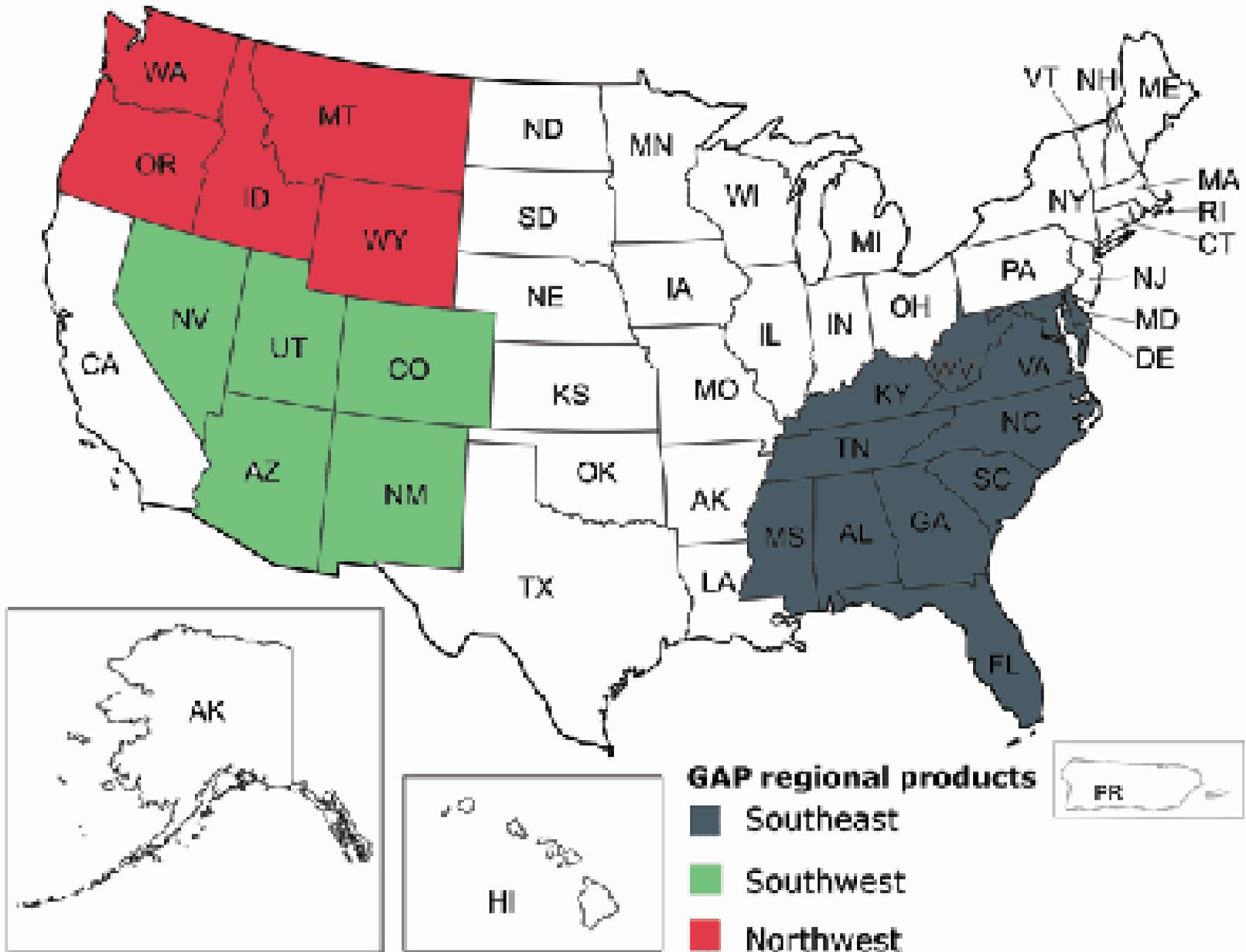


Table 15: Conservation Status of steppe zones (hectares).

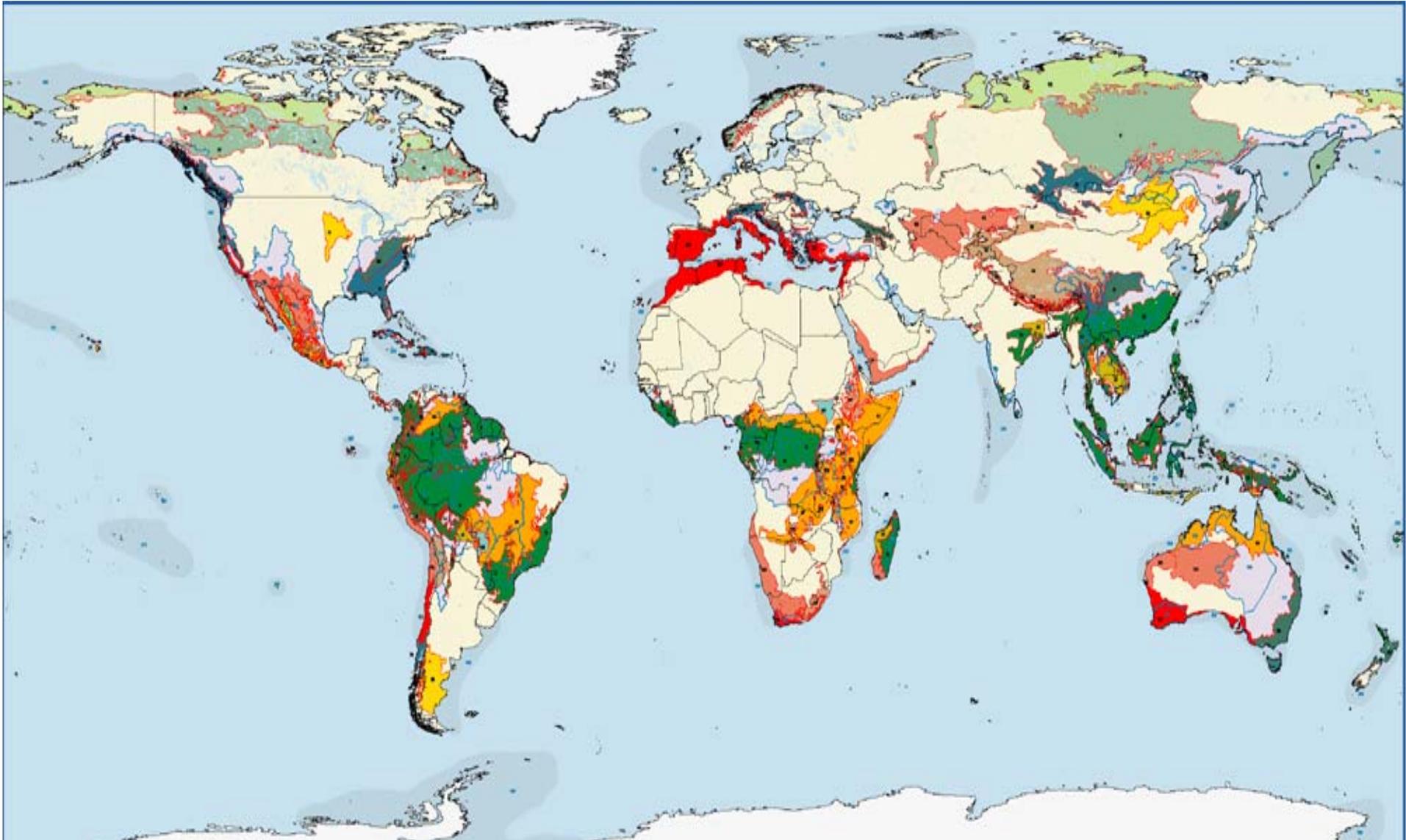
Steppe zone	Status 1	Status 2	Status 3	Status 4	Total
Blue Mountains Steppe	0	3,833	9,283	51,780	64,896
Palouse	0	416	12,792	454,263	467,471
Three-tip Sage	0	13,761	131,510	941,735	1,087,006
Klickitat Meadow Steppe	0	239	4,089	58,680	63,008
Bitterbrush	0	0	1,696	22,767	24,463
Central Arid Steppe	0	182,423	282,836	2,622,834	3,088,093
Wheatgrass/Fescue	2,987	3,632	52,264	811,384	870,267
Canyon Grassland	0	1,238	10,845	196,999	209,082
Big Sage/Fescue	0	119	8,197	197,407	205,723
All steppe zones	2,987	205,661	513,512	5,357,849	6,080,009



Gap Analysis Program Regional Projects

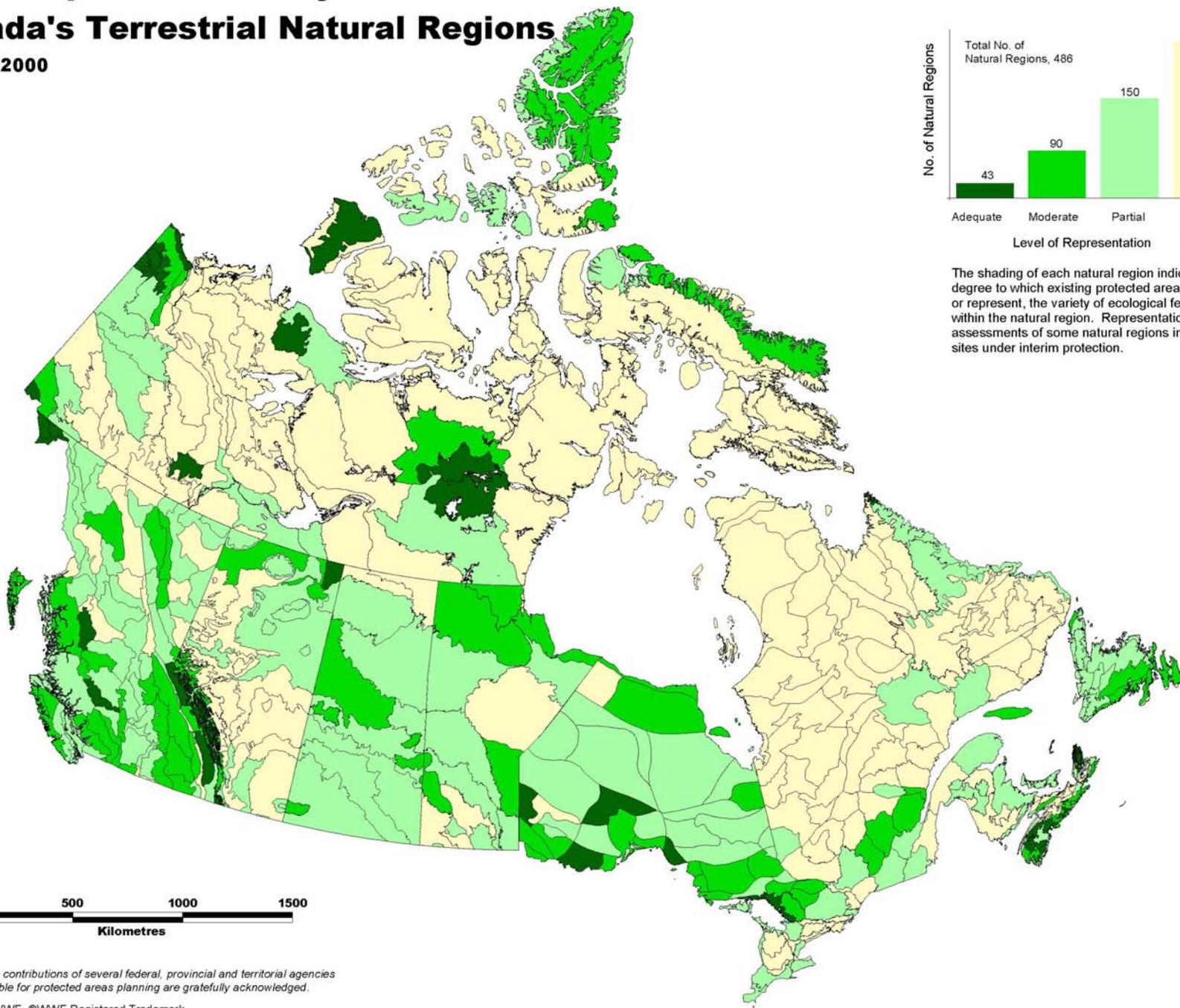


Global 200 Ecoregions – WWF
Biological Distinctiveness and Conservation Status Indices
Also Terrestrial and Aquatic analyses for North America



