Agricultural Research Service

Overview of ARS involvement in Grazing Land Conservation Effects Assessment Project (CEAP)

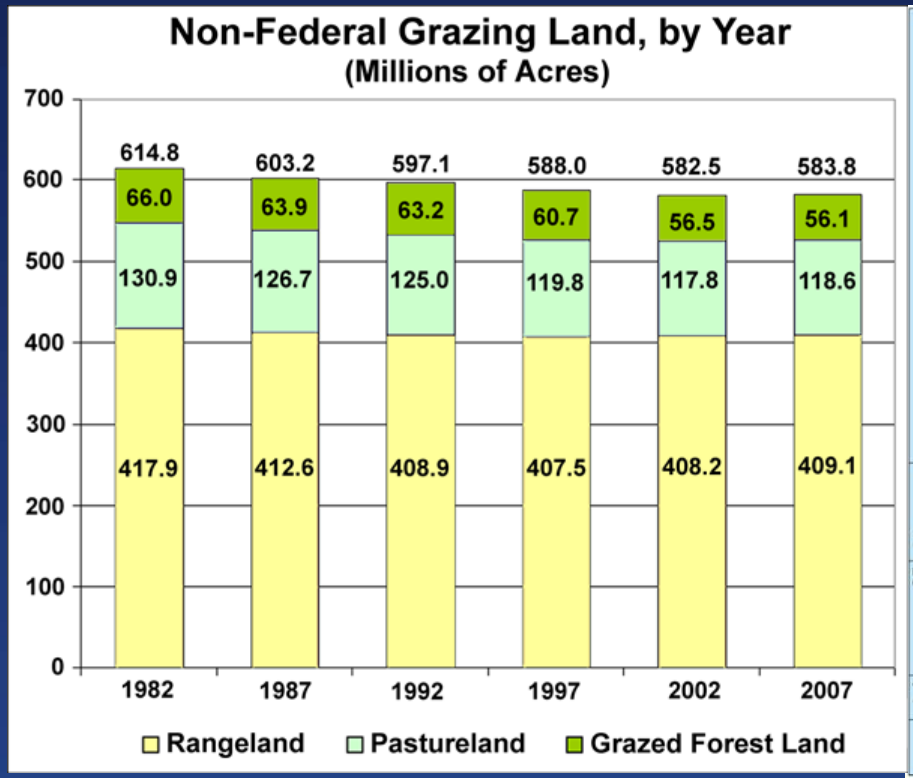
Mark A. Weltz

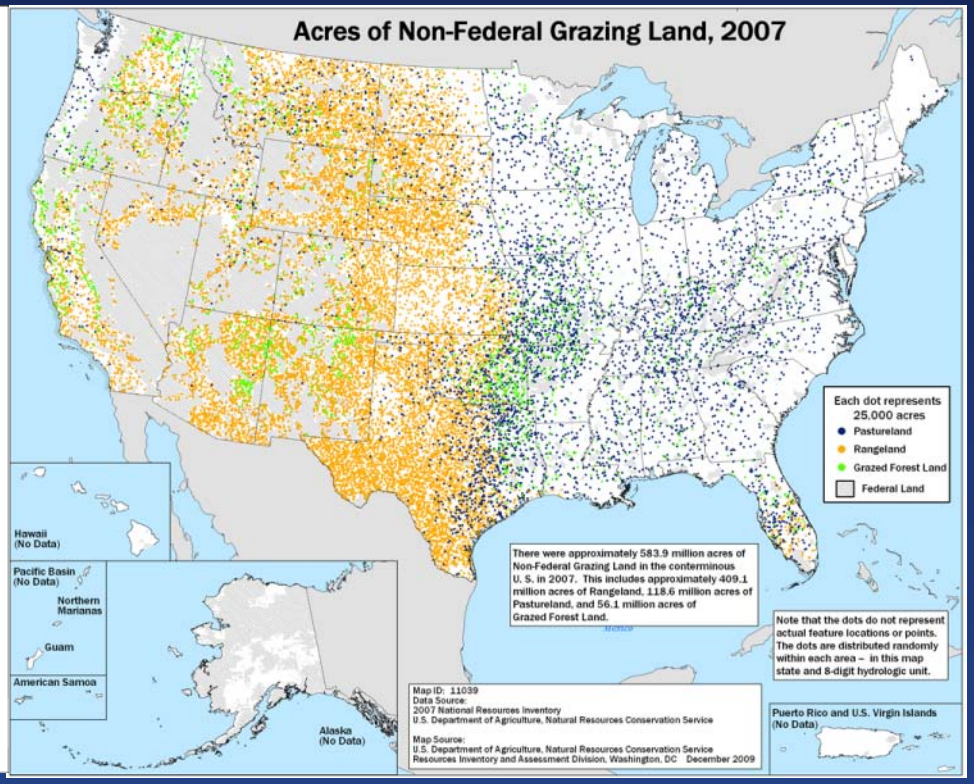
Rangeland Hydrologist

Exotic and Invasive Weeds Research Unit

Reno, Nevada

Extent of the Challenge:
Grazing Lands





NRCS National Resources Inventory estimates of the distribution and amount of non-federal grazing lands in the continental United States

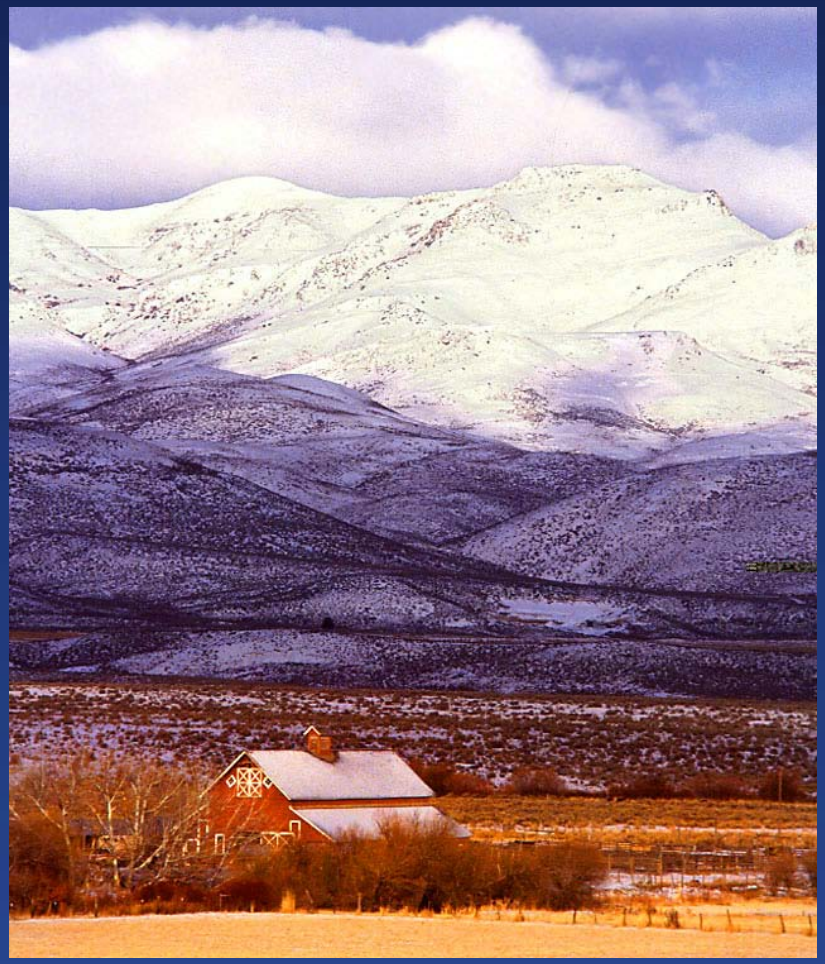
Natural Resources Conservation Service:

Practices Deployed (2004 – 2008)

Practice Name	Treatment area (ha)
Prescribed Grazing	13,815,150
Upland Wildlife habitat Management	6,980,243
Pest Management	2,474,783
Use Exclusion	912,322
Brush management	410,754
range Planting	260,274
Forage Harvest Management	213,292
Pasture and Hay Planting	131,974
prescribed Burning	34,660
Grazing Lnad Mechanical Treatment	17,191
Heavy Use Area Protection	6,174
Riparian Herbaceous Cover	3,721
Total	25,256,817

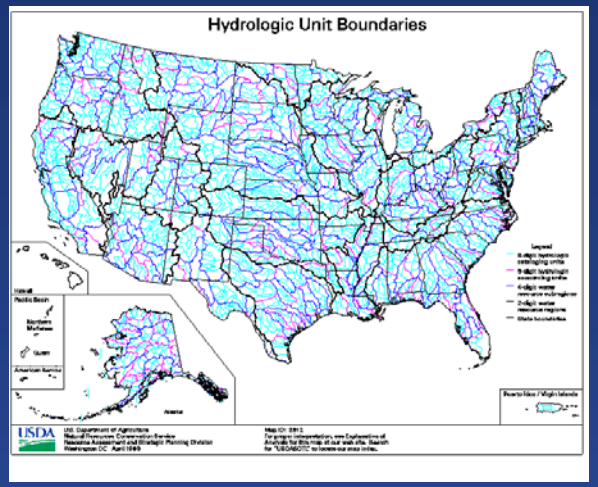
Categories of Management Practices

- Prescribed grazing
- Pest management
- Fire management
- Brush management
- Riparian management
- Range Seeding
- Upland Habitat Management



National Assessment of Environmental Benefits: Objectives

- Develop a database for national assessments
- Quantify environmental benefits at hillslope scale
- Assess uncertainties for achieving environmental benefits at hillslope scale
- Develop regionalized watershed models for national assessments
- Develop indicators or performance measures



Conservation Effects Assessment Project:

Framework for Multi-location Projects

Northwest Watershed Research Center, Boise, Idaho

Forage and Range Research Center, Logan, Utah

Pasture Systems & Watershed Management Center, University Park, Pennsylvania

Range and Meadow Forage Management Research, Burns, Oregon

The Jornada Experimental Range, Las Cruces, New Mexico

Central National Technology Support Center, Ft. Worth, Texas

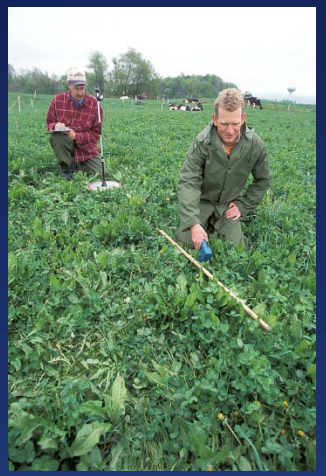
Exotic and Invasive Weeds Center, Reno, Nevada

Grassland Soil and Water Center, Temple, Texas

Southwest Watershed Research Center, Tucson, Arizona

Components of Grazing Land Assessment

National:



