Hydrologic and Erosional Impacts of Pinyon and Juniper Encroachment Into Sagebrush Steppe Communities of the Great Basin, USA

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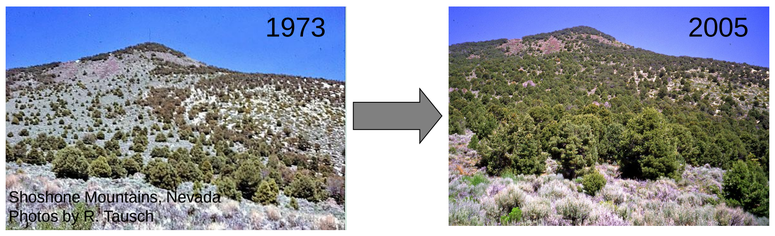
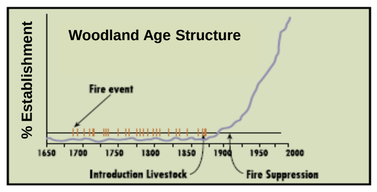
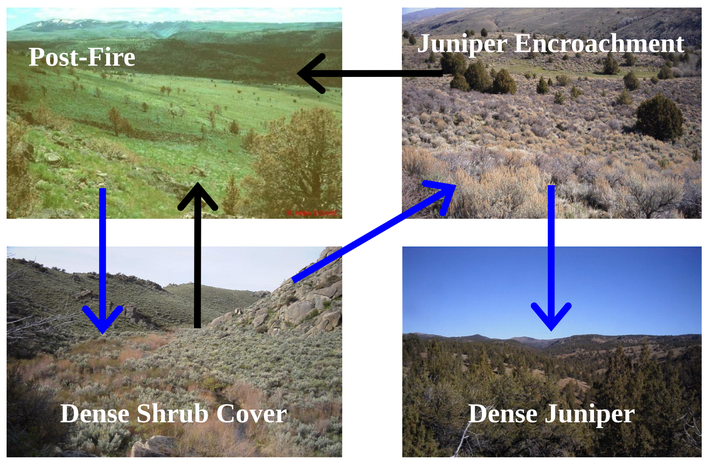
JUNIPER ENCROACHMENT INTO SAGEBRUSH STEPPE:

- Pinyon and juniper woodlands have expanded 10-fold in the last 130 years and now occupy 30 million hectares of the western United States.
- Warmer and wetter climate conditions, reduction in fine fuels associated with cattle grazing and fire suppression, and elevated CO_2 levels have favored establishment and expansion of woodland communities.





Chewaucan River Basin, Fremont National Forest, Oregon, USA (Graph modified from Miller et al., 2005)



State and Transition Models: Fire Cycle - Juniper

THE CONVERSION OF SAGEBRUSH STEPPE TO PINYON AND JUNIPER WOODLANDS HAS BEEN LINKED TO:

- Reduced fuels and role of fire.
- Reduced shrub/herbaceous cover and species diversity.
- Increased overland flow and erosion.
- Reduced wildlife abundance and diversity.
- Decreased pre-invasion species seed pools.

SAGEBRUSH STEPPE TREATMENT EVALUATION PROJECT (SAGESTEP – *www.sagestep.org*):

- SageSTEP, implemented in 2005, is a 5-year interdisciplinary research study evaluating restoration methodologies for sagebrush rangelands degraded by woodland and grassland encroachment.
- Study includes 6 governmental agencies and 5 major universities working in 18 study sites across a 6-state area of the Great Basin Region, USA.
- Researchers are investigating the impacts of woodland and grassland encroachment on vegetation and fuels, soils, hydrology, wildlife, entomology, economics, and sociopolitical disciplines.

- The project will evaluate prescribe fire, mechanical thinning, and herbicide treatments on sagebrush steppe invaded by exotic grasses and woodland conifers.

- Monitoring data will determine impacts of treatments relative to study disciplines.