Level of Representation by Protected Areas of Canada's Terrestrial Natural Regions

as of July 1, 2000



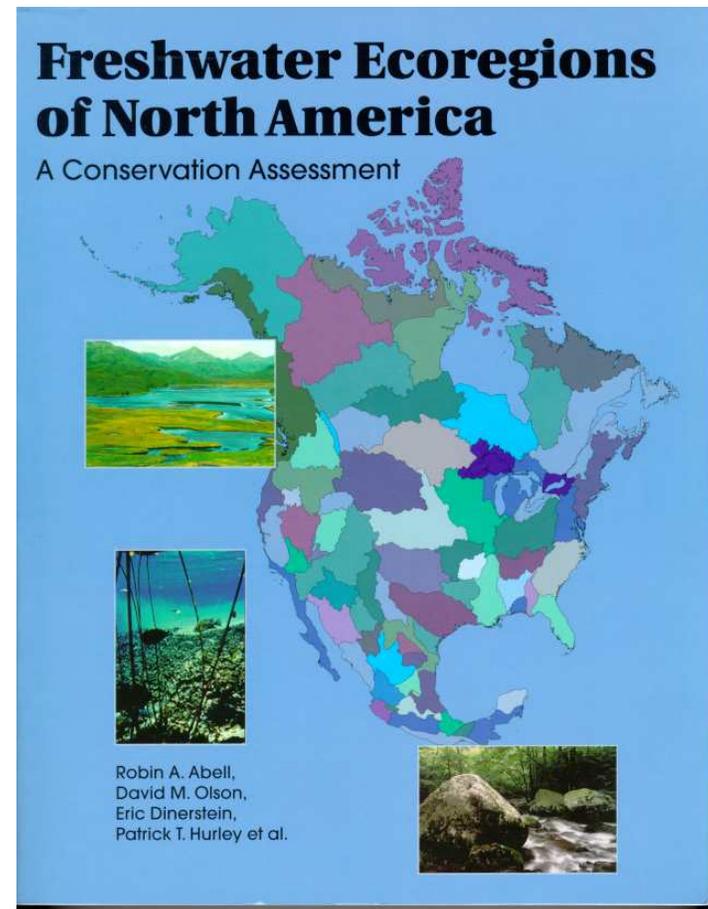
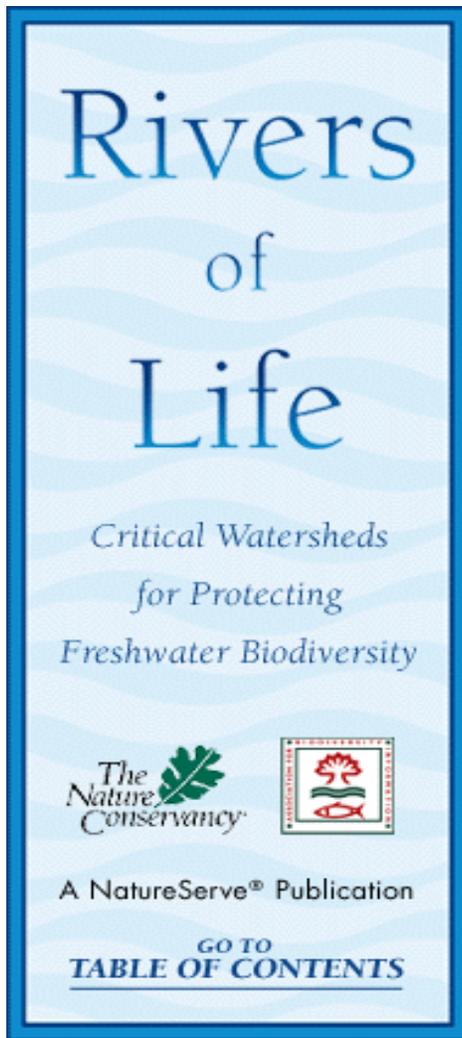
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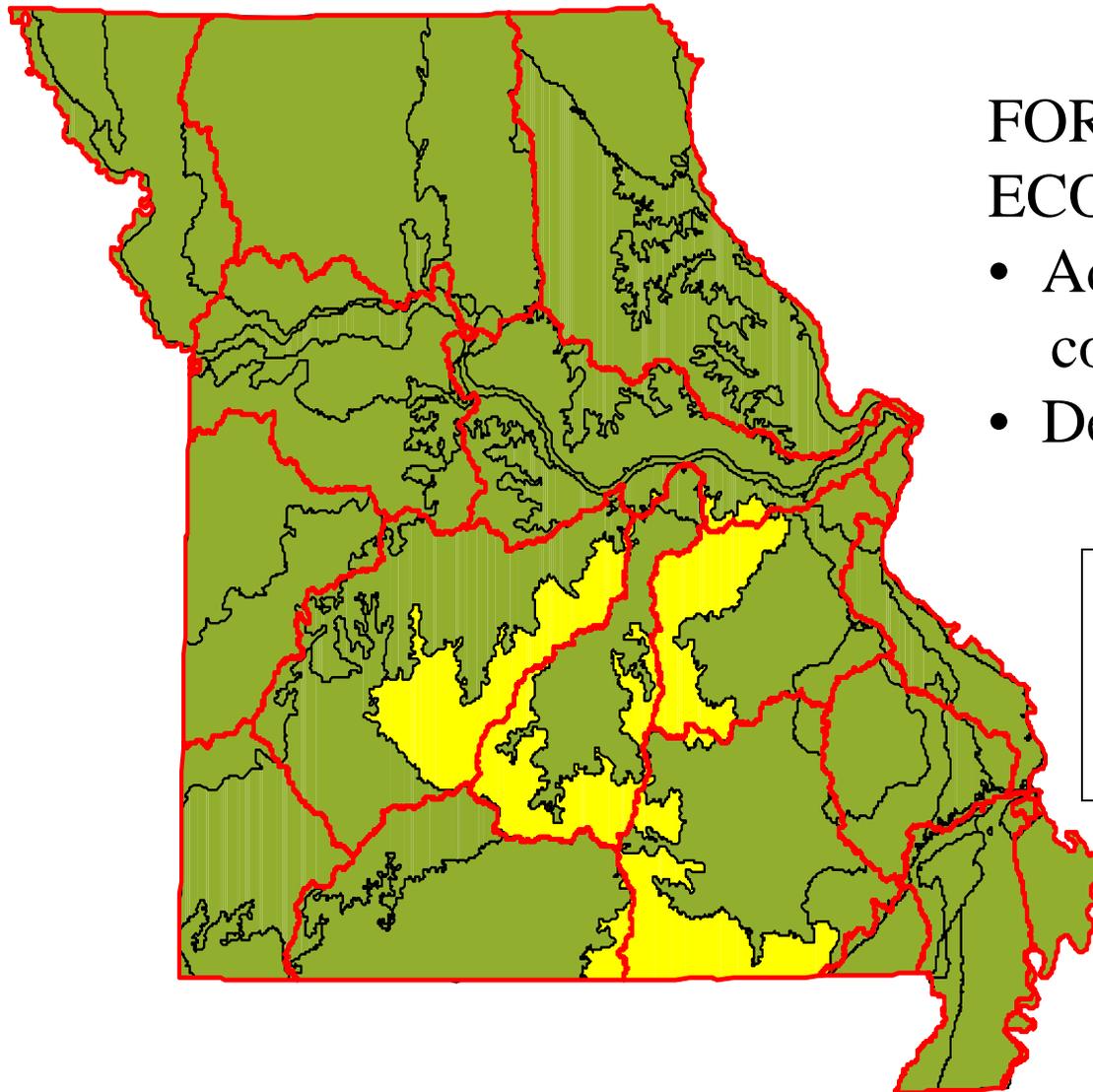
The data contributions of several federal, provincial and territorial agencies responsible for protected areas planning are gratefully acknowledged.

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Aquatic Assessments

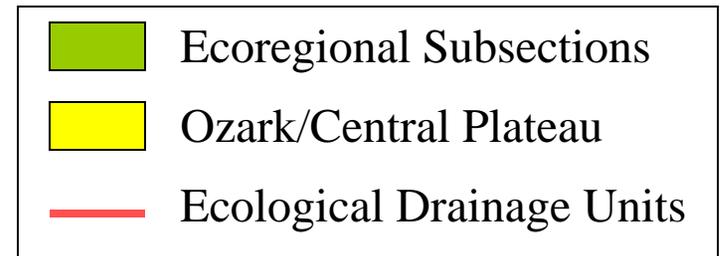


Ecoregions are Not Always the Best Geographic Framework



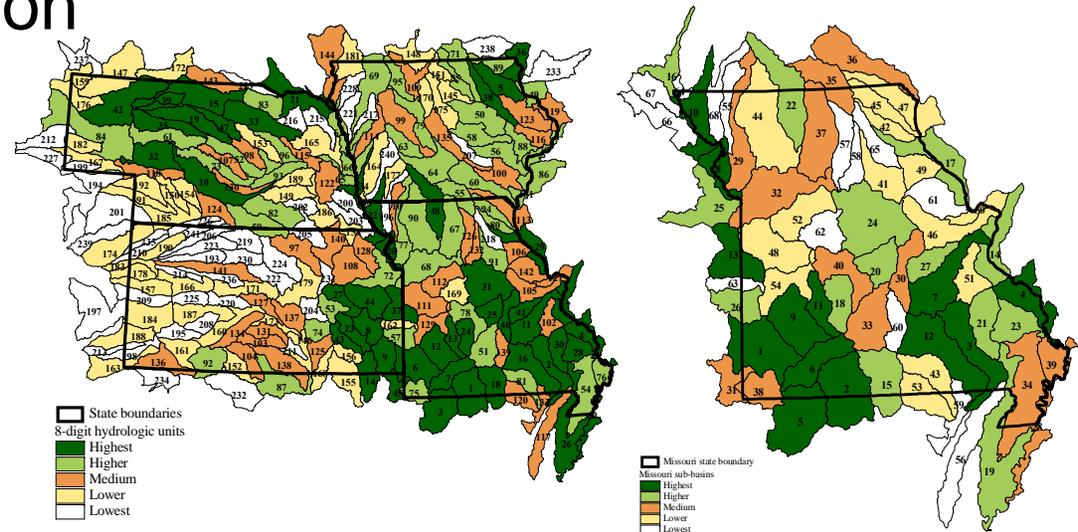
FOR FRESHWATERS
ECOREGIONS DO NOT:

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



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**

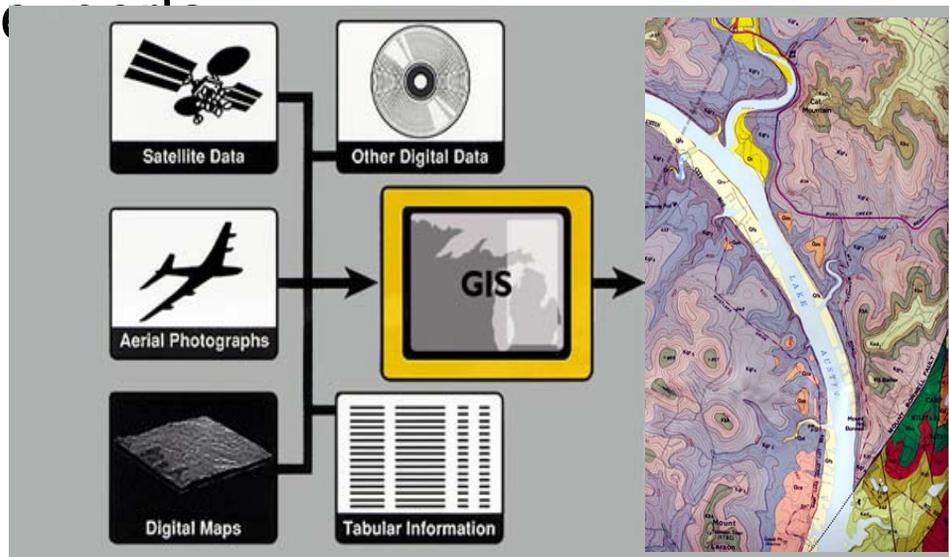
Conservation Planning

- “Failing to plan, is planning to fail.”