- Hillslope hydrology and water erosion
  Tucson, AZ; Boise, ID; Reno, NV
- Estimating rangeland net primary productivity
  Temple, TX; Reno, NV; Boise, ID
- Watershed modeling of conservation practice impacts
  Tucson, AZ; Reno, NV; Boise, ID; Temple, TX
- New sampling protocols for National Resources Inventory on rangelands and pasture lands
  University Park, PA and Las Cruces, NM
- Hillslope and landscape estimates of wind erosion
  Las Cruces, NM

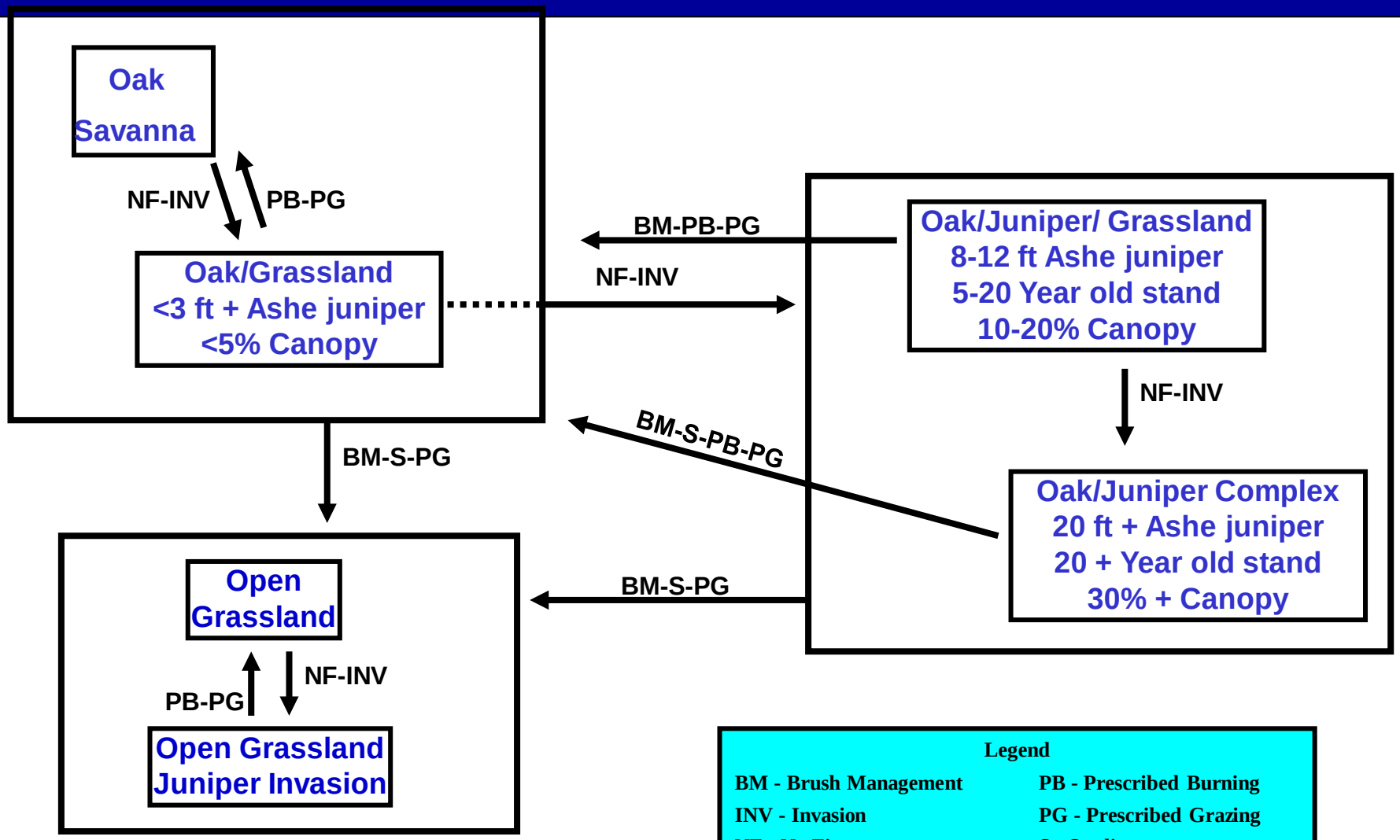
Components of Grazing Land Assessment

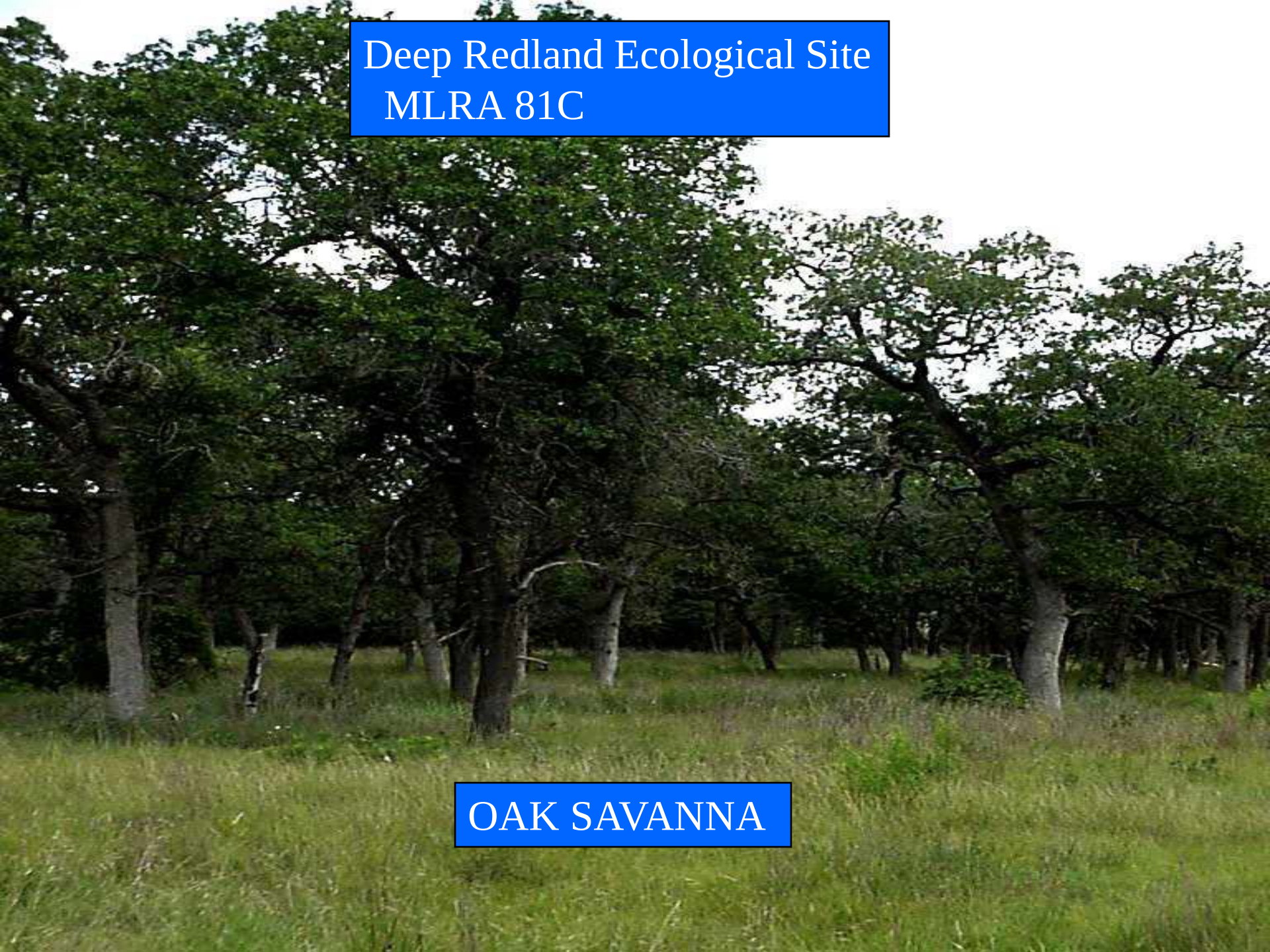
Great Basin Region:

- Reducing impacts of wildfire and revegetating disturbed rangelands
  Boise, ID, Burns, OR; Reno, NV; Logan, UT, and Tucson, AZ

- Ecologically Based Integrated Pest Management
  Burns, OR; Boise, ID; Logan, UT; Reno, NV

Ecological Site Development:
Deep Redland MLRA 81C



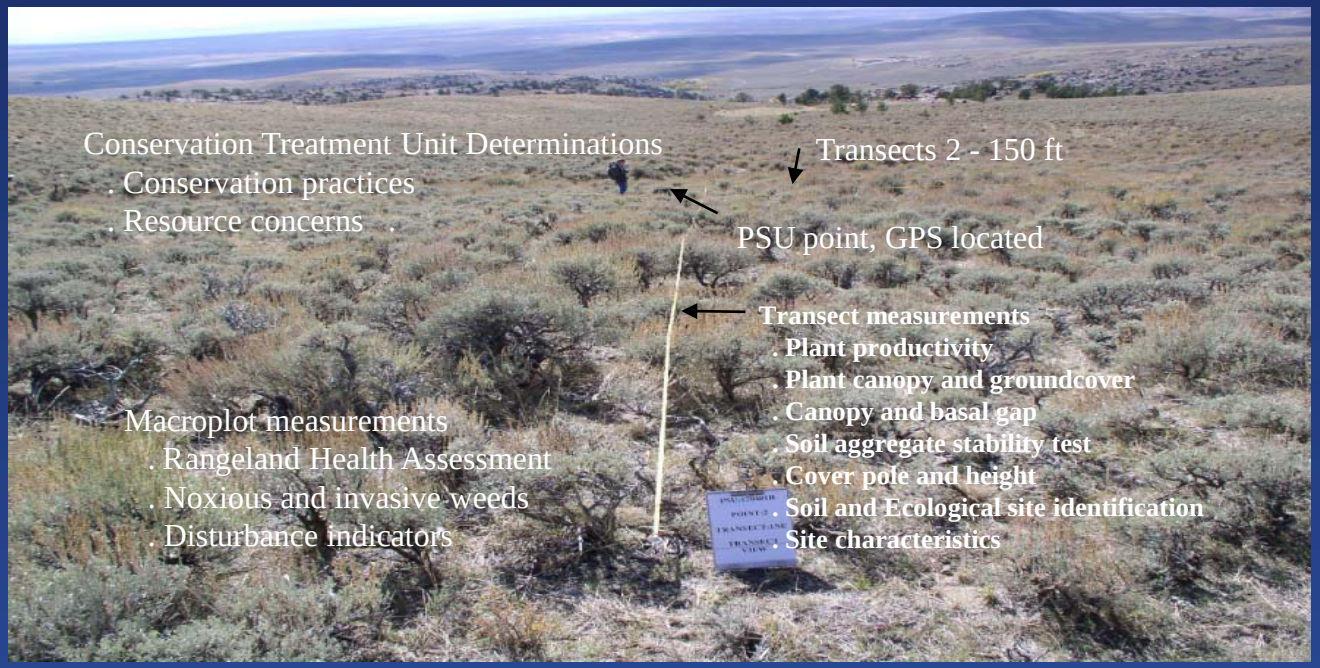

Deep Redland Ecological Site
MLRA 81C
OAK SAVANNA

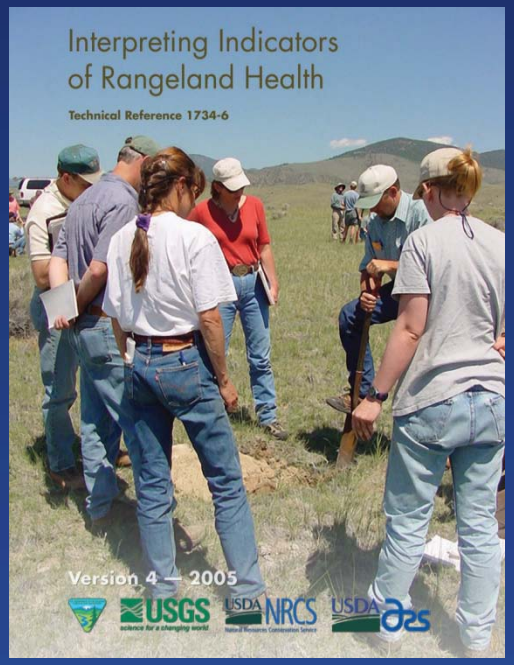
OAK / GRASSLAND

Monitoring and Sampling Protocols:

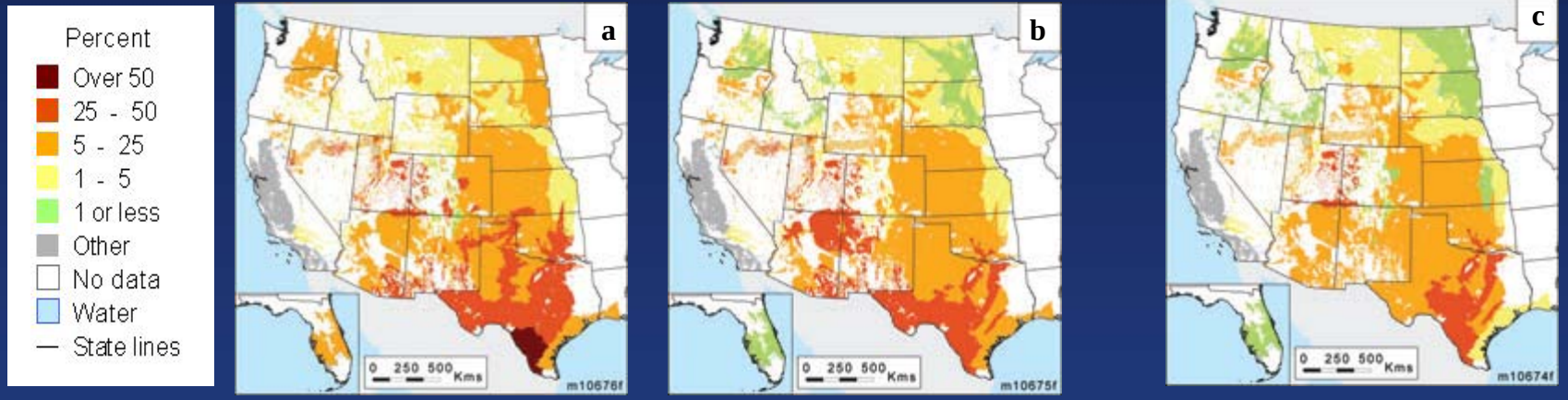
New sampling protocols for National Resources Inventory on rangelands and pasture lands

New Indicators of Rangeland Health adopted and implemented by NRCS, BLM, and USGS





National Assessments:
Rangeland Health



Results of land-degradation assessment relative to reference conditions (a–c) for non-federal rangelands in the US. Proportion of rangeland where (a) biotic integrity, (b) hydrologic function, and (c) soil and site stability were rated moderately degraded or worse, relative to the reference (Herrick, J.E., V. C. Lessard, K.E. Spaeth, P.L. Shaver, R. S. Dayton, D.A. Pyke, L.Jolley, and J.J. Goebel. 2010. National ecosystem assessments supported by scientific and local knowledge. Frontiers in Ecology and the Environment. doi:10.1890/100017).

Measuring Soil Erosion:
Hillslope and Watershed

Raindrop Splash

Concentrated Flow

Combined

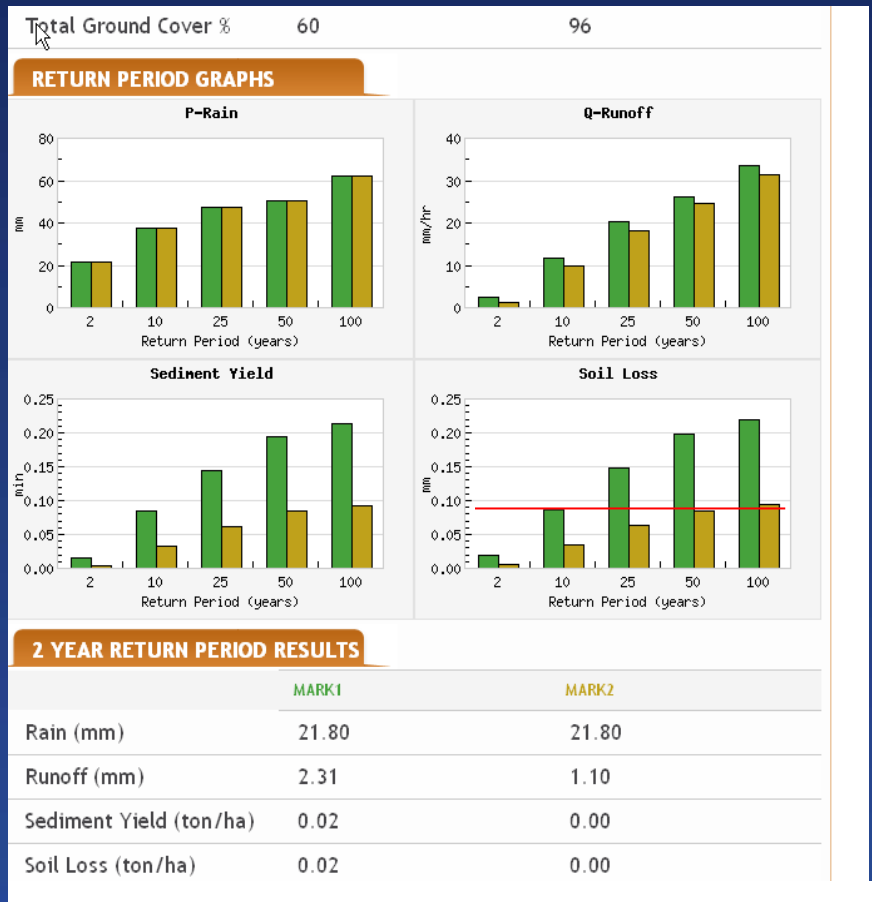
Watershed

Rangeland Hydrology and Erosion Model

RHEM is designed to:

- Estimates runoff, erosion, and sediment delivery rates and volumes at
  - the spatial scale of the hillslope
  - the temporal scale of a single rainfall event
  - use input from National Res. Inventory