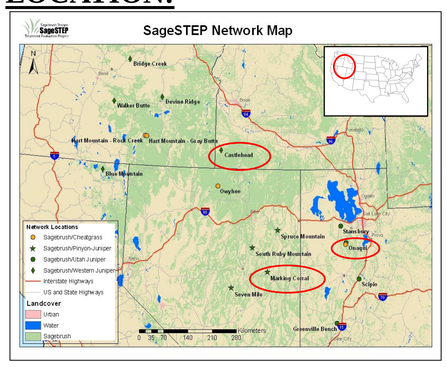
SAGESTEP HYDROLOGY RESEARCH QUESTIONS:

- Do critical thresholds exist in vegetation and ground cover that significantly influence runoff and erosion in woodland communities?
- How do land management treatments influence hydrology and erosion relative to these thresholds?

PRE-TREATMENT HYDROLOGY OBJECTIVES:

- Quantify runoff and erosion under rainfall simulation on tree coppice, shrub coppice, and interspace areas within woodland communities at the small plot (0.5 m^2) and large plot scales (13 m^2) before application of land management treatments.
- Evaluate the influence of surface-soil properties and vegetation on runoff and erosion processes.

LOCATION:



Onaqui, UT

Marking Corral, NV

Onaqui, UT	Marking Corral, NV
• Utah Juniper	• Western Juniper, Pinyon
• Gravely Loam	• Very Gravely Silt Loam
• Annual Rainfall 300 – 355 mm	• Annual Rainfall 330 - 380 mm

0.5 m^2 RAINFALL SIMULATIONS

- Meyer – Harmon Simulator
- 140 Repetitions
- Intensities:
  - 64 mm hr^{-1} for 45 min
  - 102 mm hr^{-1} for 45 min
- 1 to 3 Minute Grab Samples
- Samples Processed for Volume of Runoff and Mass of Sediment

Vegetation Cover Data

- 105 Point Grid
- Ground Cover, Canopy Life Forms

Supporting Data

- Soil Moisture
- Water Drop Penetration Times
- Wetting Front / Trench Test
- Soil Stability
- Microtopography (on 105 point grid)
- Litter Depth
- Particle Size Analysis

13 m^2 RAINFALL SIMULATIONS

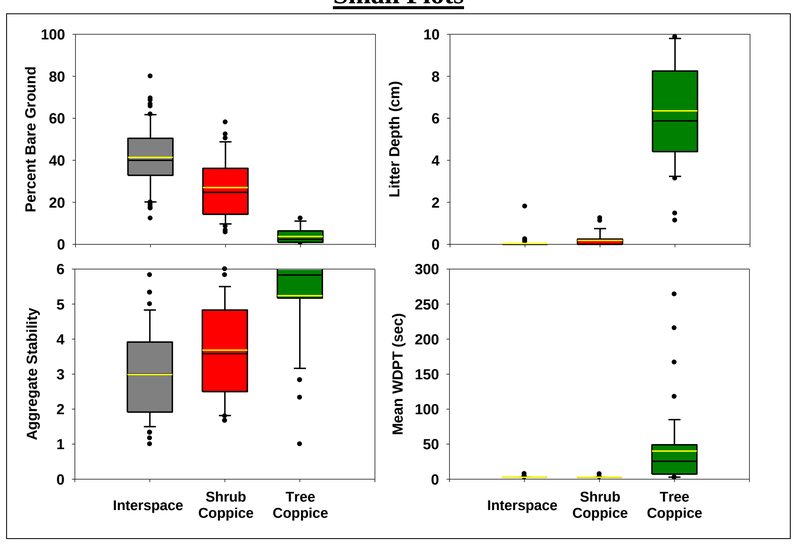
- CSU Type Simulator
- 60 Repetitions
- Intensities:
  - 64 mm hr^{-1} for 45 min
  - 102 mm hr^{-1} for 45 min
- Samples Processed for Volume of Runoff and Mass of Sediment