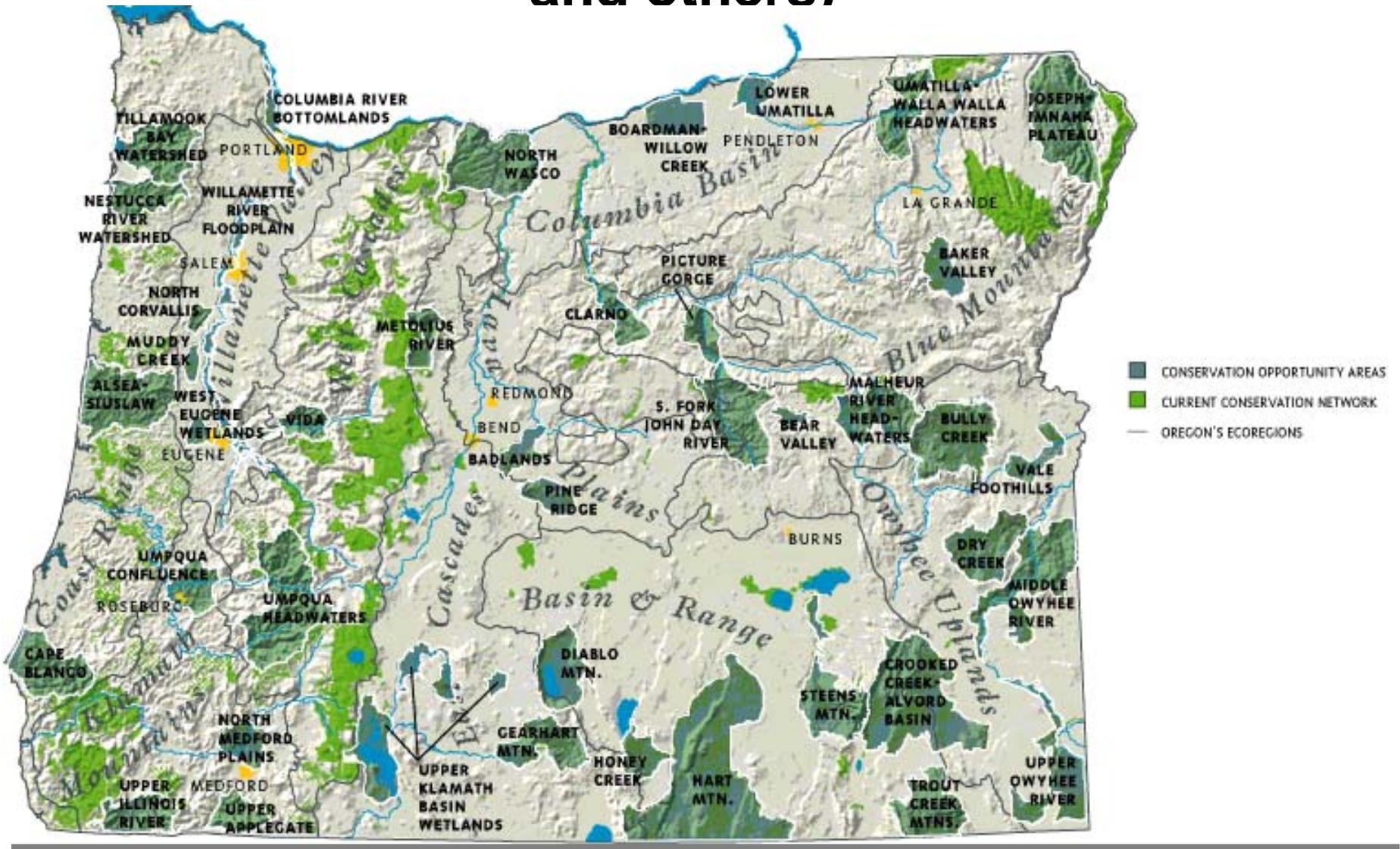
Alan Lakein

Conservation Planning is a Geographical and Logistical Exercise

- Geographical: **Where?**
- Logistical: **Who, What, How, When?**
- GIS is a powerful tool for conservation planning
- Problem: Do not have all the information we need in a geospatial format, must incorporate collective knowledge of



Oregon's Living Landscape: inventory of conservation opportunity areas (Sara Vickerman and others)

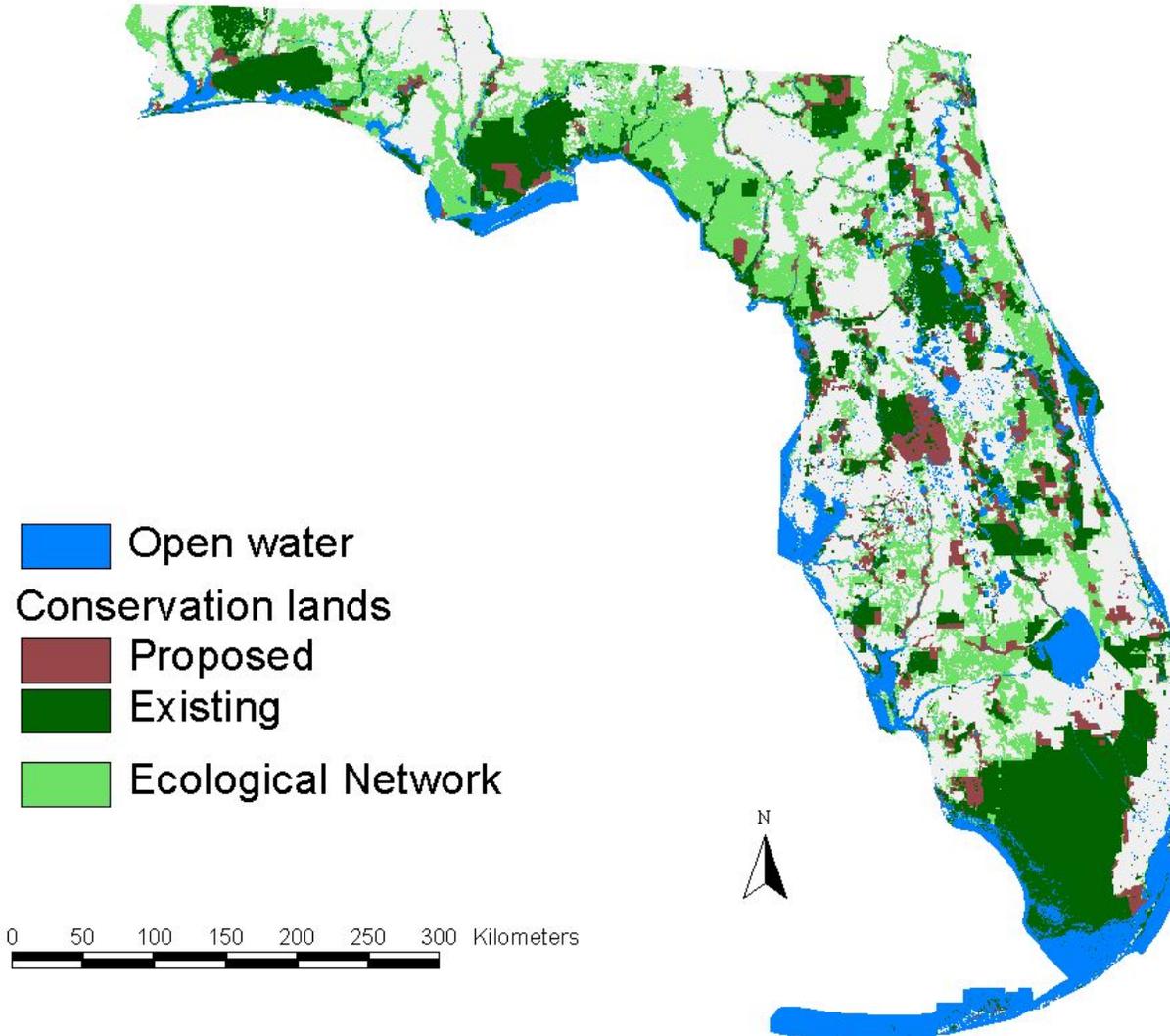


Strategic Habitat Conservation Areas

- Strategic habitat
- Public land



Hub & Corridor Approach

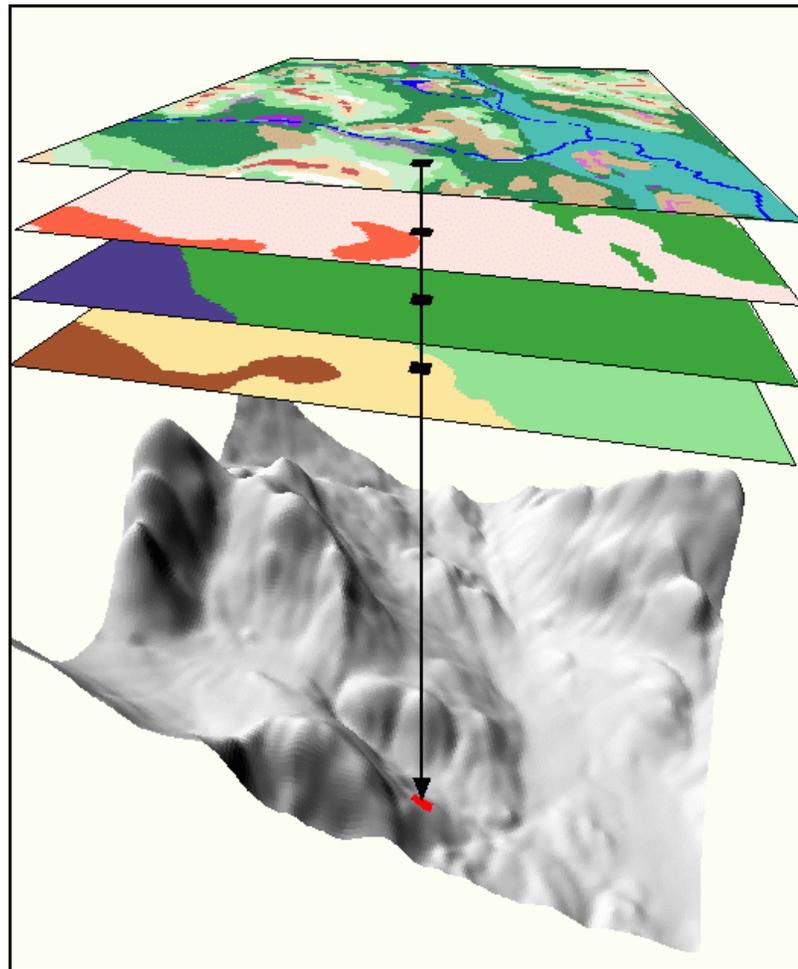


Vermont Biodiversity Project

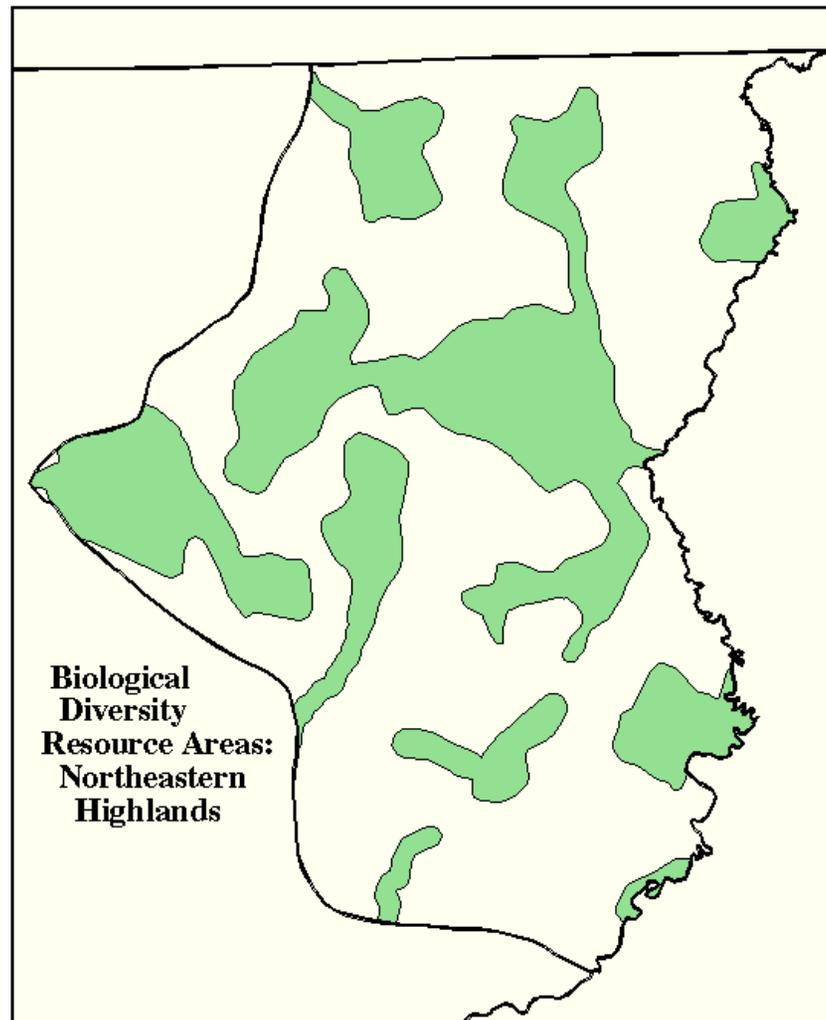


The overarching vision of the Vermont Biodiversity Project is to maintain ecological integrity in a manner that insures the long-term viability of all native species and natural community types in Vermont within their natural ranges

Landscape Diversity Units (LDUs): Geology/Elevation/Landform



Vermont Biodiversity Project: Biological Diversity Resource Areas (overlay of aquatic sites/biodiversity hotspots/representative landscapes)



