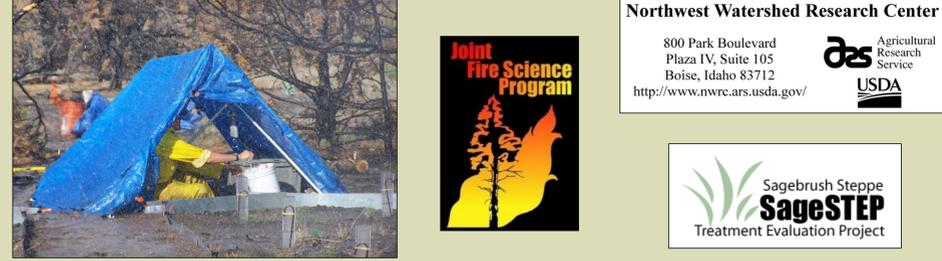




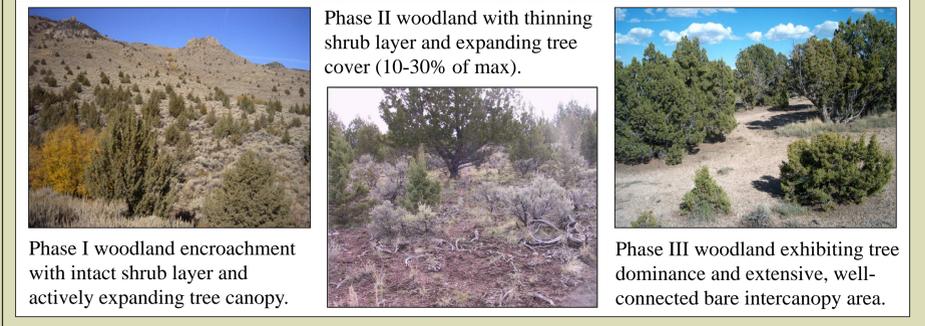
Hydrologic Vulnerability of Great Basin Sagebrush Steppe Following Pinyon and Juniper Encroachment

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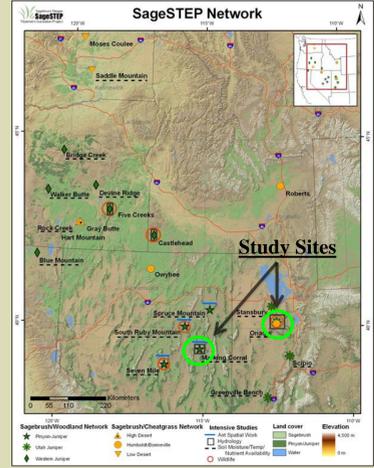


OVERVIEW
 Extensive woodland encroachment across the western US has altered the ecological structure and function of sagebrush steppe rangelands. Woodland encroachment can elicit a vegetation pattern of tree dominance and spatially well-connected, sparsely-covered intercanopy area (area between tree canopies). Coarsening cover structure has been linked to amplified surface runoff and soil loss. This study evaluates these relationships and the hydrologic impacts of tree removal treatments at two woodland sites using rainfall simulation and concentrated flow experiments.



STUDY SITES

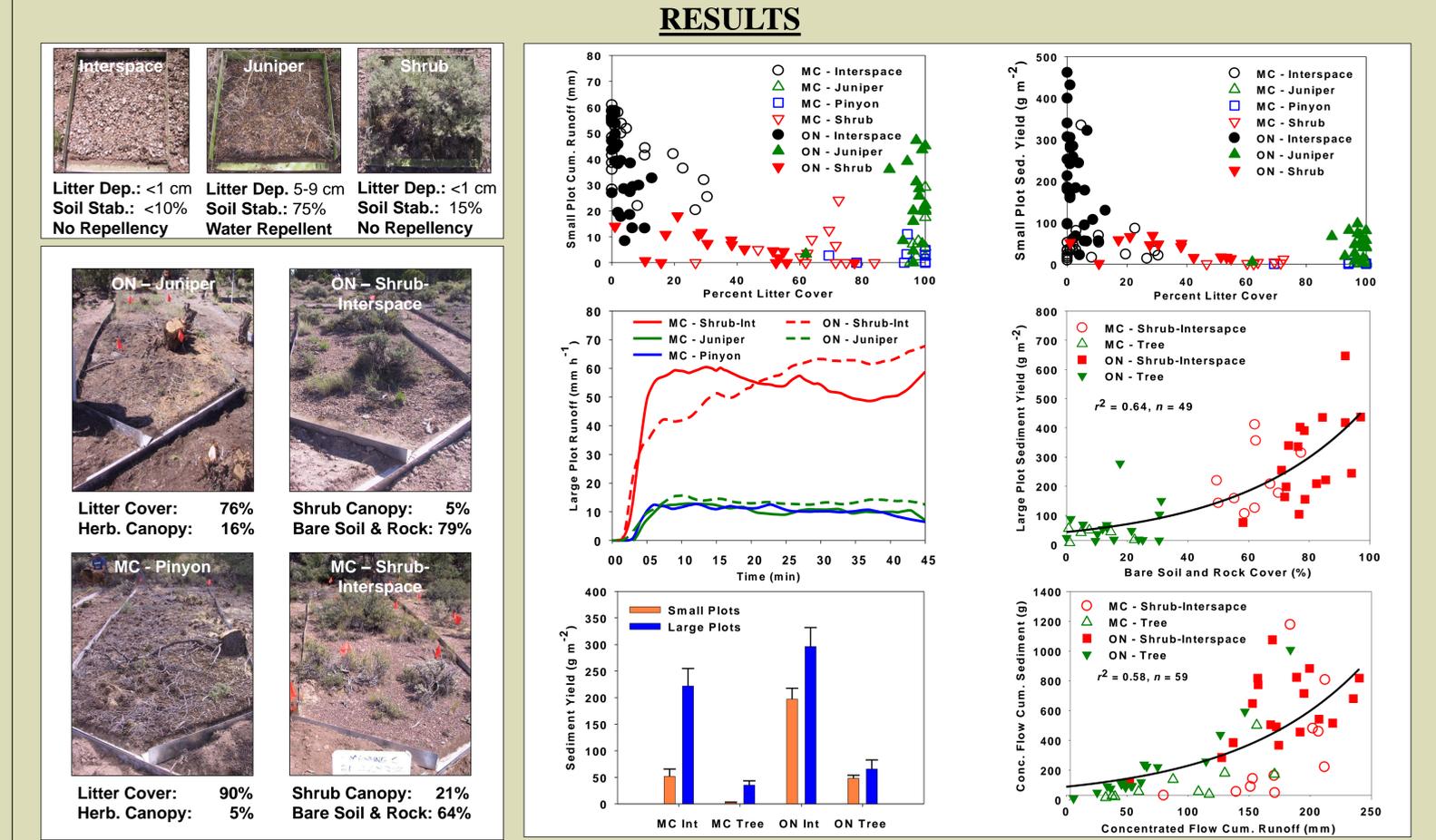
- This study is part of the Sagebrush Steppe Treatment Evaluation Project (SageSTEP, McIver et al. 2010) investigating the ecological impacts of invasive species, woodland encroachment, and restoration methodologies.
- One single-leaf pinyon (*Pinus monophylla* Torr. & Frém.) - Utah juniper (*Juniperus osteosperma* [Torr.] Little) site and one Utah juniper site were selected from within the greater SageSTEP study network.
- Understory vegetation includes: *Artemisia tridentata* Nutt. ssp. *wyomingensis* Beetle & Young; *Artemisia nova* A. Nelson; *Purshia* spp.; *Poa secunda* J. Presl; *Pseudoroegneria spicata* (Pursh) A. Löve; and various forbs.



