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Advancements from Long-Term Research on Woody Plant Encroachment in the Western United States: the Hydrology Component of the Sagebrush Steppe Treatment Evaluation Project (SageSTEP)

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Mitigating and reversing negative ecohydrologic impacts of woody plant encroachment is of global concern. Current knowledge on the ramifications of woody plant encroachment and landscape responses to management is largely based on short-term or point-in-time field studies. The limited longevity of these studies is often dictated by the short-term nature of funding sources and associated infrastructure. Short-term studies advance process-based ecohydrologic knowledge of natural systems and yield valuable insight on treatment effects for various practices to mitigate woody plant encroachment. However, scientists, public and private land owners, and policy makers require knowledge of long-term effectiveness of treatment practices and associated conceptual and quantitative tools to successfully target land management expenditures and actions. This presentation highlights science-based knowledge and ecohydrologic model advancements in management of woody plant encroachment over a nearly 15 yr study period associated with ecohydrologic research at multiple sites in the sagebrush biome within the Great Basin Region of the western United States (the SageSTEP study, www.sagestep.org). The sagebrush biome is considered one of the most ecologically important and imperiled rangeland domains in the United States. A primary driver of degradation to the sagebrush biome is encroachment by pinyon and juniper conifers. These encroaching trees can outcompete sagebrush vegetation for

soil and water resources and ultimately propagate and perpetuate pinyon and juniper woodland conditions with extensive bare ground and amplified runoff and soil loss. This study evaluated the ecohydrologic impacts of pinyon and juniper encroachment on sagebrush steppe and the long-term effectiveness of various tree-removal practices to restore sagebrush steppe vegetation and associated ecohydrologic function. Experiments in the study include assessment of vegetation, ground cover, soils, and infiltration, runoff, and erosion processes spanning point to hillslope spatial scales prior to tree removal treatments and at time periods 1 yr, 2 yr, 9 yr, and 13 yr after tree removal. Research products include: 1) advances in conceptual and quantitative understanding of linkages in vegetation and hydrology and erosion processes for the sagebrush steppe ecosystem, 2) enhancements to various conceptual ecological models and the Rangeland Hydrology and Erosion Model (RHEM) tool, 3) advanced understanding of the effectiveness of various tree-removal practices across diverse conditions in the sagebrush biome, and 4) delivery of an extensive publicly-available dataset for developing, enhancing, and/or evaluating other conceptual and quantitative ecohydrologic and erosion models. Lastly, the collective advances in science-based knowledge and modeling tools from the study demonstrate the utility and value of funding and conducting long-term ecohydrological research, particularly for ecologically important biomes around the world.