Systematic conservation planning

C. R. Margules* & R. L. Pressey†

A conservation plan for a global biodiversity hotspot—
the Cape Floristic Region, South Africa

R.M. Cowling^{a,*}, R.L. Pressey^b, M. Rouget^c, A.T. Lombard^a

**A Multicriteria Assessment of the Irreplaceability
and Vulnerability of Sites in the Greater
Yellowstone Ecosystem**

REED F. NOSS,* CARLOS CARROLL, KEN VANCE-BORLAND,
AND GEORGE WUERTHNER

Modern Assessments Share:

- Planning Region (ecoregion, watershed)
- Assessment Units (regular grid, watersheds)
- Biological Targets (multi-resolution: landscapes or watersheds to species)
- Abiotic Targets (landforms, site types, watershed types, stream types)
- Process Targets (seldom addressed successfully)
- Use of Practical Surrogates for Targets
- Most use softwares for conservation design (e.g. C-Plan or SPOT but many others exist)
- Threats and resource condition have proven illusive

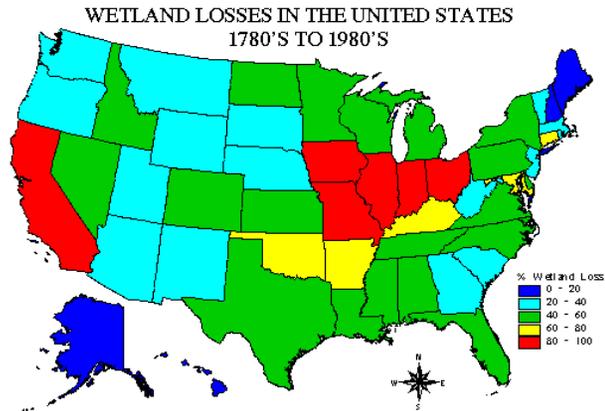
Planning Regions and Assessment Units

- 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**

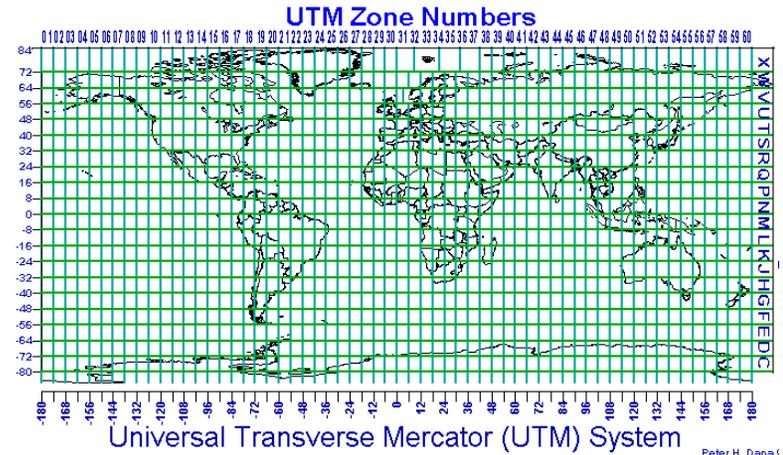


Planning Regions and Assessment Units

Political/Administrative



Political/Regular Grid



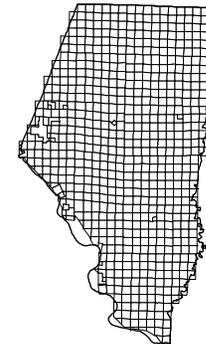
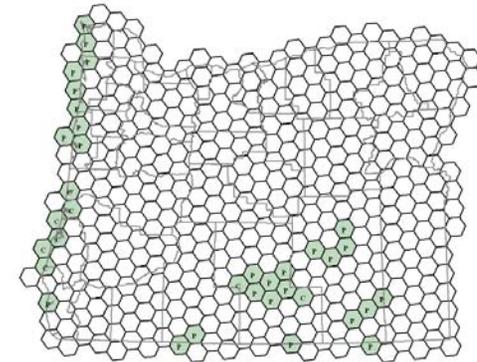
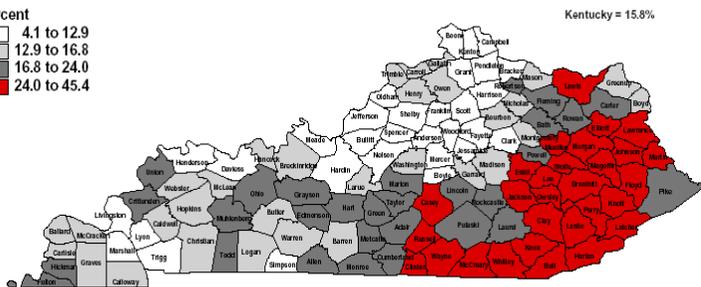
Larger

Spatial Extent
And Grain

Smaller

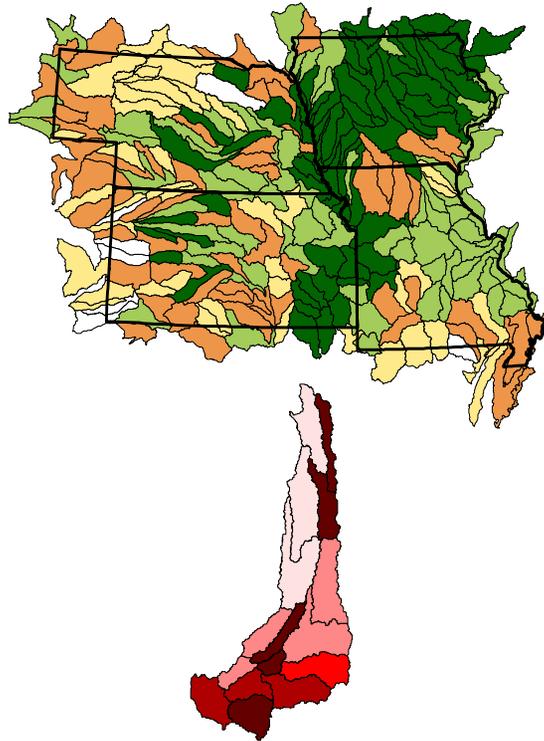
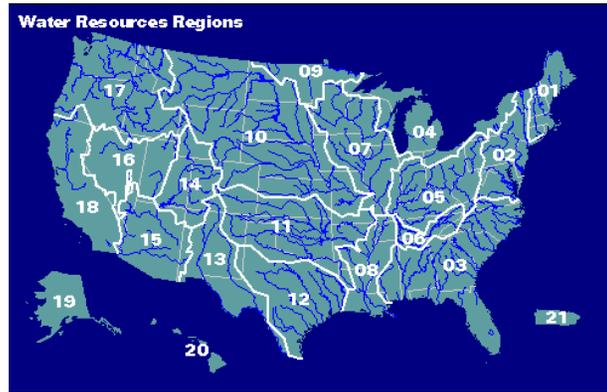
Percent

- 4.1 to 12.9
- 12.9 to 16.8
- 16.8 to 24.0
- 24.0 to 45.4

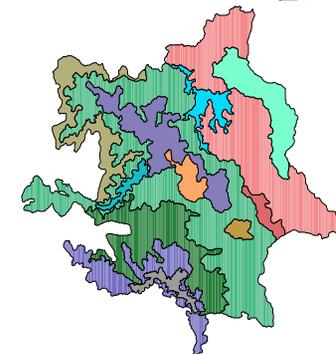
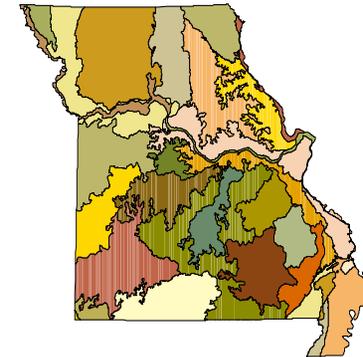
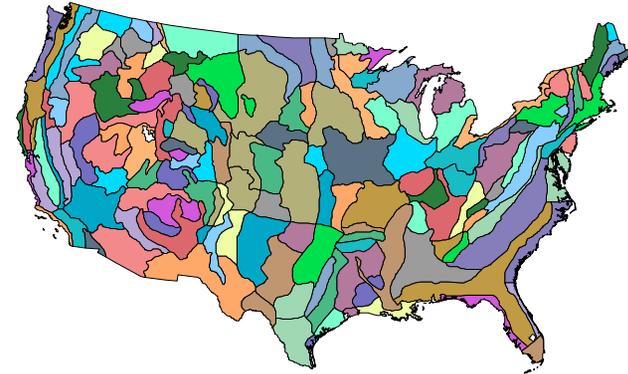


Planning Regions and Assessment Units

Watersheds/Hydrologic Units



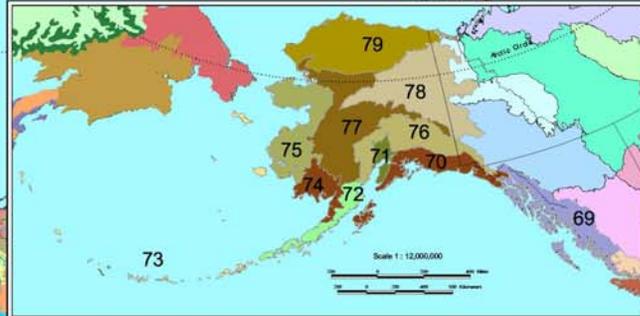
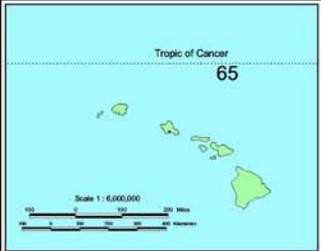
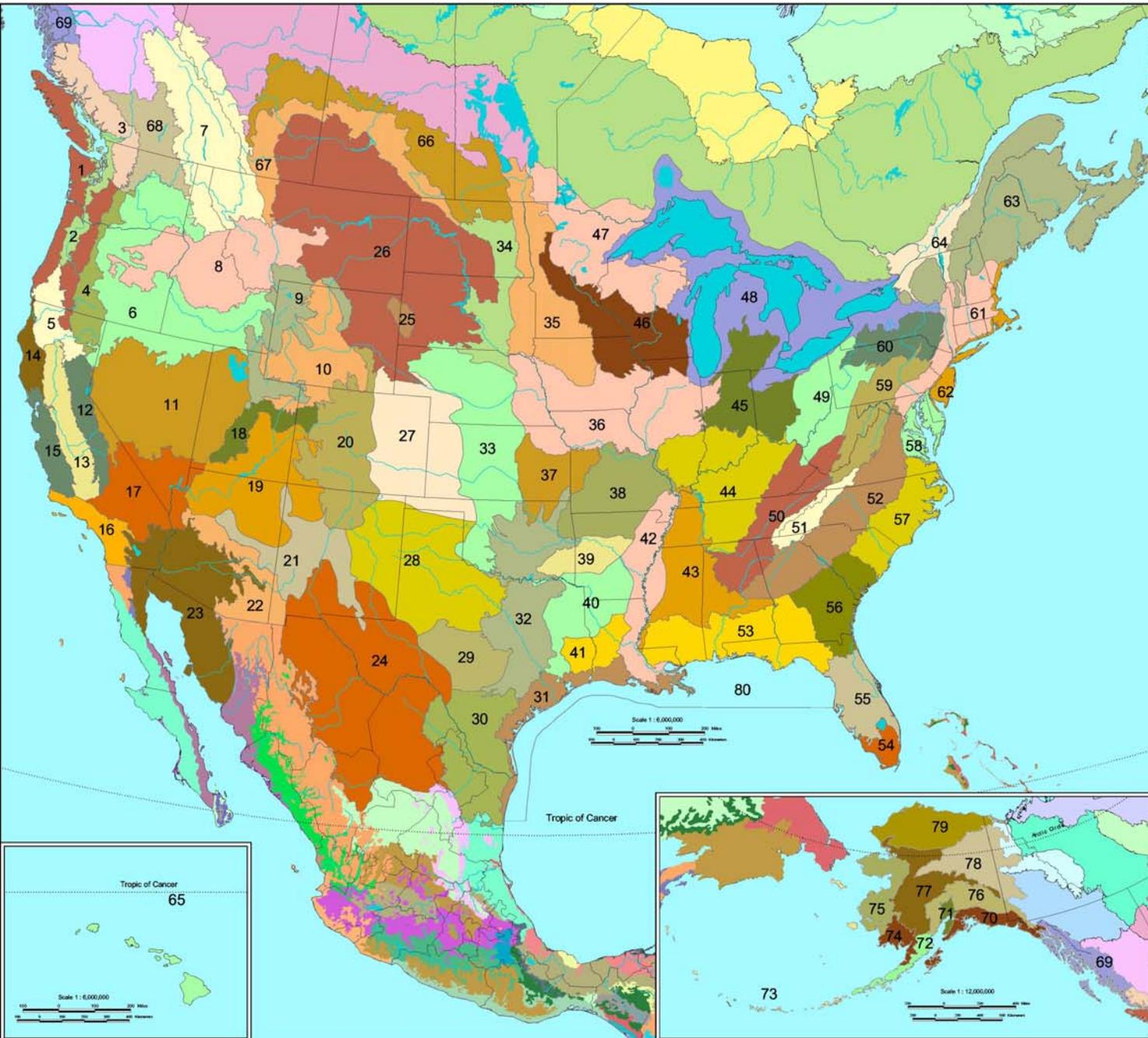
Ecologically-Based