Site Characteristic	Marking Corral (MC), Nevada	Onaqui (ON), Utah
Woodland community	single-leaf pinyon ^a /Utah juniper ^b	Utah juniper
Elevation (m)	2250	1720
Mean annual precip (mm), temp (°C)	351, 7.2	345, 7.5
Slope (%)	10-15	10-15
Soil profile texture	gravelly clay to clay loam	gravelly loam
Tree canopy cover (%)	15 ^a , 10 ^b	26
Trees per hectare	329 ^a , 150 ^b	476
Mean tree height (m)	2.3 ^a , 2.4 ^b	2.4

METHODS

- Runoff and erosion were measured during small-plot and paired large-plot rainfall simulations (102 mm h⁻¹, 45 min).
- Runoff, erosion, flowpath geometry, and flow velocity were measured during concentrated flow simulations (15, 30, and 45 L min⁻¹ release rates).
- Canopy and ground cover, litter depth, soil moisture and physical properties, and the strength of soil water repellency were quantified.

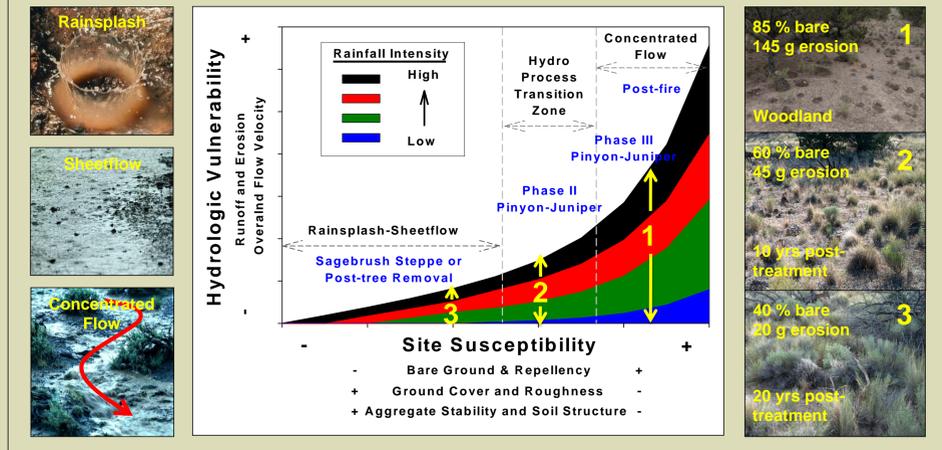


PRETREATMENT CONCLUSIONS

- Hydrologic response was dictated by the amount and type of ground cover.
- Extensive bare ground amplified splash and sheet erosion and facilitated development of concentrated flow paths with high sediment detachment and transport capacities.
- Runoff and erosion increased exponentially where bare soil and rock cover exceeded 50%, but site specific erosion differences were observed.
- Results indicate overall hydrologic vulnerability following woodland encroachment depends on potential influence of encroachment on bare intercanopy expanse and the erodibility of respective intercanopy areas.

PRELIMINARY POST-TREE REMOVAL INFERENCES

- Post-treatment hydrologic vulnerability is a function of site susceptibility, which is dictated by short- and long-term ground cover recruitment.
- Burning amplifies short-term vulnerability by increasing continuity of bare ground, exacerbating water repellency effects, and facilitating concentrated flow.
- Tree cut-and-drop and/or mastication methodologies may reduce short-term vulnerability if treatment increases intercanopy ground cover.
- Other studies by the authors have found the full effects of tree removal treatments may not be evident for 20 or more years.



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