Supporting Data

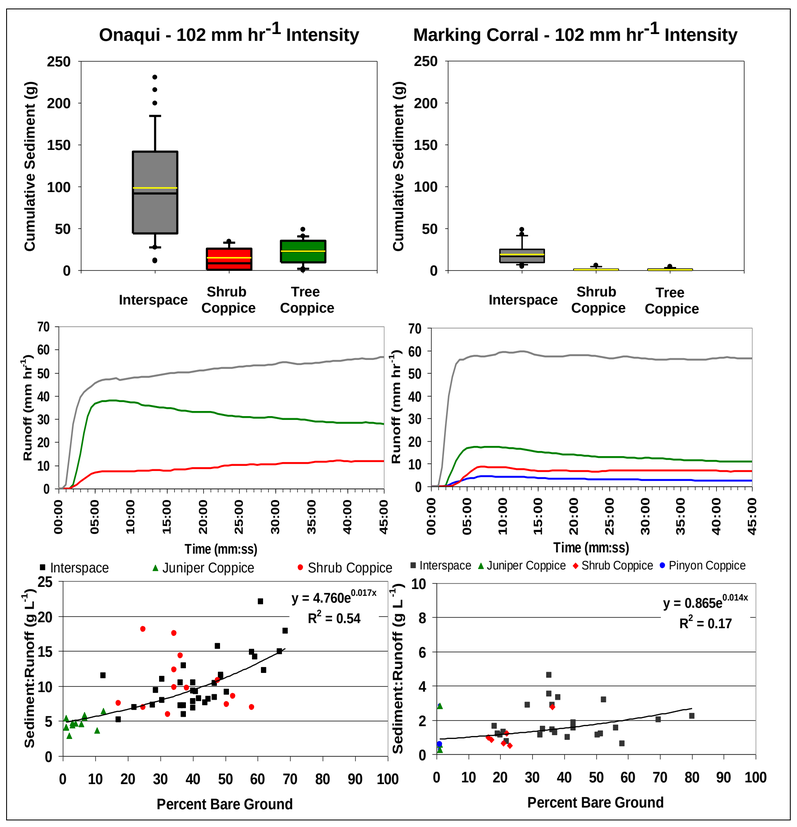
- Canopy and Ground Cover
- Canopy and Basal Gaps
- Microtopography
- Wetting Front / Trench Test
- Soil Moisture
- Particle Size Analysis

PRELIMINARY RESULTS:

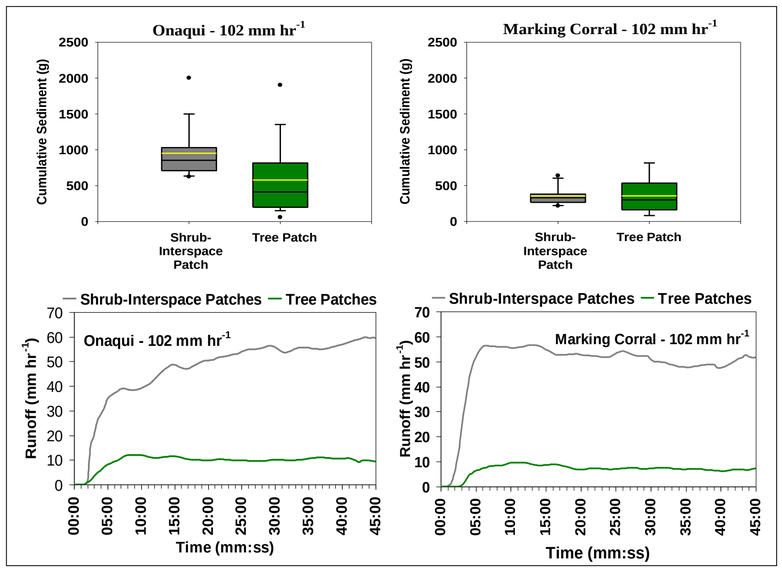
Small Plots



Small Plots by Site for 102 mm hr^{-1} Intensity



Large Plots by Site for 102 mm hr^{-1} Intensity



SUMMARY:

- Interspace microsites have the highest % bare ground and contribute the greatest runoff and erosion rates.
- Shrub coppices produce a low amount of runoff and erosion.
- Although tree coppices have high runoff attributed to strong soil water repellency, thick litter depth and strong aggregate stability protect the microsites from erosion.
- Runoff and erosion increase with increasing bare ground and are generally greater from shrub-interspace than tree patches, but the magnitude of these relationships depends on site level soil properties and erodibility and other site characteristics.
- The impact of juniper/pinyon encroachment on hydrology and erosion likely depends on its influence on spatial expanse and continuity of interspace and bare ground.
- The hydrologic impacts of woodland control practices such as controlled burning, mechanical cutting, and mechanical mastication treatments on trees will be examined to improve the understanding of managing woodland encroachment in sagebrush steppe ecosystems.

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