Coarse

Spatial Extent
And Grain

Fine



Ecoregions of the United States of America

- TNC U.S. Ecoregions 2000
- 1 West Cascades and Coastal Forests
 - 2 Puget Trough - Willamette Valley - Georgia Basin
 - 3 North Cascades
 - 4 Modoc Plateau and East Cascades
 - 5 Klamath Mountains
 - 6 Columbia Plateau
 - 7 Canadian Rocky Mountains
 - 8 Middle Rockies - Blue Mountains
 - 9 Utah-Wyoming Rocky Mountains
 - 10 Wyoming Basins
 - 11 Great Basin
 - 12 Sierra Nevada
 - 13 Great Central Valley
 - 14 California North Coast
 - 15 California Central Coast
 - 16 California South Coast
 - 17 Mojave Desert
 - 18 Utah High Plateaus
 - 19 Colorado Plateau
 - 20 Southern Rocky Mountains
 - 21 Arizona-New Mexico Mountains
 - 22 Apache Highlands
 - 23 Sonoran Desert
 - 24 Chihuahuan Desert
 - 25 Black Hills
 - 26 Northern Great Plains Steppe
 - 27 Central Shortgrass Prairie
 - 28 Southern Shortgrass Prairie
 - 29 Edwards Plateau
 - 30 Tamaulipan Thorn Scrub
 - 31 Gulf Coast Prairies and Marshes
 - 32 Cross-timbers and Southern Tallgrass Prairie
 - 33 Central Mixed-Grass Prairie
 - 34 Dakota Mixed-Grass Prairie
 - 35 Northern Tallgrass Prairie
 - 36 Central Tallgrass Prairie
 - 37 Osage Plains/Flint Hills Prairie
 - 38 Ozarks
 - 39 Ouachita Mountains
 - 40 Upper West Gulf Coastal Plain
 - 41 West Gulf Coastal Plain
 - 42 Mississippi River Alluvial Plain
 - 43 Lower East Gulf Coastal Plain
 - 44 Interior Low Plateau
 - 45 North Central Tillplain
 - 46 Prairie-Forest Border
 - 47 Superior Mixed Forest
 - 48 Great Lakes
 - 49 Western Allegheny Plateau
 - 50 Cumberland and Southern Ridge and Valley
 - 51 Southern Blue Ridge
 - 52 Piedmont
 - 53 East Gulf Coastal Plain
 - 54 Tropical Florida
 - 55 Florida Peninsula
 - 56 South Atlantic Coastal Plain
 - 57 Mid-Atlantic Coastal Plain
 - 58 Chesapeake Bay Lowlands
 - 59 Central Appalachian Forest
 - 60 High Allegheny Plateau
 - 61 Lower New England/Northern Piedmont
 - 62 North Atlantic Coast
 - 63 Northern Appalachian-Boreal Forest
 - 64 St. Lawrence-Champlain Valley
 - 65 Hawaiian High Islands
 - 66 Aspen Parkland
 - 67 Fescue-Mixed Grass Prairie
 - 68 Okanogan
 - 69 Alaska Coastal Forest and Mountains
 - 70 Gulf of Alaska Mountains and Fjordslands
 - 71 Cook Inlet Basin
 - 72 Alaska Peninsula
 - 73 Bering Sea and Aleutian Islands
 - 74 Bristol Bay Basin
 - 75 Beringian Tundra
 - 76 Alaska Range
 - 77 Interior Alaska Taiga
 - 78 Yukon Plateau and Flats
 - 79 Brooks Range Tundra Coastal Plain
 - 80 Northern Gulf Coast

TNC U.S. Ecoregions 2000, based on Bailey, 1984, modified by TNC. Ecological Planning program. Canadian Ecological Zones developed by the Ecological Stratification Working Group, 1994. Latin American and Caribbean Ecoregions based on World Wildlife Fund Ecoregions, 1995, modified by TNC Ecological Planning program.



Best Practices for General Conservation Assessments



Since 1990, the Conservation Assessment Program has helped nearly 2,000 small museums undertake general conservation assessments. CAP helps these museums

of success to be the rate of CAP assessments available for Conservation District

Conservation Action Planning (CAP) Process



THE 10 STEPS OF THE CAP PROCESS

- ~~1. *Identify People Involved In Your Project*~~
- ~~2. *Define Project Scope & Focal Conservation Targets*~~
- ~~3. *Assess Viability of Focal Conservation Targets*~~
- ~~4. *Identify Critical Threats*~~
- ~~5. *Conduct Situation Analysis*~~
- ~~6. *Develop Strategies: Objectives and Actions*~~
- 7. Establish Measures*
- 8. Develop Work Plans*
- 9. Implement*
- 10. Analyze, Learn, Adapt, & Share*



Assessment

Targets, Viability, Threats & Situation Analysis

- Targets
 - Landscapes (larger watersheds), Communities (subwatersheds; valley segment types), Species
- Viability
 - Identify key ecological attributes and indicators for each KEA; rank viability 1 – 4 (many parks may be too small for viability analysis)
- Threats & Situation Analysis
 - “stresses” caused by “threats” – each threat ranked 1 – 4 for scope, severity, and irreversibility; make a table of Targets X Threats (software e-Adaptive Management available; this and diagrams are essentially the “situation analysis”)

Lower Missouri River CAP Targets

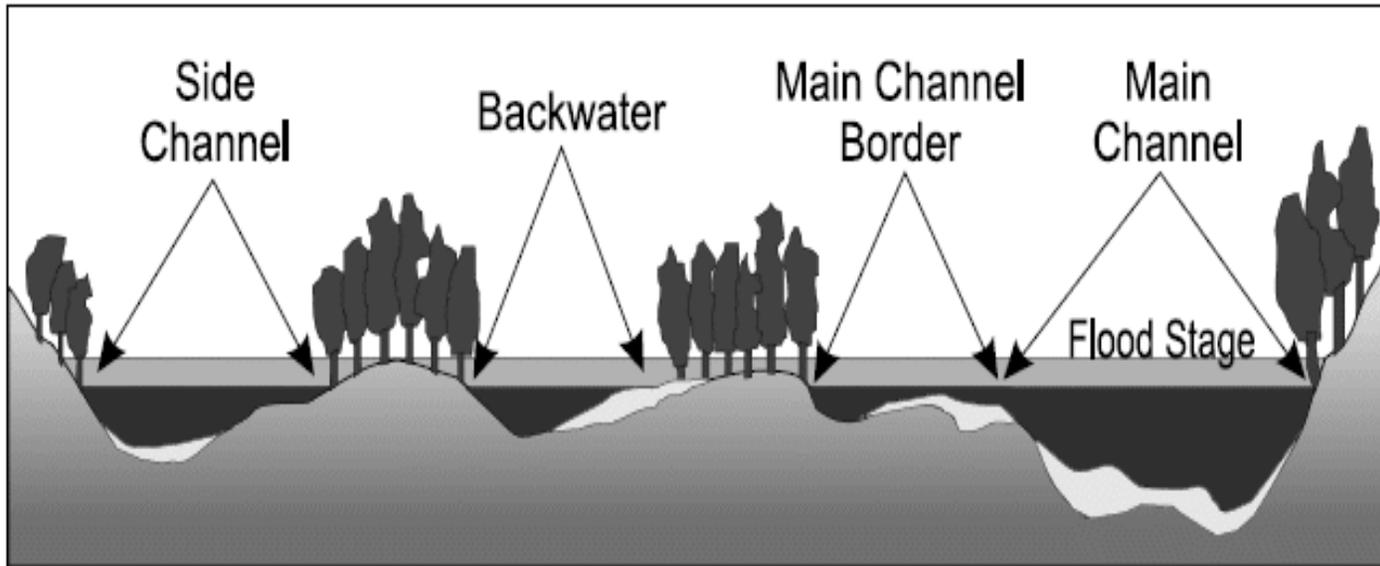
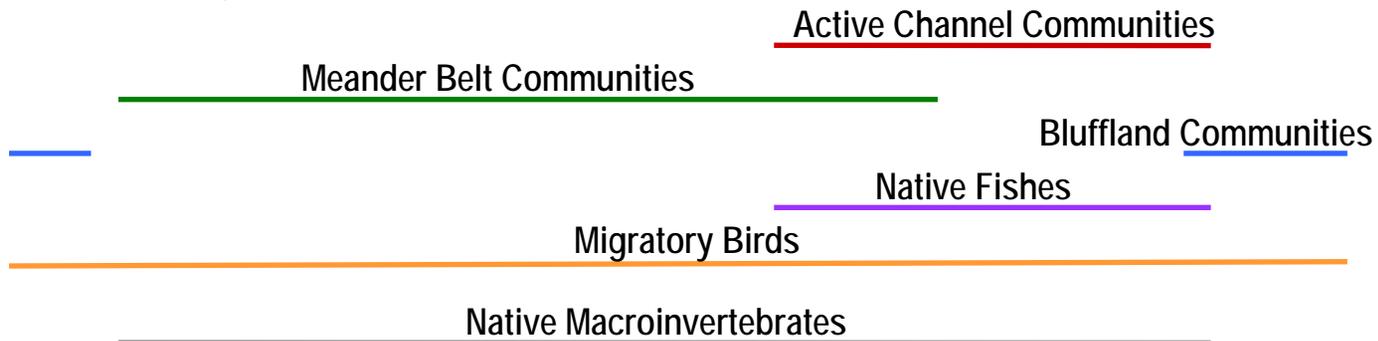


FIGURE 3.1 Typical cross-section of the pre-regulation Missouri River.
SOURCE: Rasmussen, 1999.

Source: Rasmussen, 1999



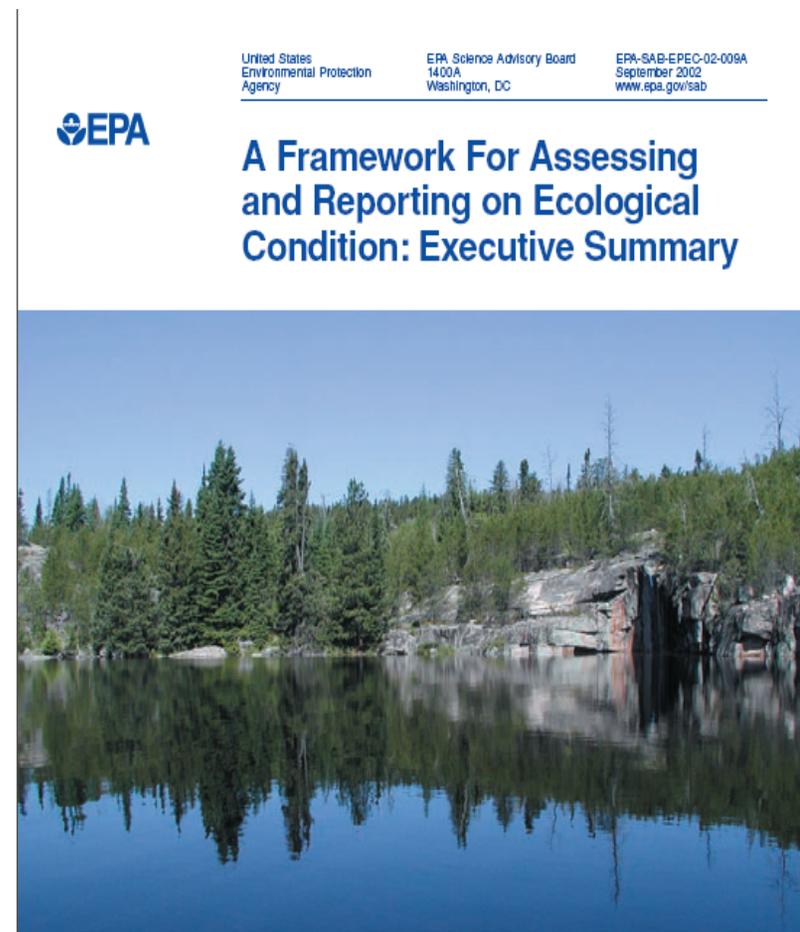
Lower MO River CAP Situation: List of Targets by Threats