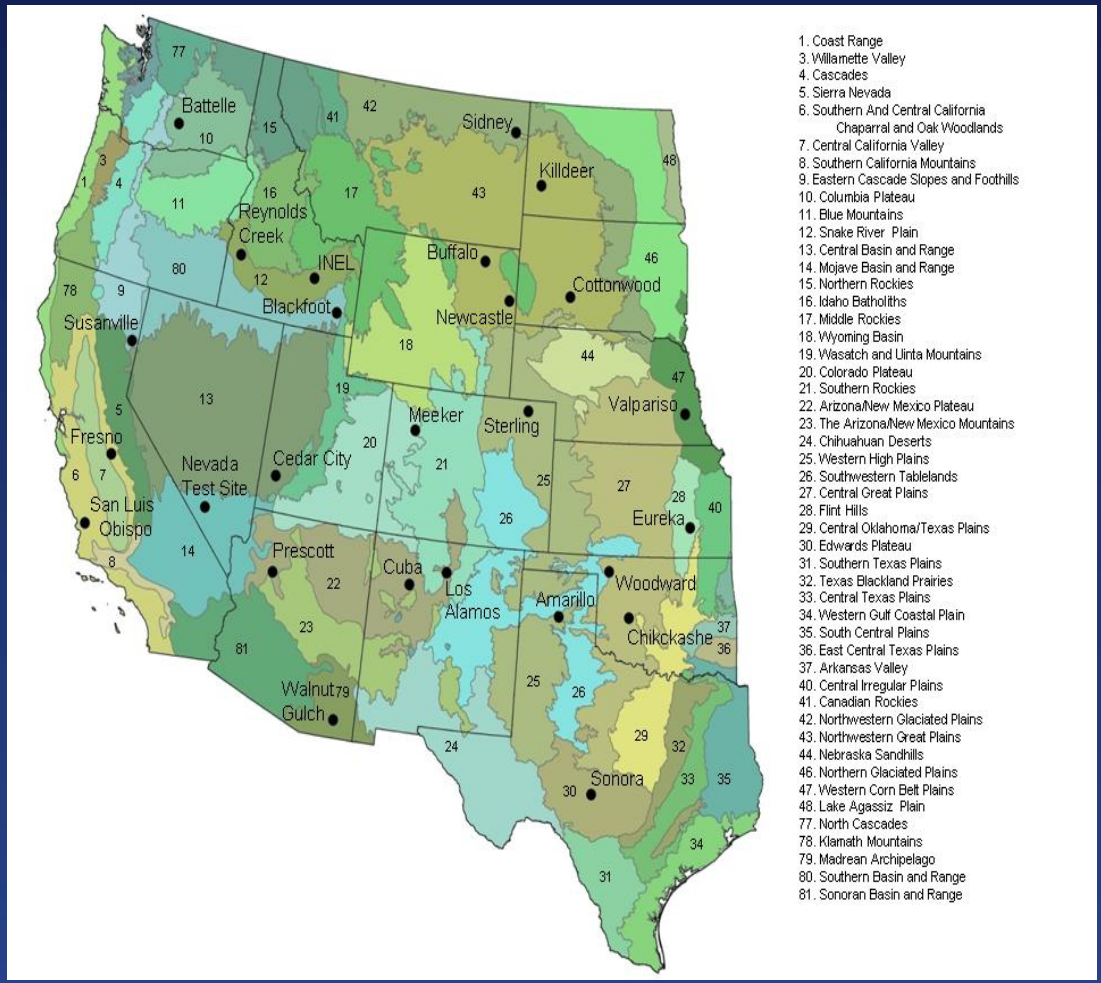
Risk Assessment Framework



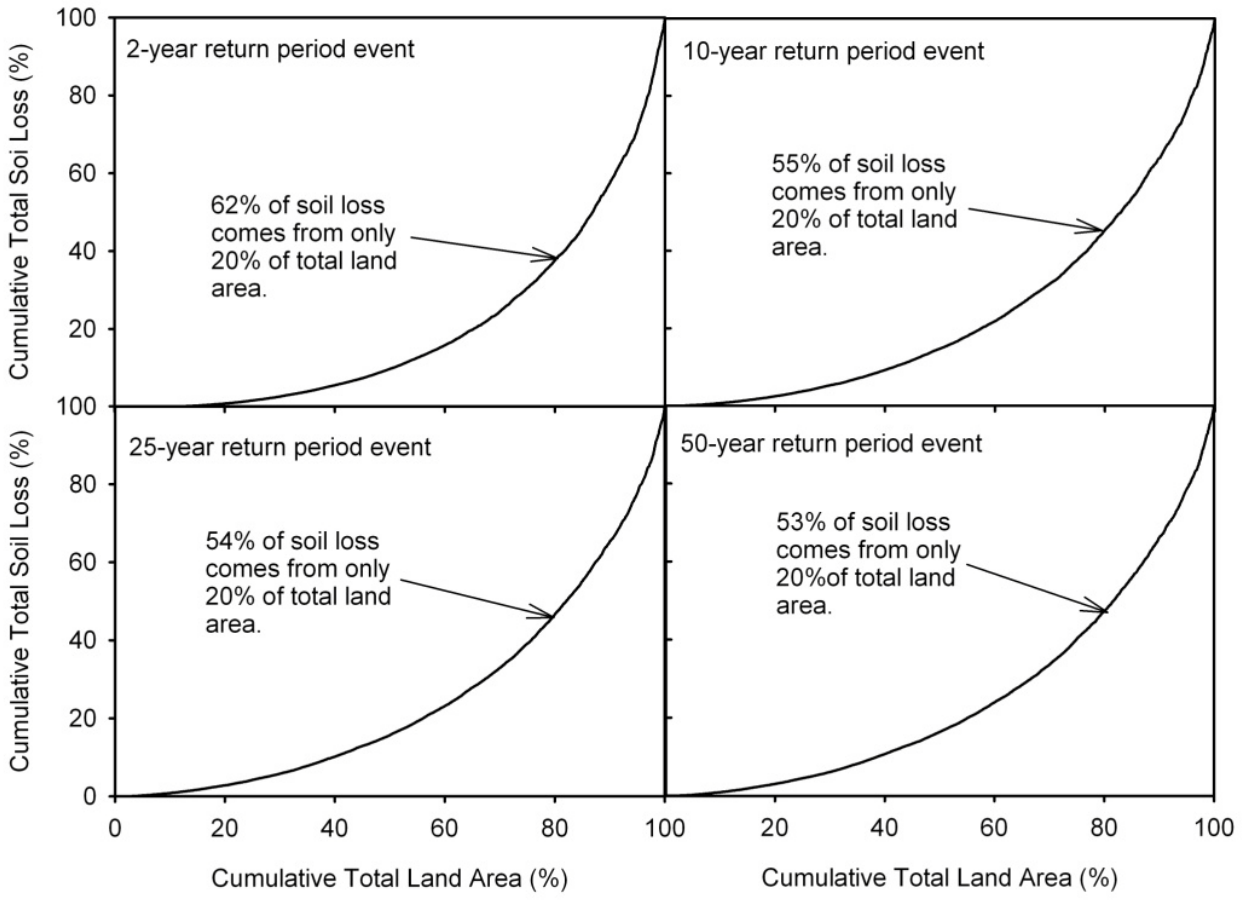
Validation

Rangeland soil erosion study sites used to develop and validate the Rangeland Hydrology and Erosion Models (displayed over Omernik level III ecoregions).

Field data collection is ongoing through ARS, NRCS, and University partnerships to fill in gaps in the western U.S.



National Assessment of Soil Loss on Rangelands



National estimates of cumulative soil loss by percent area for 4 runoff events: 2 year, 10 year, 25 year, and 50 year return period.

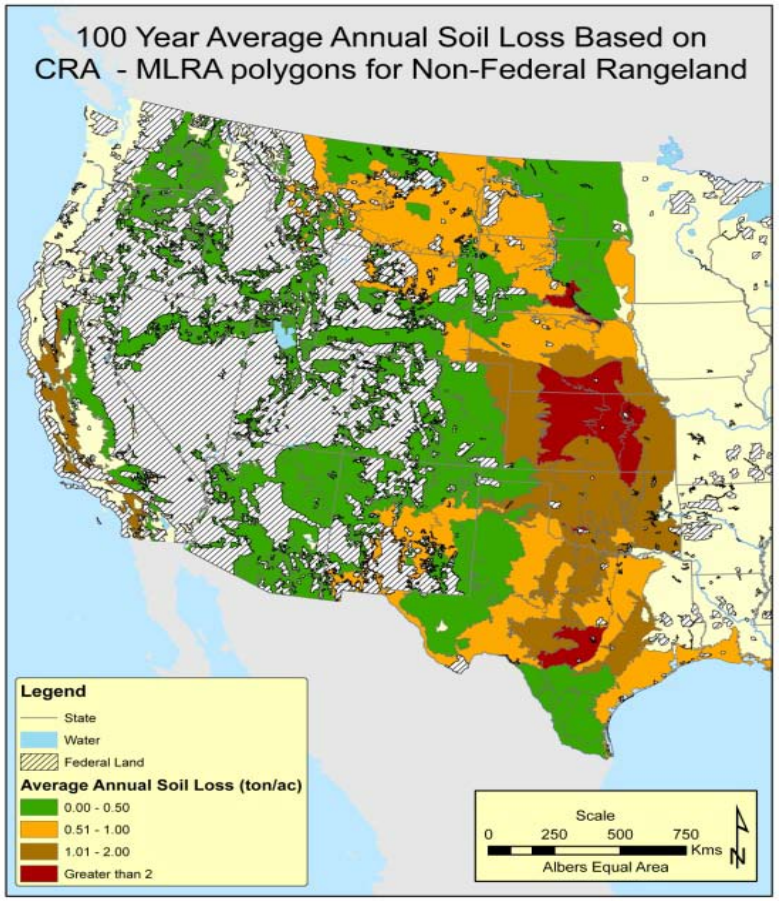
National Assessment of Soil Loss on Rangelands

On non-federal rangelands soil loss (tons/acre) is not uniformly distributed across the landscape. Twenty per cent of the landscape contribute over 55% of total soil loss.

Region	Soil loss from 20% of the region	Soil loss (0 and 0.99)	Soil loss (1 and 1.99)	Soil loss (>2)
National	65%	82%	10%	8%
California	66%	66%	10%	24%
Kansas	61%	52%	20%	28%
North Dakota	58%	71%	14%	15%
Nebraska	56%	61%	20%	19%
New Mexico	59%	95%	3%	2%
Nevada	76%	100%	0%	0%
Oklahoma	80%	66%	17%	17%
South Dakota	71%	77%	9%	8%
Texas	65%	78%	13%	10%
Utah	65%	98%	2%	0%

National Assessment of Soil Loss on Rangelands

- Central Plains region from Texas to South Dakota has highest potential soil loss.
- California soil loss risk is likely underestimated because of high probability of landslides due to inherent instability in the geologic formations along the coast.

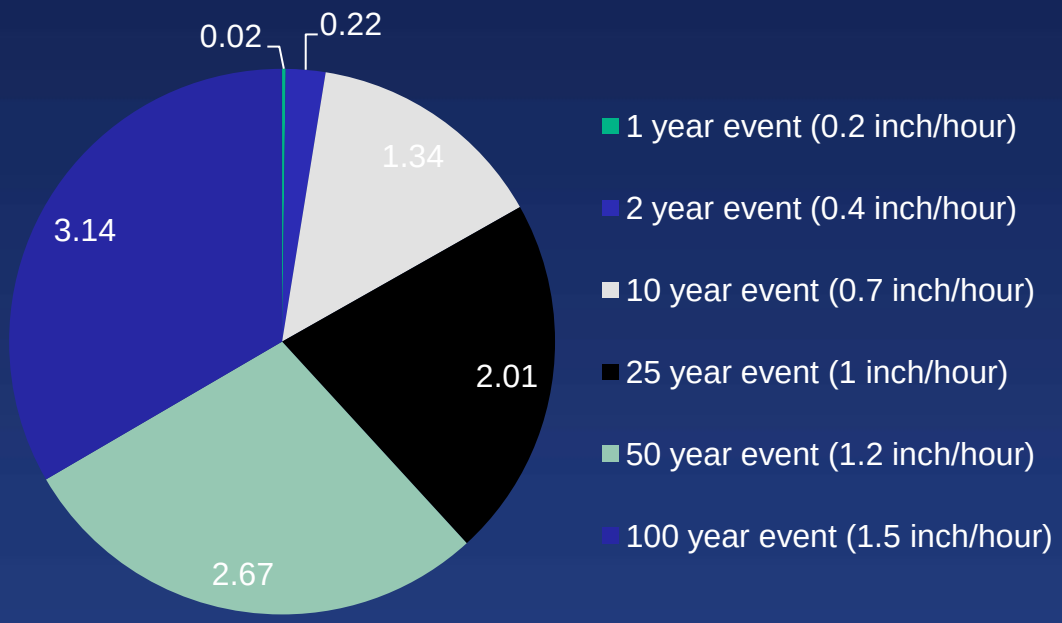


National Assessment of Soil Loss on Rangelands

Estimated percent soil loss (tons/acre) for Utah by erosion class on non-federal rangelands for average annual, 2 year, 10 year, 25 year, and 50 year return periods

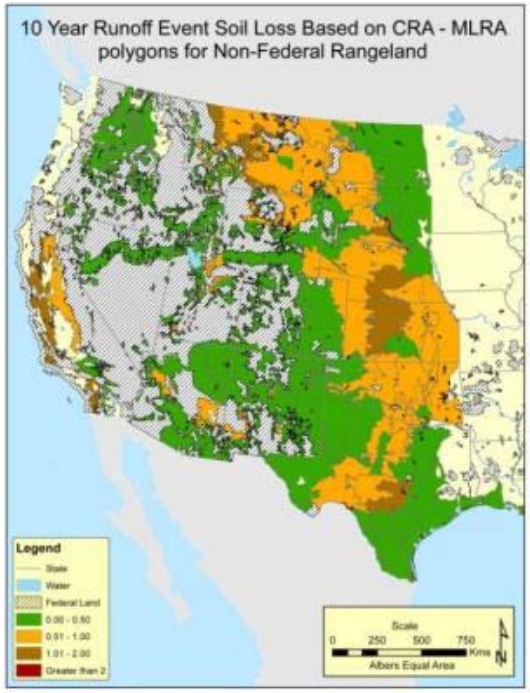
Runoff event	Soil loss (0 – 0.99)	Soil loss (1 – 1.99)	Acres	Soil loss (> 2)	Acres
Average annual	98%	2%	21,300	0%	0%
2 year return event	100%	0%	0%	0%	0%
10 year return event	99%	1%	10,600	0%	0%
25 year return event	86%	11%	117,300	3%	32,000
50 year return event	80%	12%	127,900	8%	85,300