Targets →								
Threats Across System ↓	Active Channel Communities	Meander Belt Tributary Systems	Meander Belt Communities	Bluffland Communities	Migratory Birds	Native Macro-invertebrates	Native Fishes	Overall Threat Rank
Dam Operations	Very High	-	High	-	High	High	Very High	Very High
Bank Stabilization	Very High	-	Medium	-	-	High	Very High	Very High
Housing and Urban Development	-	Very High	-	Very High	High	-	-	Very High
Invasive Exotics - Terrestrial	-	-	Very High	Very High	-	-	-	Very High
Levees	-	-	High	-	-	-	Very High	High
Fire Suppression	-	-	Medium	Very High	-	-	-	High
Floodplain Drainage Systems	Medium	High	High	-	High	-	-	High
Detrimental Grazing	-	-	-	Very High	-	-	-	High
Invasive Exotics - Future Aquatic	-	-	-	-	-	High	High	High
Tributary Grade Control Structures	-	-	-	-	-	High	High	High

EPA Assessment Framework



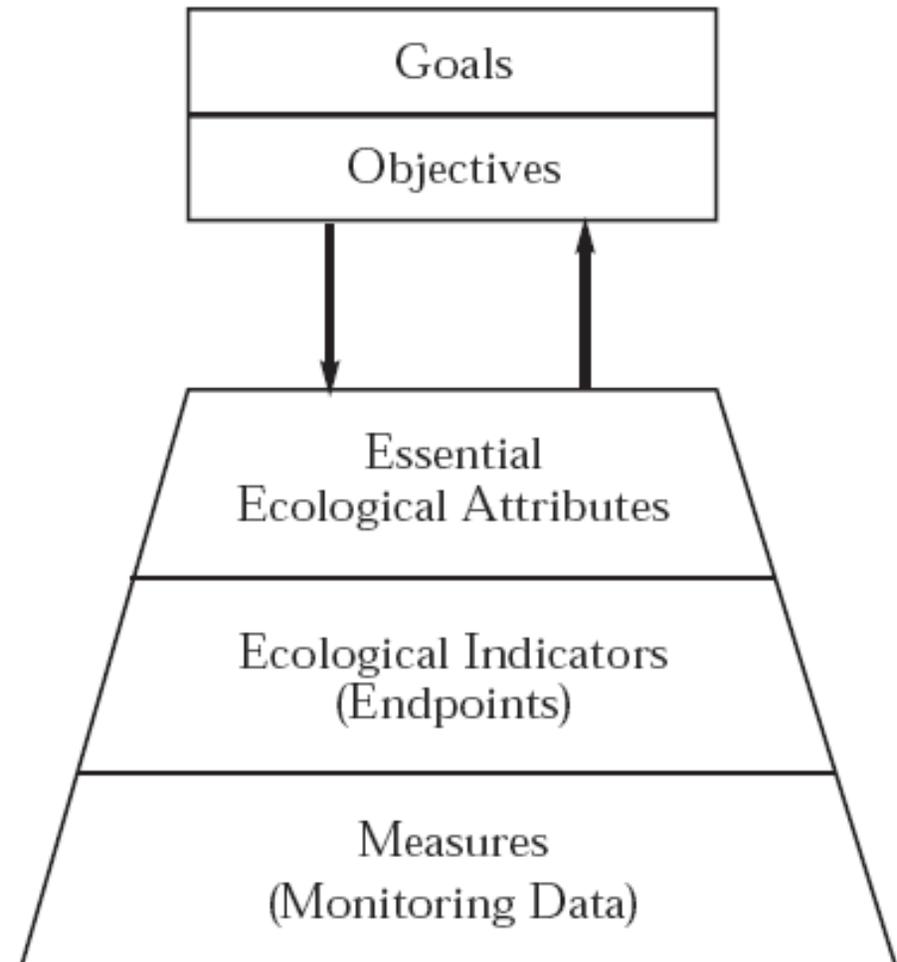
- Developed by EPA Science Advisory Board
- Guide for developing “report cards” on ecological condition
- Hundreds of relevant indicators exist
- Roadmap for synthesizing a large number of indicators into a few, scientifically defensible categories



EPA Assessment Framework

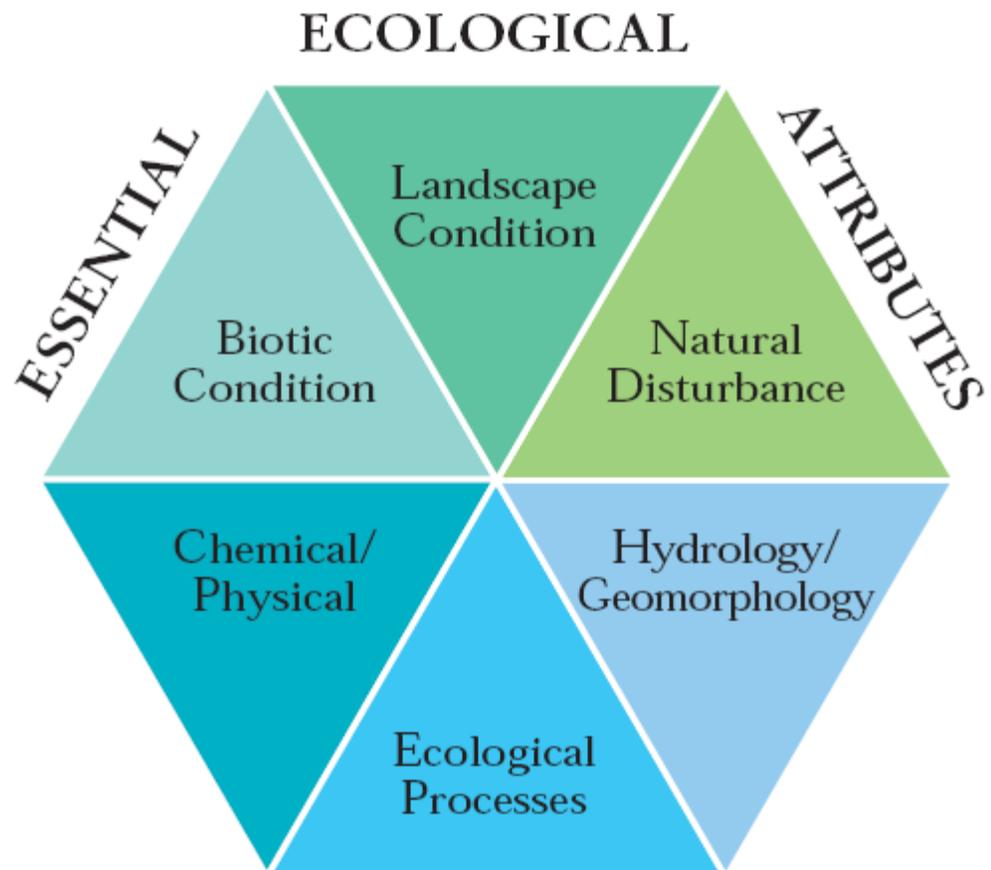


- Goals and Objectives are “separate”
- **EEAs** were developed to apply generically
- Allows for consistent application
- **EEAs** are hierarchical and derived from conceptual model of ecological
 - Pattern, composition, and function
- **EIs** measurable endpoints related to EEAS
- **Measures** are specific variables measured in the field or with GIS data that are then aggregated into EIs



Essential Ecological Attributes

- EEAs
 - 3 pattern
 - 3 process
- Processes create and maintain patterns
- Patterns affect how processes are expressed



EEA Reporting Categories



- EEAs have:
 - Component categories
 - Subcomponent categories
- Component and Subcomponents must be defined for each assessment

Table ES-1. Essential Ecological Attributes and Reporting Categories

Landscape Condition

- Extent of Ecological System/Habitat Types
- Landscape Composition
- Landscape Pattern and Structure

Biotic Condition

- Ecosystems and Communities
 - Community Extent
 - Community Composition
 - Trophic Structure
 - Community Dynamics
 - Physical Structure
- Species and Populations
 - Population Size
 - Genetic Diversity
 - Population Structure
 - Population Dynamics
 - Habitat Suitability
- Organism Condition
 - Physiological Status
 - Symptoms of Disease or Trauma
 - Signs of Disease

Chemical and Physical Characteristics (Water, Air, Soil, and Sediment)

- Nutrient Concentrations
 - Nitrogen
 - Phosphorus
 - Other Nutrients
- Trace Inorganic and Organic Chemicals
 - Metals
 - Other Trace Elements
 - Organic Compounds
- Other Chemical Parameters
 - pH
 - Dissolved Oxygen
 - Salinity
 - Organic Matter
 - Other
- Physical Parameters

Ecological Processes

- Energy Flow
 - Primary Production
 - Net Ecosystem Production
 - Growth Efficiency
- Material Flow
 - Organic Carbon Cycling
 - Nitrogen and Phosphorus Cycling
 - Other Nutrient Cycling

Hydrology and Geomorphology

- Surface and Groundwater Flows
 - Pattern of Surface Flows
 - Hydrodynamics
 - Pattern of Groundwater Flows
 - Salinity Patterns
 - Water Storage
- Dynamic Structural Characteristics
 - Channel/Shoreline Morphology, Complexity
 - Distribution/Extent of Connected Floodplain
 - Aquatic Physical Habitat Complexity
- Sediment and Material Transport
 - Sediment Supply/Movement
 - Particle Size Distribution Patterns
 - Other Material Flux