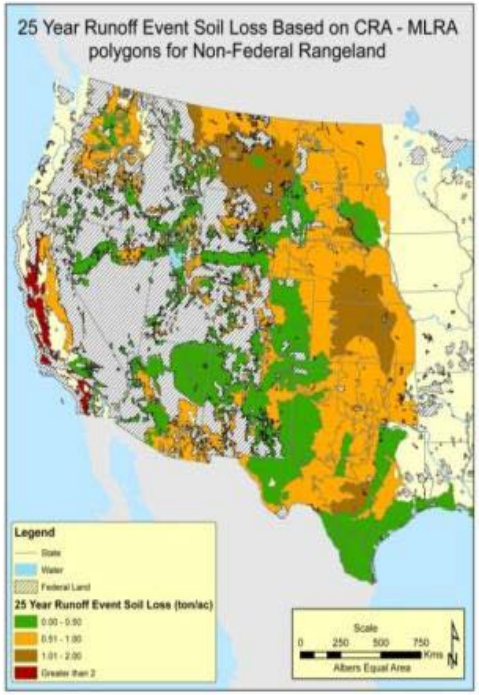
National Assessment of Soil Loss on Rangelands

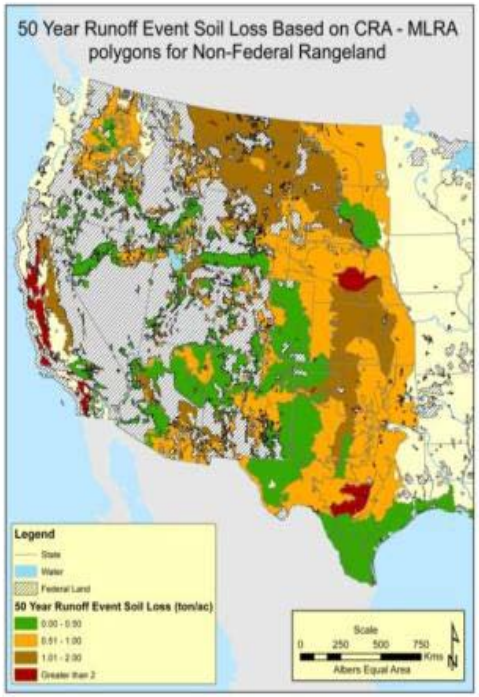


Relationship of soil loss to precipitation events for sagebrush site on a loamy soil near Elko Nevada illustrating how a once in a 100 year return runoff event can generate over 150 times more soil loss (ton ha^{-1}) then the 1year return runoff event.

National Assessment of Soil Loss on Rangelands







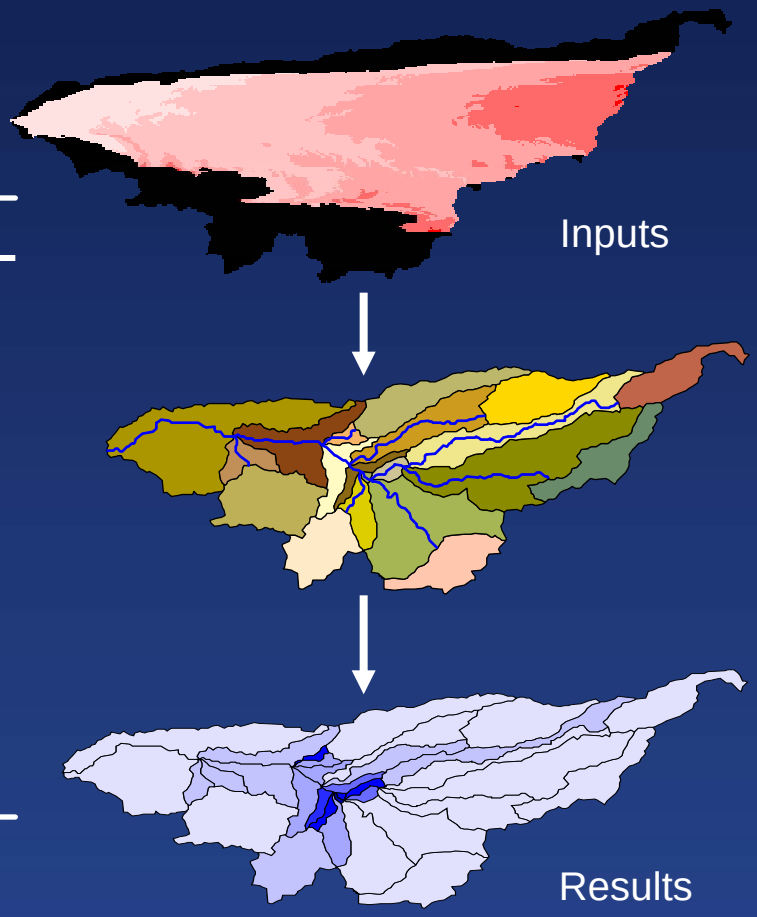
- The RHEM decision support system can identify where vulnerability to accelerated soil loss (> 2 tons/acre/rainfall event) changes with risk of rainfall event to assist in cost-effective targeting of conservation practice deployment.

Watershed Assessment:

Conceptual Design

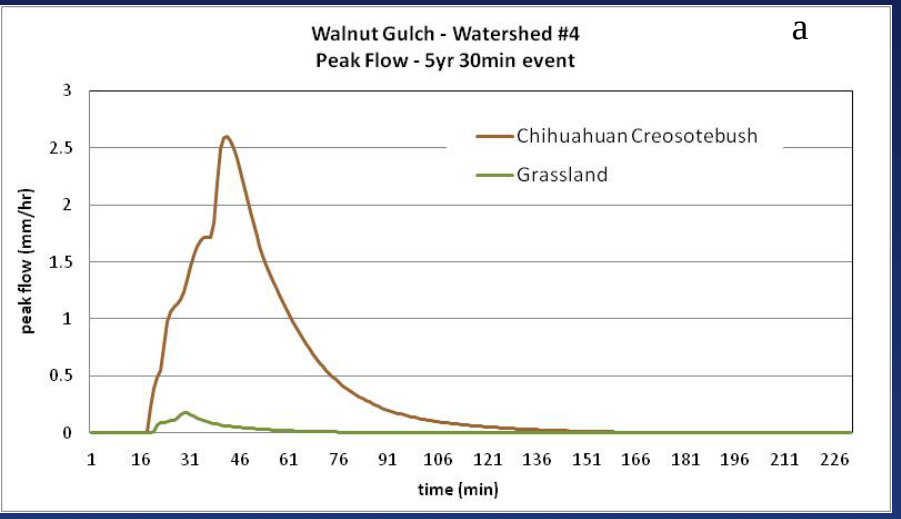
Output results that can be displayed in AGWA

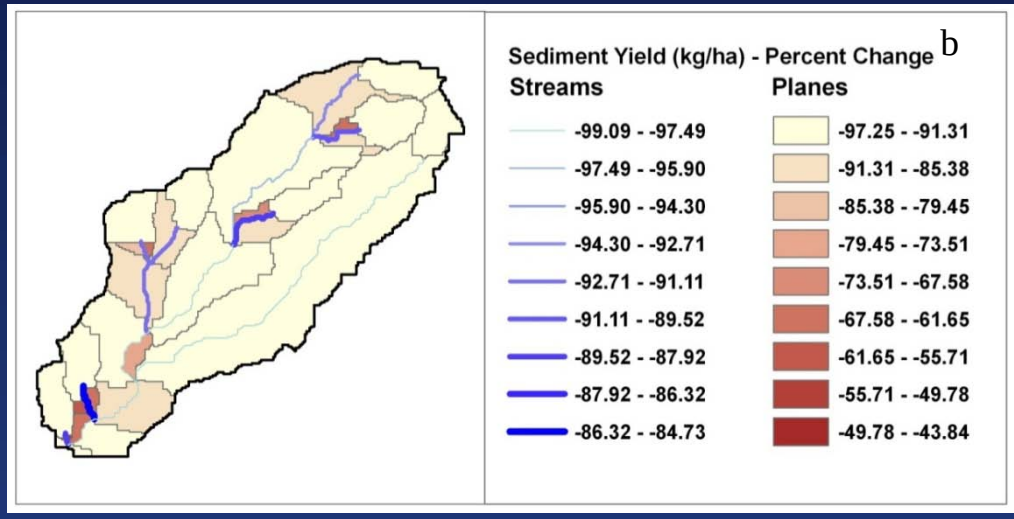
KINEROS Outputs	*SWAT Outputs*
Channel Infiltration (m^3/km)	Precipitation (mm)
Plane Infiltration (mm)	ET (mm)
Runoff (mm or m^3)	Percolation (mm)
Sediment yield (kg)	Channel Discharge (m^3/day)
Peak flow (m^3/s or mm/hr)	Transmission loss (mm)
Channel Scour (mm)	Water yield (mm)
Sediment discharge (kg/s)	Sediment yield (t/ha)
	Nitrogen (kg)
	Phosphorus (kg)



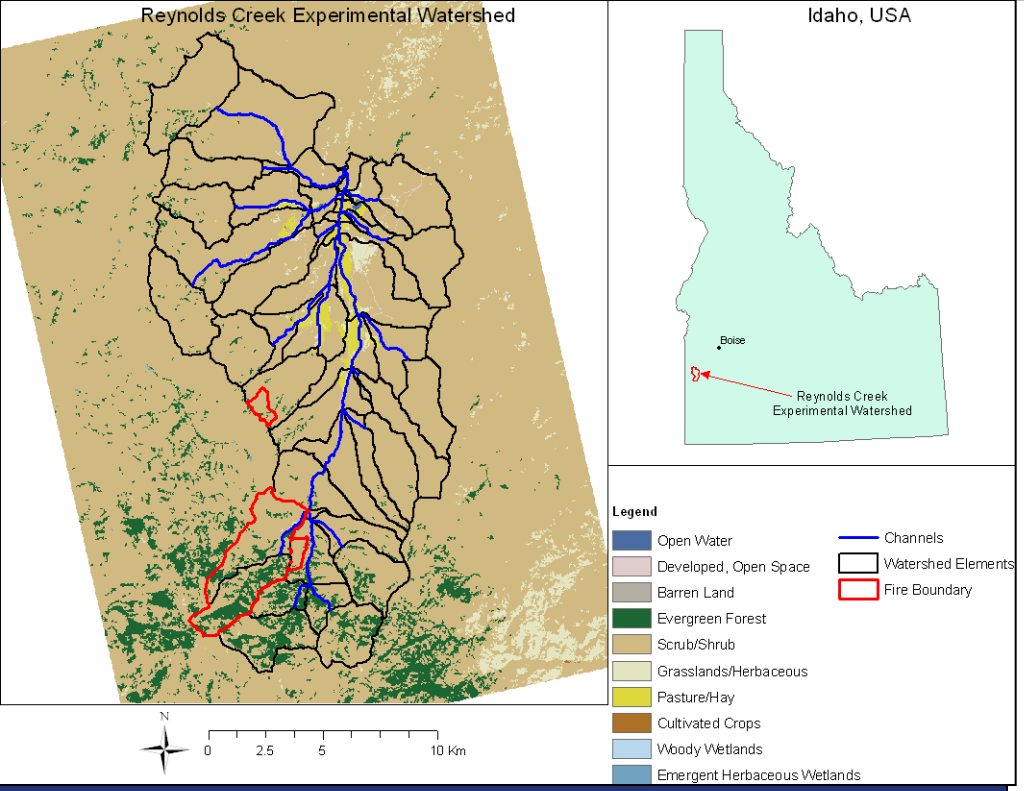
Watershed Assessment:

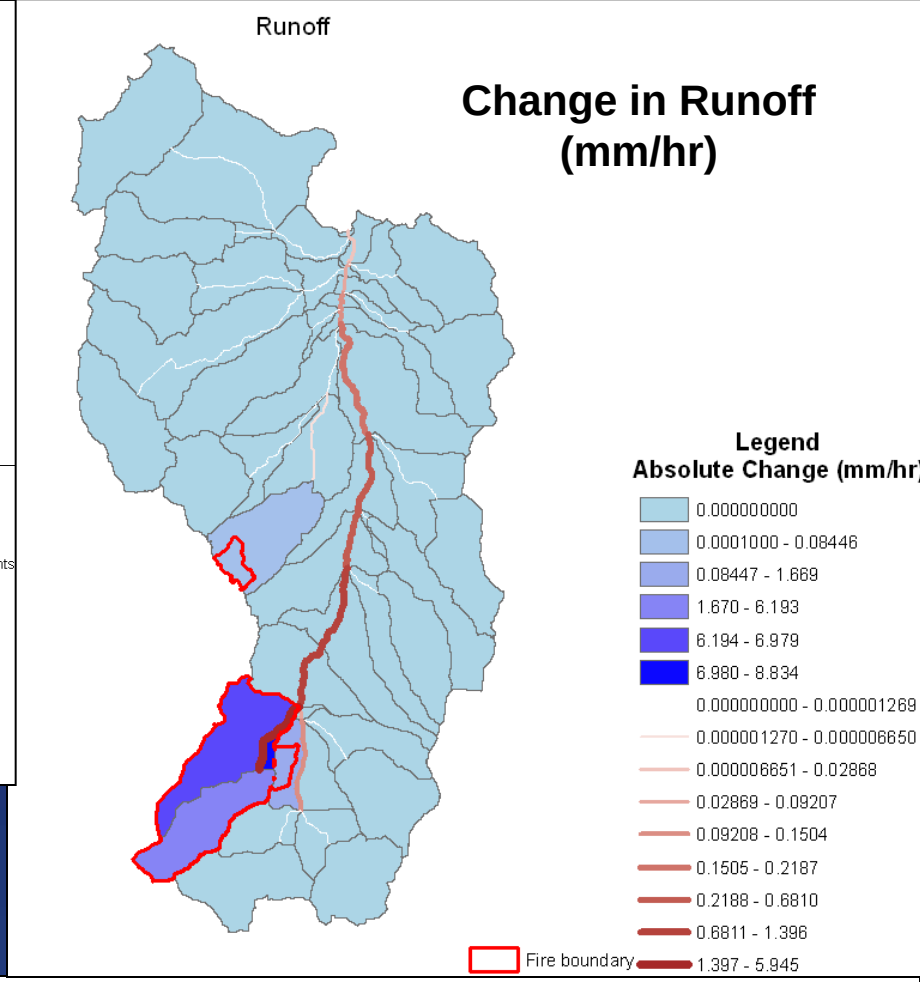
Initial Assessment





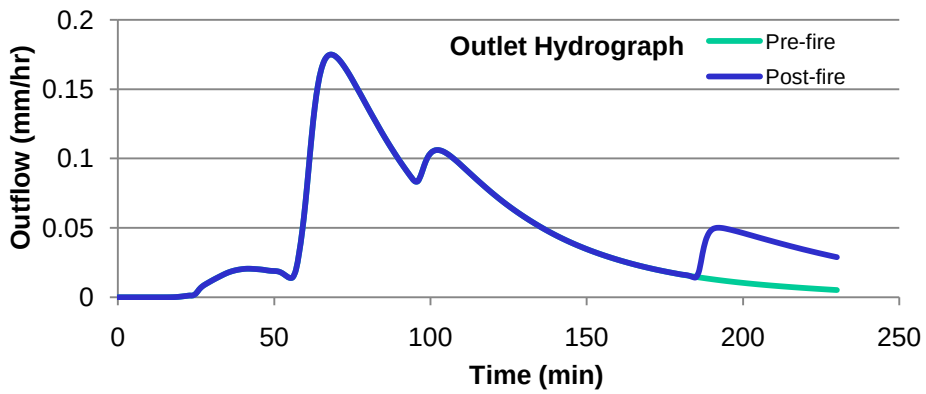
Walnut Gulch Experimental Watershed subbasin 4 illustrating the percent change in peak flow rate (a) (mm hr^{-1}) and in sediment yield (b) (kg/ha) derived from implementing a brush management practice to remove creosotebush and companion reseeding conservation practice aimed at restoring the native desert grassland community.





Fire

- 6.7% of watershed burned, including
- On burned areas:
  - Intercepting cover reduced to 5%
  - Manning's N reduced to 0.011
  - Saturated hydraulic conductivity reduced to 2mm/hr
- At outlet:
  - 13.03% increase in runoff;
  - 6.55% increase in sediment yield; and
  - 0% change in peak sediment discharge.

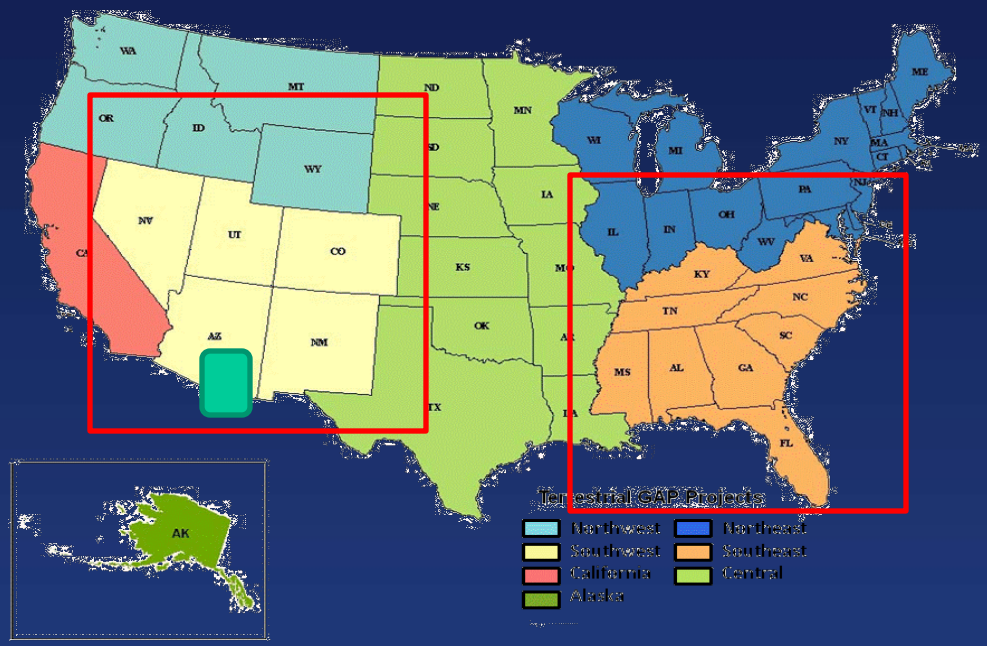


Metrics to Measure Wildlife Biodiversity

Category
Recreational Hunting
Wildlife –cultural, spiritual, intrinsic
Biodiversity for its intrinsic value, ecosystem resilience
Species Composition Intactness
Rarity/scarcity of ecological systems

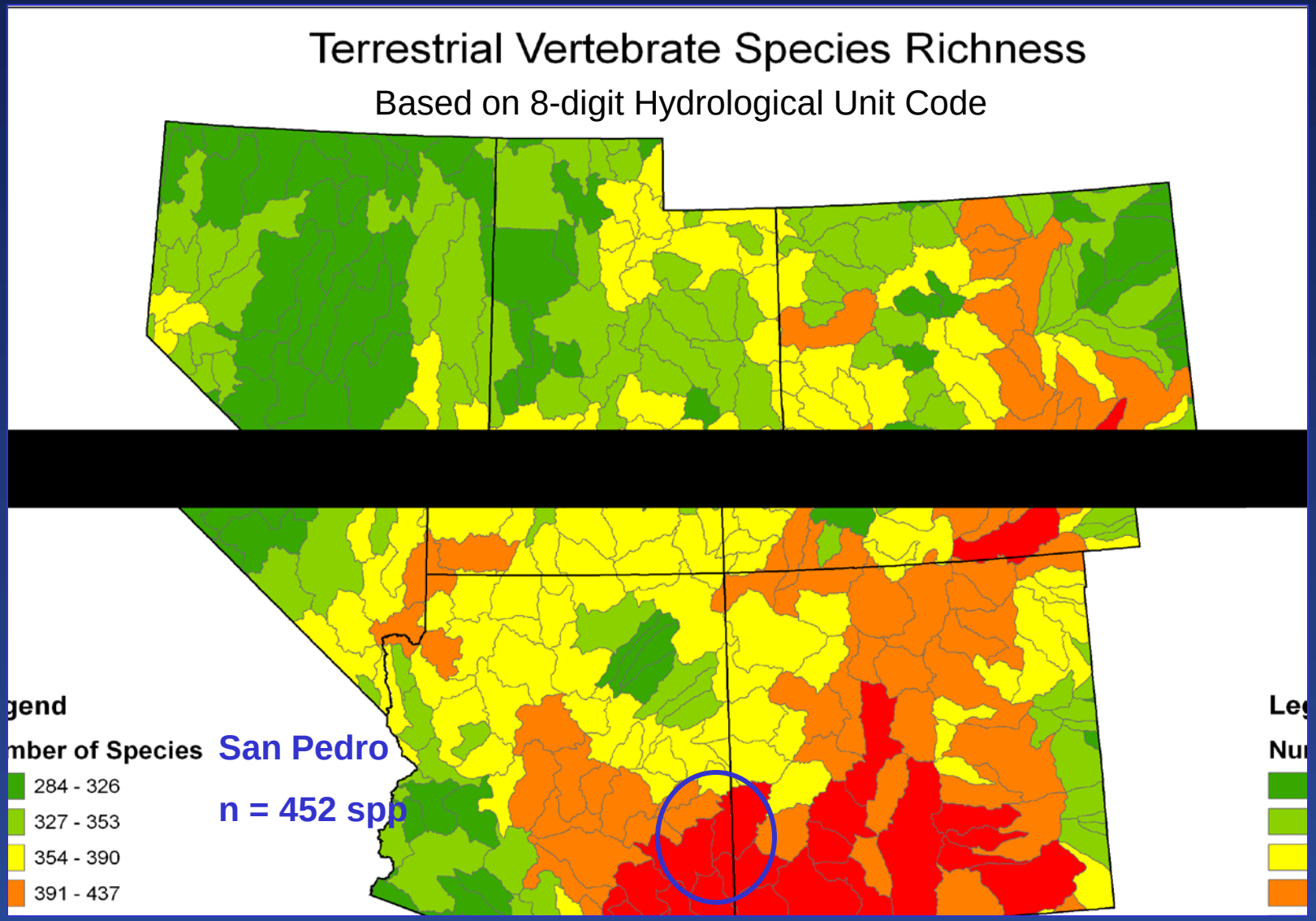
Terrestrial Vertebrates	Species of Greatest Conservation Need	Harvestable Species	Ecological Systems
All Species	All Species	All Harvestable	Richness
Amphibians	Amphibians	Big Game	
Birds	Birds	Upland Game	
Mammals	Mammals	Furbearers	
Reptiles	Reptiles	Waterfowl	
Bats			
T & E Species			

Species Richness by Scale

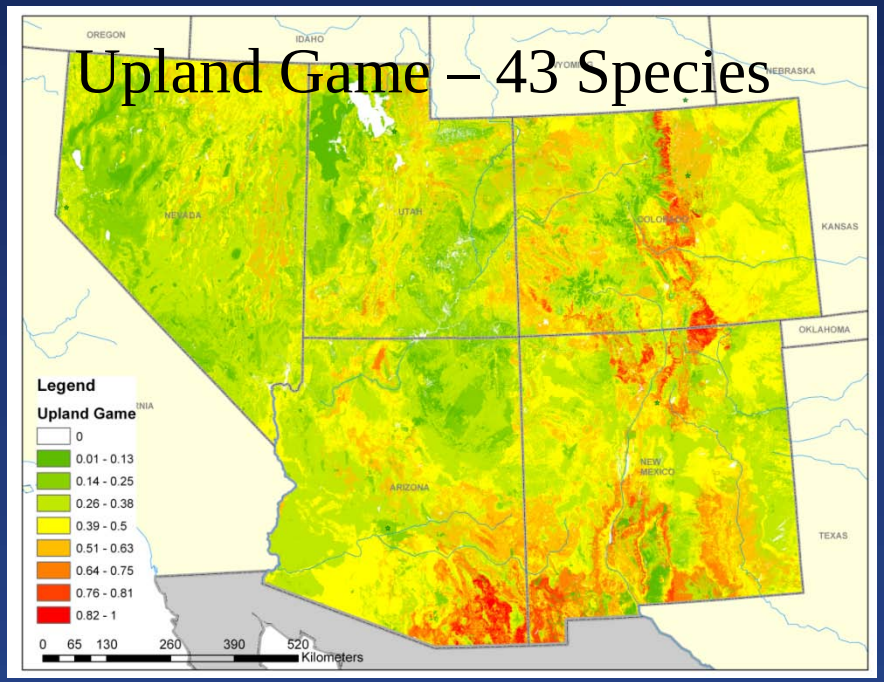


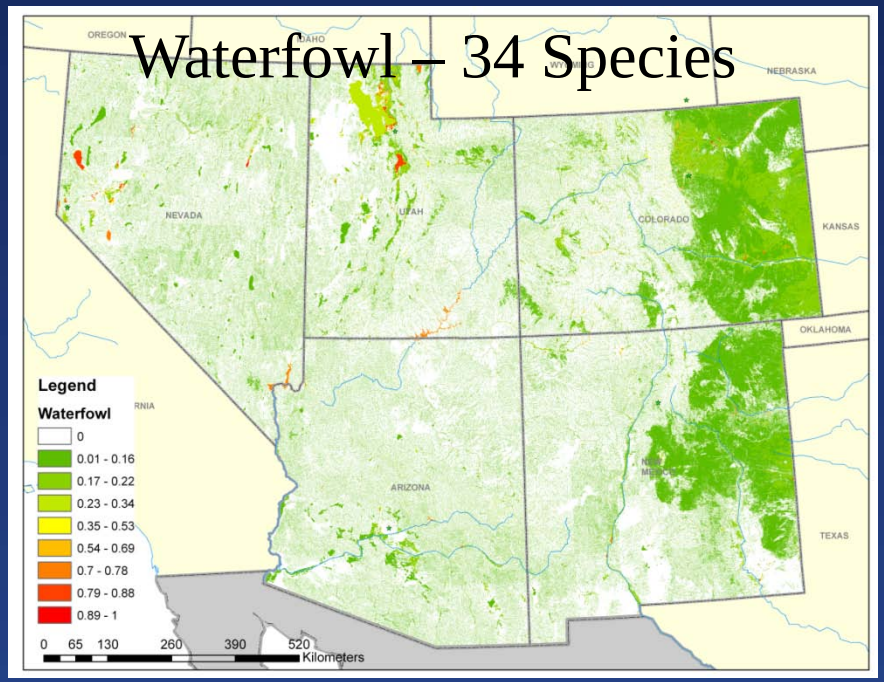
Taxon	San Pedro	Southwest	Southeast	Nation
Amphibians	16	37	124	?
Birds	287	435	259	?
Mammals	88	215	99	?
Reptiles	61	130	124	?
Total Species	452	817	606	?

Southwest Terrestrial Vertebrate Richness



Potential Means of Reporting by Species Groupings





United States Department of Agriculture
Natural Resources Conservation Service

USDA NRCS

Conservation Effects Assessment Project for Grazing Lands

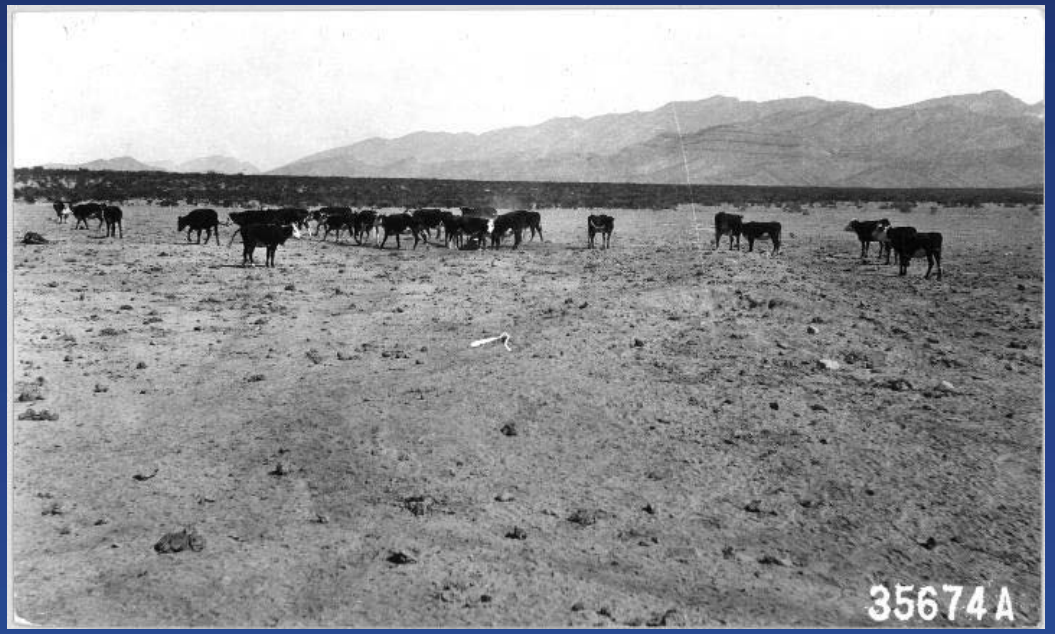
Impacts of ARS research since March 2006

Leonard Jolley, Ph.D.

Rangeland and Pastureland Ecologist

Resource Inventory and Assessment Division

Beltsville, MD



- Makes use of NRI data collected on rangeland,, to populate erosion models. New pastureland NRI data has similar potential
- CEAP GL is augmenting funding at several USDA ARS labs accelerating efforts to develop Rangeland Hydrology Erosion Model
- Objectives…
- Measuring the Environmental Benefits of Conservation
- Managing the Agricultural Landscape for Environmental Quality

New soil erosion models to be deployed by NRCS at Field Offices:

- Rangeland Hydrology and Erosion Models (RHEM)
- Wind Erosion Model (WEMO)

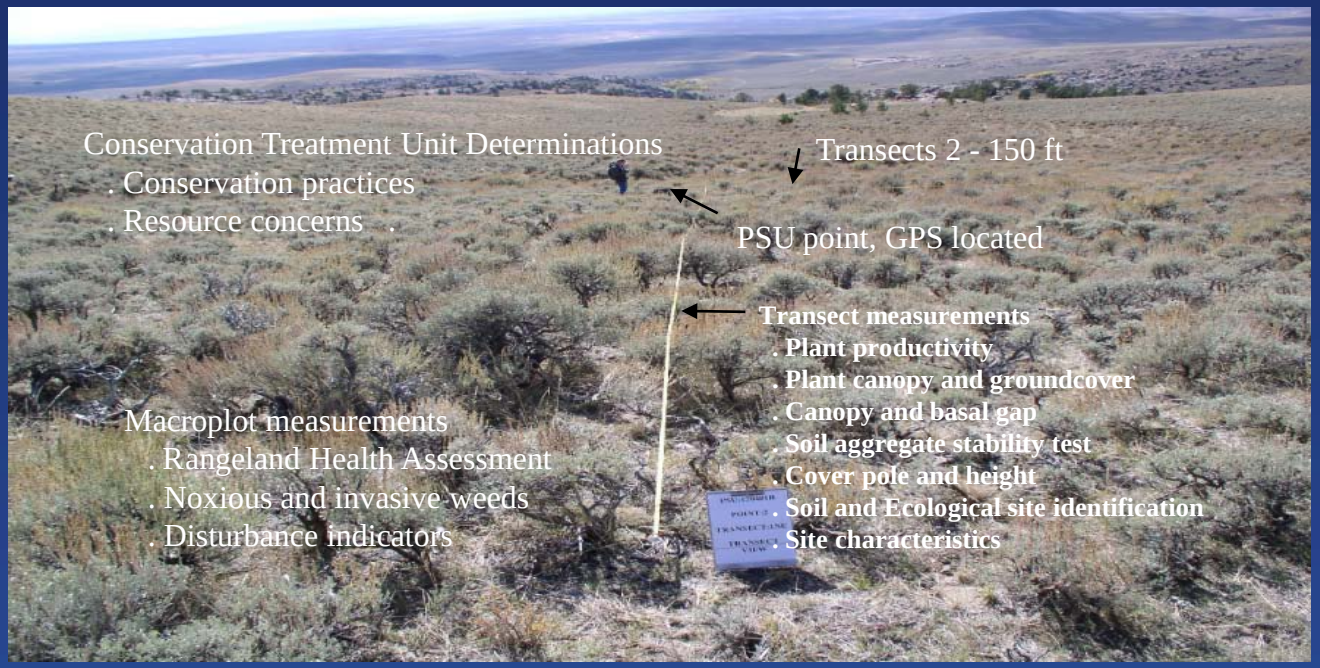
New Watershed Assessment Tools for National Assessments:

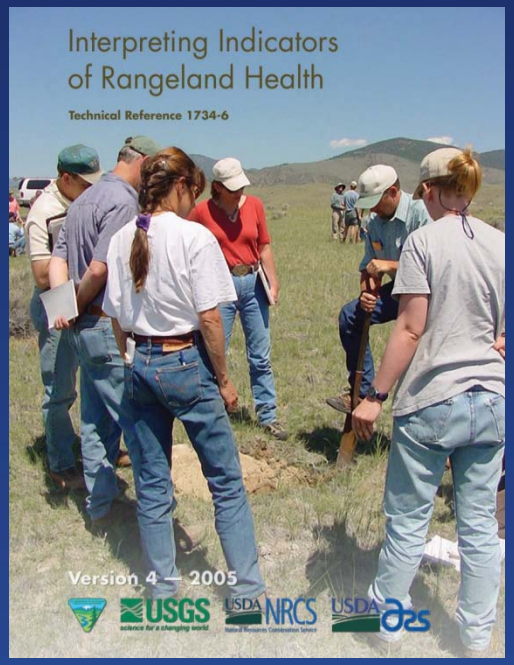
- Automated Geospatial Watershed Assessment Tool (AGWA) adopted by NRCS, EPA, & NPS

Conservation Practices Standards proposed for amendment by NRCS and US Forest Service for woodland management (Pinyon-Juniper treatments)

New sampling protocols for National Resources Inventory on rangelands and pasture lands

New Indicators of Rangeland Health adopted and implemented by NRCS, BLM, and USGS





NRCS National Plant Material Centers using ARS protocols to collect and assess new rangeland plant materials to facilitate use of the ALMANAC model in demonstrating how NRCS plant materials can be used at various sites for forage, reducing wildfire loads, enhancing wildlife habitat, and controlling soil erosion.

Four varieties of grass with Susan Winslow: Bridger, MT

Three grasses and two woody species with Derek Tilley: Aberdeen, ID

Three grasses and a woody species with Annie Young-Matthews: Lockeford, CA

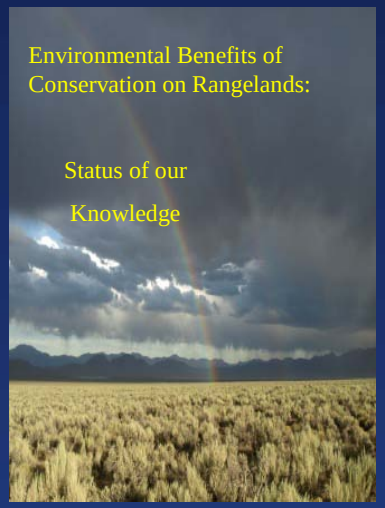
Two grasses, a vetch, and two woody species with Heather Plumb: Meeker, CO

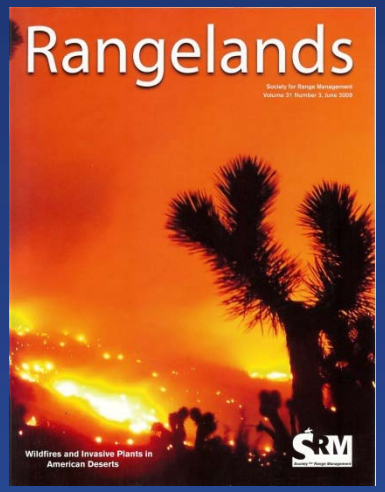
New synthesis book of literature on conservation practices for rangelands (Society for Range Management)

New synthesis book of literature on conservation practices for pasture lands (American Forage and Grassland Council)

Comprehensive literature reviews on grazing land conservation practices (ARS-NAL)

Publish scientific findings in peer reviewed Journals (> 25 peer reviewed publications by team)



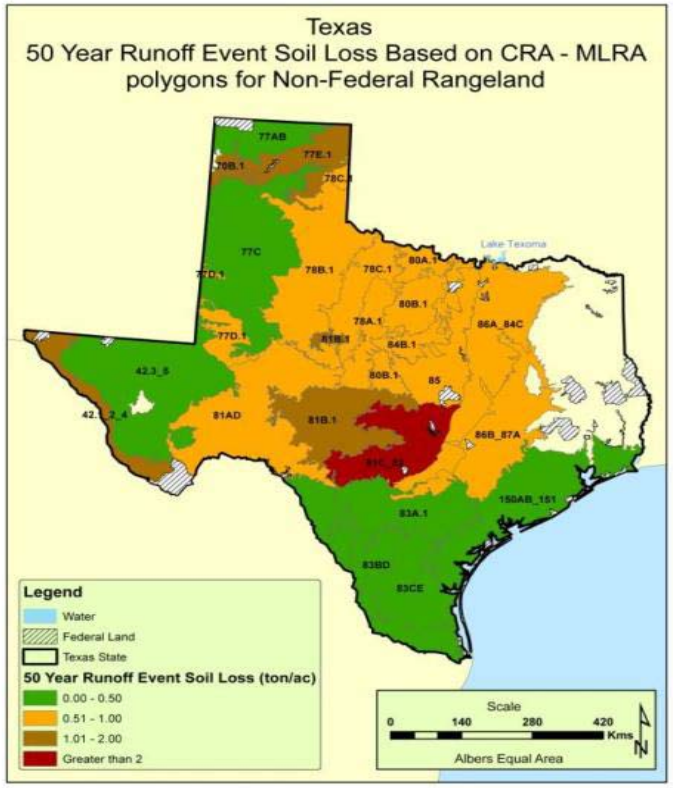


ARS and NRCS installed 3 new SCAN automated weather stations (Oregon, Nevada, and California) above the 10 we currently use on ARS watersheds across the nation.

These climate stations are part of the NRCS national climate network and provide critical information for water availability, irrigation scheduling, drought assessment, and environmental services derived from deploying conservation practices in the Great Basin and across the nation.

National Assessment of Soil Loss on Rangelands: USDA Resource Conservation Assessment

Working with professional societies to develop specialty sessions & conferences (SWCS, SSSA, SRM, AFGC, GLCI, etc.) to document science-based assessment technology and public awareness of new technology being deployed (5 held so far and 2 planned)



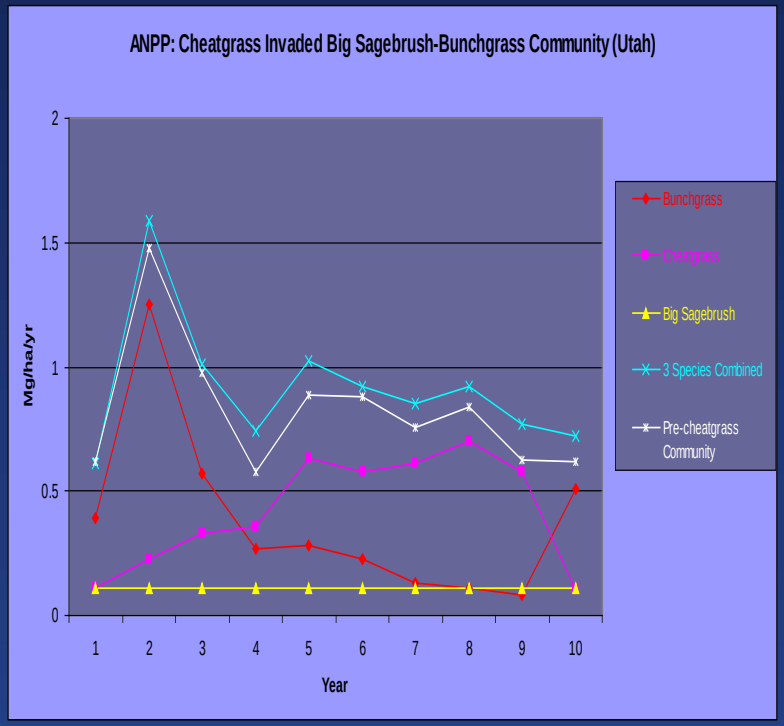
Enhancements to the RHEM model to estimate concentrated flow (rill) soil erosion.

Expand plant communities (Ecological states) represented in RHEM

Develop techniques to quantify benefit of individual practices (i.e., prescribed grazing).

Collaborate with NRCS national range staff, Texas A&M, and the Society for Range Management to improve the simulation of **Plant Functional Groups** within ALMANAC for National/regional assessment efforts.

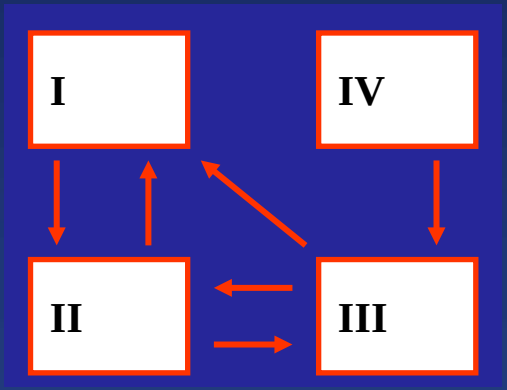
Collaborate with ARS researchers and NRCS Plant Materials Centers in the western states to improve the ability of ALMANAC to simulate the most relevant plant species to estimate forage availability, resistance to drought, revegation success following wildfire, response to brush control treatments, etc.



Incorporate NRCS Ecological Sites with state and transition models to quantify spatially distributed ecosystem services within a watershed

Expand conservation practices in AGWA:

Rangeland seeding, Brush management, Prescribed grazing (fencing / water development), Invasive species control, Wildlife habitat enhancements, Manure management



State and Transition Model

Develop technology to assess impact of individual conservation practices and cumulative effects of multiple practices.

Develop technology to optimize selection of conservation practice and placement(s) to achieve target goals for the ranch and the watershed

Develop a rangeland land cover database so regional and national estimates of environmental benefits can be estimated

Develop rangeland conservation practice database so local, regional, and national estimates of environmental benefits can be estimated with NRCS, BLM, and USGS historical data.

Develop techniques to estimate unmeet conservation needs to reach targeted goals for watersheds