Natural Disturbance Regimes

- Frequency
- Intensity
- Extent
- Duration

Indicators and Measures



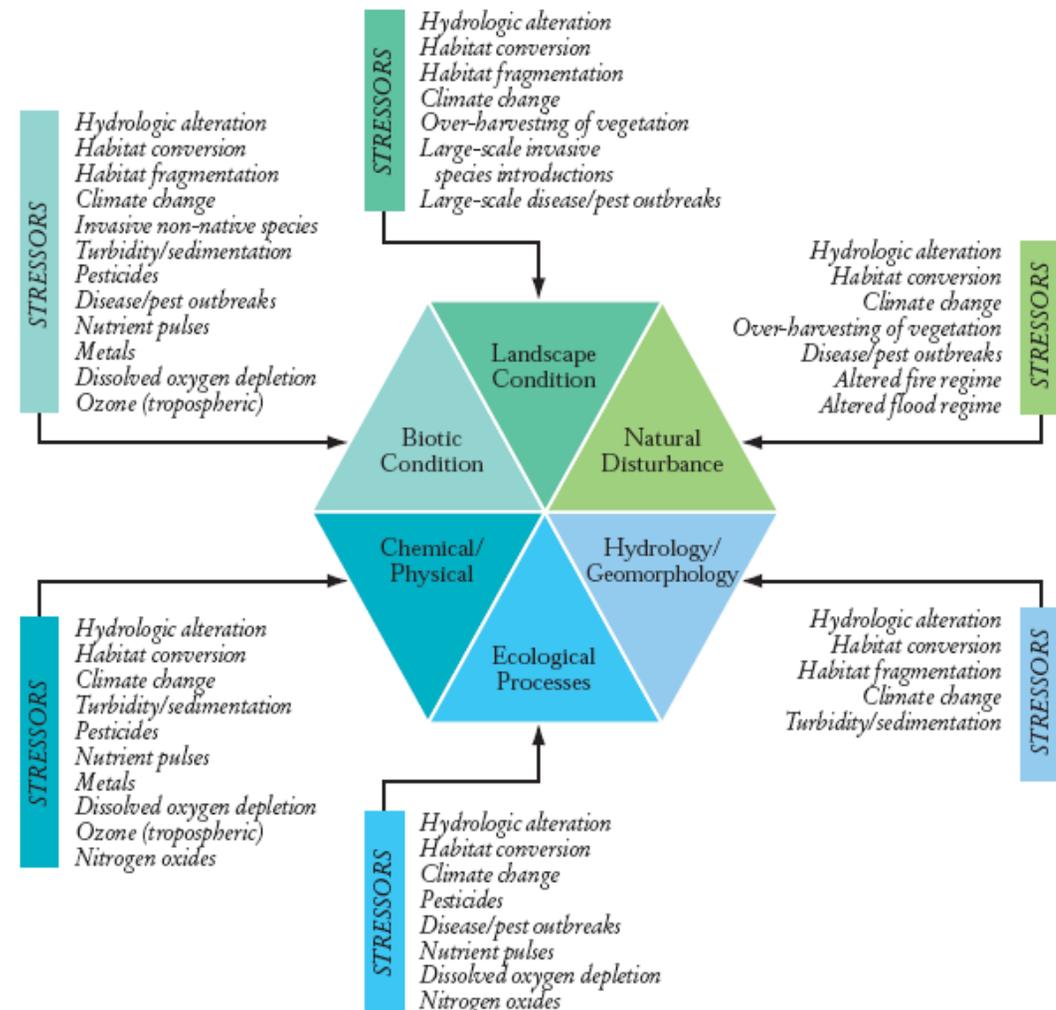
LANDSCAPE CONDITION		
Category	Subcategory	Example Indicators and Measures
Extent of Each Ecological System/Habitat Type		e.g., area, perimeter-to-area ratio, core area, elongation
Landscape Composition		e.g., number of habitat types; number of patches of each habitat; size of large patch; presence/absence of native plant communities; measures of topographic relief, slope, and aspect
Landscape Pattern/Structure		e.g., dominance; contagion; fractal dimension; distance between patches; longitudinal and lateral connectivity; juxtaposition of patch types or serial stages; width of habitat adjacent to wetlands
BIOTIC CONDITION		
Ecosystems and Communities	Community Extent	e.g., extent of native ecological communities; extent of successional states
	Community Composition	e.g., species inventory; total species diversity; native species diversity; relative abundance of species; % non-native species; presence/abundance of focal or special interest species (e.g., commonness/rarity); species/taxa richness; number of species in a taxonomic group (e.g., fishes); evenness/dominance across species or taxa
	Trophic Structure	e.g., food web complexity; presence/absence of top predators or dominant herbivores; functional feeding groups or guilds
	Community Dynamics	e.g., predation rate; succession; pollination rate; herbivory; seed dispersal
	Physical Structure	e.g., vertical stand structure (stratification or layering in forest communities); tree canopy height; presence of snags in forest systems; life form composition of plant communities; successional state
Species and Populations	Population Size	e.g., number of individuals in the population; size of breeding population; population distribution; number of individuals per habitat area (density)
	Genetic Diversity	e.g., degree of heterozygosity within a population; presence of specific genetic stocks within or among populations
	Population Structure	e.g., population age structure
	Population Dynamics	e.g., birth and death rates; reproductive or recruitment rates; dispersal and other movements
	Habitat Suitability (if focal species)	measures of habitat attributes important to focal species
Organism Condition	Physiological Status	e.g., glycogen stores and blood chemistry for animals; carbohydrate stores, nutrients, and polyamines for plants; hormone levels; enzyme levels
	Symptoms of Disease or Trauma	e.g., gross morphology (size, weight, limb structure); behavior and responsiveness; sores, lesions and tumors; defoliation
	Signs of Disease	e.g., presence of parasites or pathogens (e.g., nematodes in fish); tissue burdens of xenobiotic chemicals
CHEMICAL AND PHYSICAL CHARACTERISTICS (WATER, AIR, SOIL, SEDIMENT)		
Nutrient Concentrations	Nitrogen	e.g., concentrations of total N; NH ₄ ⁺ ; NO ₃ ⁻ ; organic N; NO _x ; C/N ratio for forest floor
	Phosphorus	e.g., concentrations of total P; ortho-P; particulate P; organic P
	Other Nutrients	e.g., concentrations of calcium, potassium, and silicon
Trace Inorganic and Organic Chemicals	Metals	e.g., copper and zinc in sediments and suspended particulates
	Other Trace Elements	e.g., concentrations of selenium in waters, soils, and sediments
	Organic Compounds	e.g., methylmercury; selenomethionine
Other Chemical Parameters	pH	e.g., pH in surface waters and soil
	Dissolved Oxygen/Redox Potential	e.g., dissolved oxygen in streams; soil redox potential
	Salinity	e.g., conductivity
	Organic Matter	e.g., soil organic matter; pore water organic matter concentrations
	Other	e.g., buffering capacity; cation exchange capacity
Physical Parameters	Soil/Sediment	e.g., temperature; texture; porosity; soil bulk density; profile morphology; mineralogy; water retention
	Air/Water	e.g., temperature; wind velocity; relative humidity; UV-B PAR; concentrations of particulates; turbidity

ECOLOGICAL PROCESSES		
Energy Flow	Primary Production	e.g., production capacity (total chlorophyll per unit area); net primary production (plant production per unit area per year); tree growth or crop production (terrestrial systems); trophic status (lakes); 14-CO ₂ fixation rate (aquatic systems)
	Net Ecosystem Production	e.g., net ecosystem organic carbon storage (forests); diel changes in O ₂ and CO ₂ fluxes (aquatic systems); CO ₂ flux from all ecosystems
	Growth Efficiency	e.g., comparison of primary production with net ecosystem production; transfer of carbon through the food web
Material Flow	Organic Carbon Cycling	e.g., input/output budgets (source identification-stable C isotopes); internal cycling measures (food web structure); rate and efficiency of microbial decomposition; carbon storage; organic matter quality and character
	N and P Cycling	e.g., input/output budgets (source identification, landscape runoff or yield); internal recycling (N ₂ fixation capacity; soil/sediment nutrient assimilation capacity; identification of growth-limiting factors; identification of dominant pathways)
	Other Nutrient Cycling (e.g., K, S, Si, Fe)	e.g., input/output budgets (source identification, landscape yield); internal recycling (identification of growth-limiting factors; storage capacity; identification of key microbial terminal electron acceptors)
HYDROLOGY AND GEOMORPHOLOGY		
Surface and Groundwater Flows	Pattern of Surface Flows (rivers, lakes, wetlands, and estuaries)	e.g., flow magnitude and variability, including frequency, duration, timing, and rate of change; water level fluctuations in wetlands and lakes
	Hydrodynamics	e.g., water movement; vertical and horizontal mixing; stratification; hydraulic residence time; replacement time
	Pattern of Groundwater Flows	e.g., groundwater accretion to surface waters; within-groundwater flow rates and direction; net recharge or withdrawals; depth to groundwater
	Spatial and Temporal Salinity Patterns (estuaries and wetlands)	e.g., horizontal (surface) salinity gradients; depth of pycnocline; salt wedge
	Water Storage	e.g., water level fluctuations for lakes and wetlands; aquifer capacity
Dynamic Structural Characteristics	Channel Morphology; Shoreline Characteristics; Channel Complexity	e.g., mean width of meander corridor or alternative measure of the length of river allowed to migrate; stream braidedness; presence of off-channel pools (rivers); linear distance of marsh channels per unit marsh area; lithology; length of natural shoreline
	Distribution and Extent of Connected Floodplain (rivers)	e.g., distribution of plants that are tolerant to flooding; presence of floodplain spawning fish; area flooded by 2-year and 10-year floods
	Aquatic Physical Habitat Complexity	e.g., pool-to-riffle ratio (rivers); aquatic shaded riparian habitat (rivers and lakes); presence of large woody debris (rivers and lakes)
Sediment and Material Transport	Sediment Supply and Movement	e.g., sediment deposition; sediment residence time and flushing
	Particle Size Distribution Patterns	e.g., distribution patterns of different grain/particle sizes in aquatic or coastal environments
	Other Material Flux	e.g., transport of large woody debris in rivers
NATURAL DISTURBANCE REGIMES		
Example 1: Fire Regime in a forest	Frequency	e.g., recurrence interval for fires
	Intensity	e.g., occurrence of low intensity (forest litter fire) to high intensity (crown fire) fires
	Extent	e.g., spatial extent in hectares
	Duration	e.g., length of fire events (from hours to weeks)
Example 2: Flood Regime	Frequency	e.g., recurrence interval of extreme flood events
	Intensity	e.g., number of standard deviations from 30-year mean
	Extent	e.g., number of stream orders (and largest order) affected
	Duration	e.g., number of days, percent of water year (October 1- September 30)
Example 3: Insect Infestation	Frequency	e.g., recurrence interval for insect infestation outbreaks
	Intensity	e.g., density (number per area) of insect pests in an area
	Extent	e.g., spatial extent of infested area
	Duration	e.g., length of infestation outbreak

Conditions and Stressors are Kept Separate



- Not a one-to-one relation
- If both are included, must define linkages
- Avoids relying only on available data
 - Have much more threat/stressor data



Lower MO River CAP Situation: List of Targets by Threats

Targets →								
Threats Across System ↓	Active Channel Com-munities	Meander Belt Tributary Systems	Meander Belt Com- munities	Bluffland Com- munities	Migratory Birds	Native Macro- invertebrates	Native Fishes	Overall Threat Rank
Dam Operations	Very High	-	High	-	High	High	Very High	Very High
Bank Stabilization	Very High	-	Medium	-	-	High	Very High	Very High
Housing and Urban Development	-	Very High	-	Very High	High	-	-	Very High
Invasive Exotics - Terrestrial	-	-	Very High	Very High	-	-	-	Very High
Levees	-	-	High	-	-	-	Very High	High
Fire Suppression	-	-	Medium	Very High	-	-	-	High
Floodplain Drainage Systems	Medium	High	High	-	High	-	-	High
Detrimental Grazing	-	-	-	Very High	-	-	-	High
Invasive Exotics - Future Aquatic	-	-	-	-	-	High	High	High
Tributary Grade Control Structures	-	-	-	-	-	High	High	High

Pros and Cons

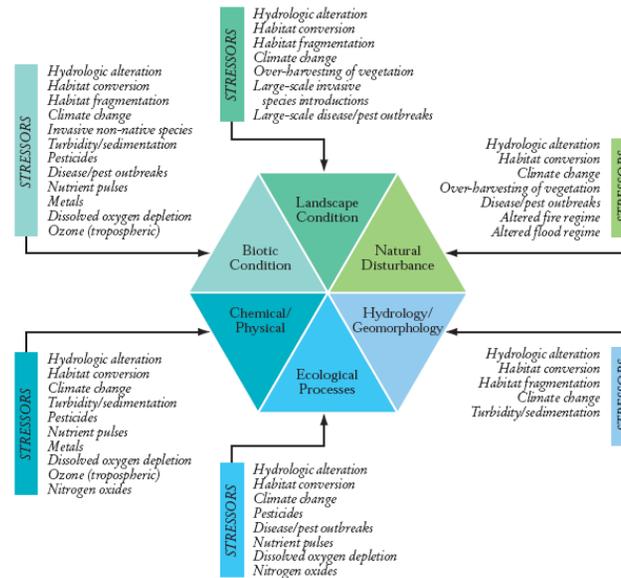
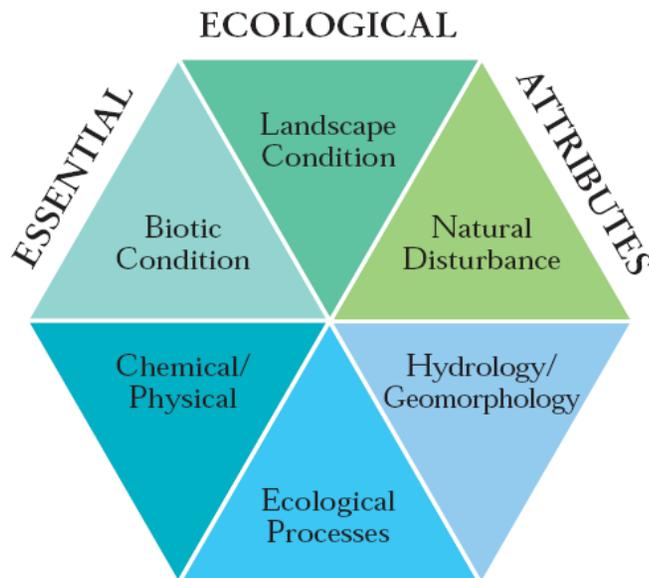


- Pros

- Holistic and detailed
- Hierarchical
- Broadly applicable
- Keeps stressors separate

- Cons

- Not fully fleshed out
- Most indicators and measures have not been measured



LANDSCAPE CONDITION		
Category	Subcategory	Example Indicators and Measures
Extent of Each Ecological System/Feature Type		e.g., area, perimeter to area ratio, core area, elongation
Landscape Composition		e.g., number of habitat types, number of patches of each habitat, size of large patch, presence/absence of native plant communities, biomass of riponiphilic soil, slope, and aspect
Landscape Pattern/Structure		e.g., distance, connectivity, forest fragmentation, distance between patches, length/width and lateral connectivity, juxtaposition of patch types or soil types, width of habitat adjacent to wetlands
BIOTIC CONDITION		
Ecosystems and Communities	Community Extent	e.g., extent of native ecological communities, extent of nonindigenous sites
	Community Composition	e.g., species richness, total species diversity, native species diversity, relative abundance of species, % non-native species, presence/abundance of focal or special interest species (e.g., conservation/focus), species loss richness, number of species in a taxonomic group (e.g., birds), evenness/relative evenness across species or taxa
	Trophic Structure	e.g., food web complexity, presence/absence of top predators or dominant herbivores, functional feeding groups or guilds
	Community Dynamics	e.g., population rate, succession, population rate, herbivory, seed dispersal
	Physical Structure	e.g., vertical stand structure (stratification or layering in forest communities), tree canopy height, presence of snags in forest systems, life form composition of other communities, successional age
Species and Populations	Population Size	e.g., number of individuals in the population, size of breeding population, population distribution, number of individuals per habitat area (density)
	Genetic Diversity	e.g., degree of heterozygosity within a population, presence of specific genetic marks within or among populations
	Population Structure	e.g., population age structure
	Population Dynamics	e.g., birth and death rates, reproductive or recruitment rates, dispersal and other movements
	Habitat Suitability, Food Supply	measures of habitat suitability important to focal species
Oxygen Conditions	Physiological Status	e.g., chlorophyll content and leaf-to-airway for animals, carotenoid stress, nutrients, and pollutants for plants, invertebrate health, enzyme levels
	Symptoms of Disease or Injury	e.g., gross morphology (size, weight, limb structure), behavior and responsiveness, color, lesions and tumors, deformation
	Signs of Disease	e.g., presence of parasites or pathogens (e.g., nematodes in fish), tissue lesions of vertebrate, chemical
CHEMICAL AND PHYSICAL CHARACTERISTICS (WATER, AIR, SOIL, SEDIMENT)		
Nitrogen Concentrations	Nitrogen	e.g., concentrations of total N, NH ₄ ⁺ , NO ₃ ⁻ , organic N, NO _x , CN ratio for forest floor
	Phosphorus	e.g., concentrations of total P, ortho-P, particulate P, organic P
	Other Nutrients	e.g., concentrations of calcium, potassium, and silicon
Toxicological and Organic Chemicals	Metals	e.g., copper and zinc in sediments and suspended particulates
	Other Trace Elements	e.g., concentrations of selenium in water, soils, and sediments
	Organic Compounds	e.g., methylmercury, polychlorinated biphenyls
Other Chemical Parameters	pH	e.g., pH in surface water and soil
	Dissolved Oxygen/Redox Potential	e.g., dissolved oxygen in stream, soil redox potential
	Salinity	e.g., conductivity
	Organic Matter	e.g., soil organic matter, pore water organic matter concentrations
	Other	e.g., buffering capacity, cation exchange capacity
Physical Parameters	Soil/Sediment	e.g., temperature, texture, porosity, soil bulk density, profile morphology, interstitial water retention
	Air/Water	e.g., temperature, wind velocity, relative humidity, UV/EPA, concentrations of particulates, turbidity

What OMB and DOI Want:



1. **Performance Measures** to demonstrate effectiveness and that taxpayer dollars are well spent;
2. **Efficiency Measures** that allow comparisons with other agencies and the private sector.

Performance Measures: “What difference does the program make? What are the end outcomes when the program is in place, versus what the outcomes would be in the absence of the program?”

Efficiency Measures: “What does it cost the NPS per acre to treat invasive plants, versus what it costs other agencies or private landowners”.

GPRA and PART – What are They?

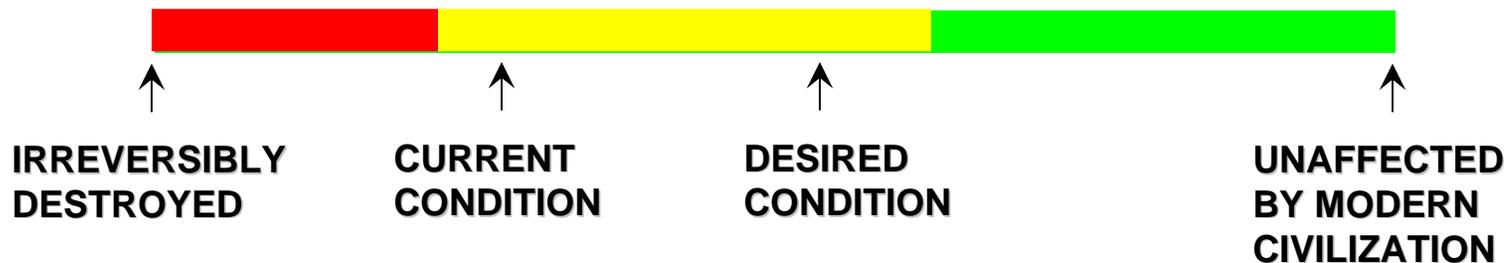
GPRA (Government Performance and Results Act) is a 1993 law that guides how agencies prepare strategic plans, performance plans, and performance reports that set goals and report on achieving them. GPRA was intended to provide “accountability by federal agencies for the results they achieve when they spend tax dollars.”

PART (Program Assessment Rating Tool) is a method for assessing program performance and how the program achieves goals. Evaluates program’s Purpose and Design, Strategic Planning, Management, and Results and Accountability.

- Is the Program’s Purpose and Design clear and defensible?
- Program Management: financial oversight and program improvement efforts.
- Has the agency developed ambitious goals and is it meeting them?

The Relationship between Changes in Condition and Funding/Effort is Not Straightforward

- You may spend lots of \$\$ controlling invasive species, and yet the condition gets worse; but if you hadn't done any control, you might have 'lost' the park's resources altogether
- Measurable changes in condition may take many years to decades to show up, even where management is very effective
- Some parks start Yellow and will always be Yellow; restoration is not economically or logistically feasible.



Resource Stewardship Strategies

Key Elements

- Defines park's desired resource conditions
- Summarizes current knowledge of park resources and identifies information gaps
- Assesses current condition of resources in comparison to desired conditions, as well as trends
- Documents long-term (10 to 20 year) stewardship strategies to achieve and maintain desired conditions
- Assesses effectiveness of previous and current resource management actions in achieving or maintaining desired conditions, and describes their implications for the stewardship strategies

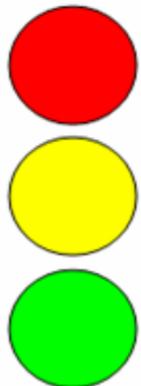
Status & Trends in Condition of Natural Resources

National Park Service
U.S. Department of the Interior



	Air	Water	Geology & Soils	Biological Integrity	Landscapes
<u>ARPO</u>					
<u>LACL</u>					
HOSP					
<u>TAPR</u>					

Status



Significant Concern

Caution

Good condition

Trend



Condition is Improving



Condition is Unchanged



Condition is Deteriorating

Confidence



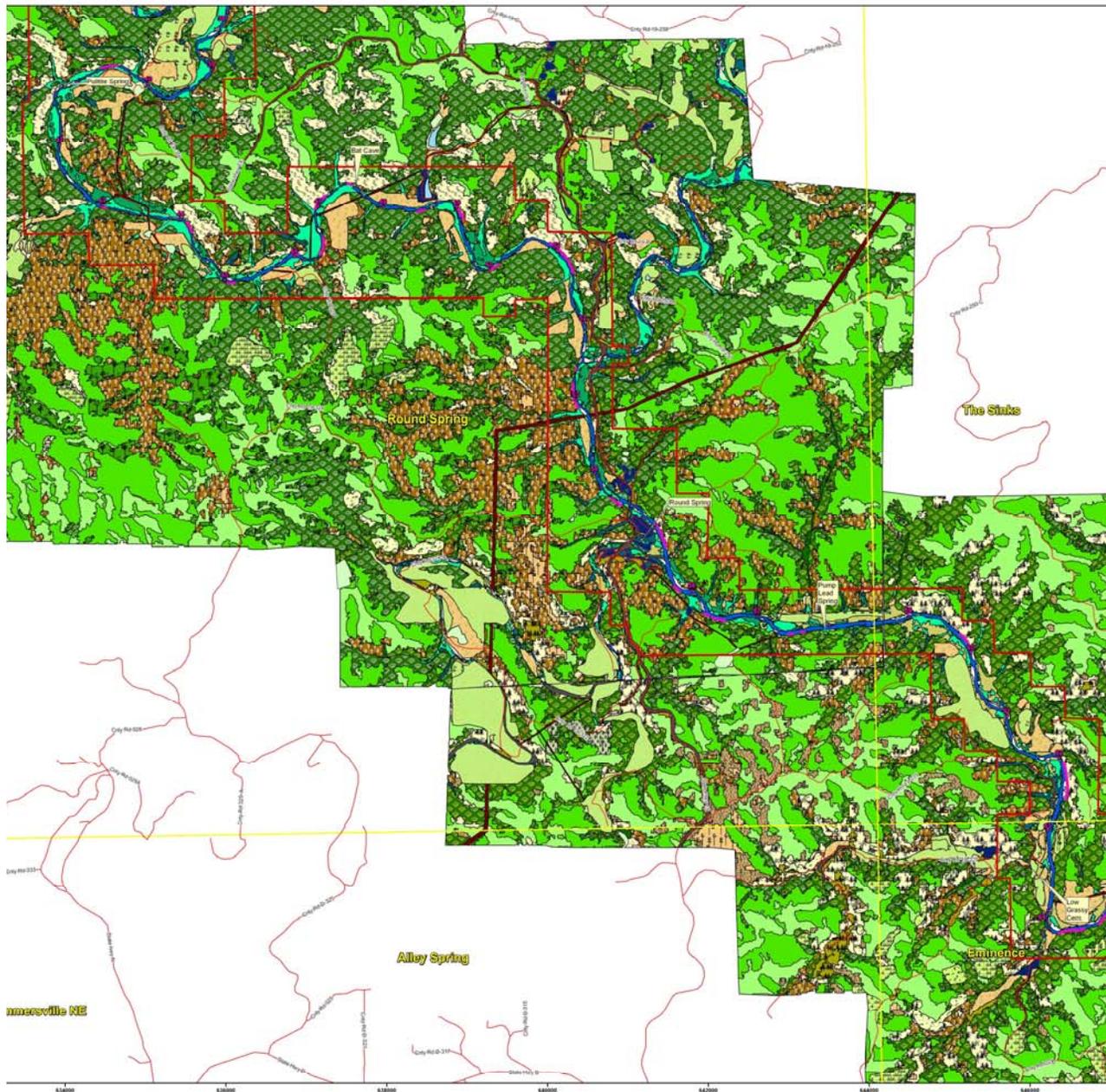
High



Medium

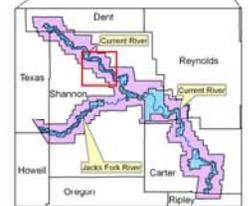


Low



Pulltite Spring to Low Grassy Cemetery

- River Kilometer (From Upstream NPS Boundary)
- Roads (from Missouri Spatial Data Information Service, 2006)
- USGS Quadrangle
- Ozark National Scenic Riverways
- Cliffs (Data Source: river_cliffs)
- Current, Jacks Fork, and Small Feeder Streams and Springs
- Surface Water (lakes, ponds, etc)
- Bare Gravel and/or Sand Bars
- Riverine Sand Flats (Herbaceous gravel bar)
- Carolina Willow Shrubland
- Witchhazel, Dogwood Gravel Bar
- Box Elder Forest
- Sycamore-Silver Maple Floodplain Forest
- Ash-Oak-Sycamore Mesic Bottomland Forest
- Sugar Maple-Oak-Bitternut Hickory Mesic Bottomland Forest
- White Oak-Red Oak-Sugar Maple Mesic Forest
- White Oak Dolomite Forest
- White Oak/Dogwood Forest
- Black Oak-White Oak-Hickory Forest
- Ozark Black Oak, Scarlet Oak Forest
- Interior Highlands Shortleaf Pine-Oak Dry-Mesic Forest
- Shortleaf Pine-Black Oak Forest
- Shortleaf Pine/Blueberry Forest
- Shortleaf Pine-Oak Dry Woodland
- Dolomite Glade Complex
- Chinkapin Oak-Ash/Little Bluestem Woodland
- Chinkapin Oak-Red Cedar Dry Alkaline Forest
- Post Oak-Blackjack Oak/Little Bluestem Woodland
- Midwest Post Oak-Blackjack Oak Forest
- Igneous Glade
- Igneous Glade Complex
- Blackjack Oak Xeric Scrub
- Post Oak-Blackjack Oak/Little Bluestem Woodland - Igneous Phase
- Midwest Post Oak-Blackjack Oak Forest-Igneous Phase
- Pine Plantation/Timber Management Forest
- Pine Plantation
- Pine Pole Stand
- Pine-Oak Regeneration Stand
- Shelterwood Cut
- Regeneration Stand
- Pole Stand
- Open Old Field (shrubby or sparse trees)
- Cedar-Deciduous Wooded Old Field
- Cedar Old Field
- Deciduous Shrubby Old Field
- Wooded Old Field
- Agricultural Field/Pasture
- Agricultural Forested Woodlot
- Residential
- Transportation Corridor
- Other Clearing
- Urban
- Utility Corridor
- Industrial/Quarry



- Ozark National Scenic Riverways
- Project Mapping Area
- Detail Map Area



1:24,000
UTM NAD83 Zone 15N

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Columbia Environmental Research Center
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Vegetation Association Data Source:
size, classmap, USNVC_code, and_names
ArcMap Project
ONSR Map Book