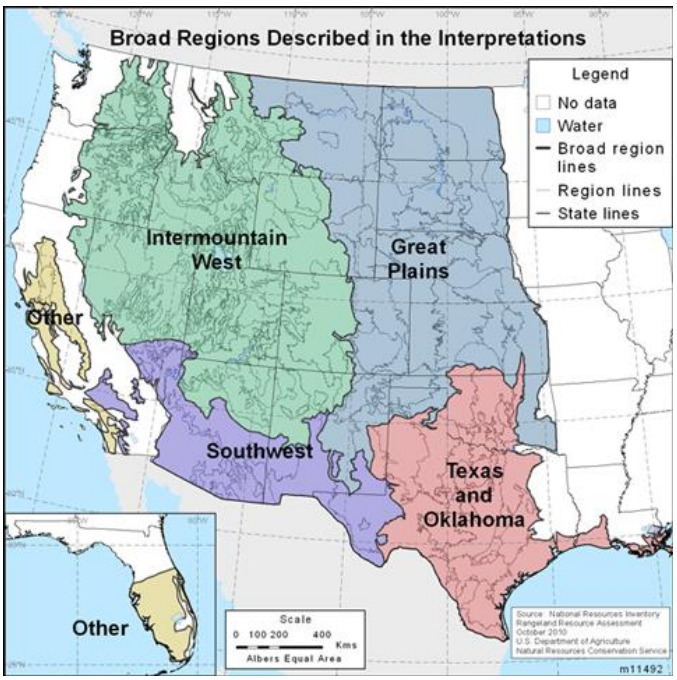
Regional Interpretation - Southwest

The Southwest region is a diverse region of plateaus, plains, basins, and isolated mountain ranges. The extent of southwestern rangeland includes the Sonoran Desert of Arizona, the Mojave Desert of southern California and Nevada, and the Chihuahuan Desert of southern New Mexico and west Texas (Figure 1). It also includes the southern Rocky Mountains of south-central Colorado and north-central New Mexico. This region includes the most arid areas of the United States and has developed many adaptations to resist drought. Strong precipitation and temperature gradients associated with latitude, longitude, and elevation largely determine general patterns of potential vegetation and plant production in the region, with local differences associated with differences in soils and landscape position.

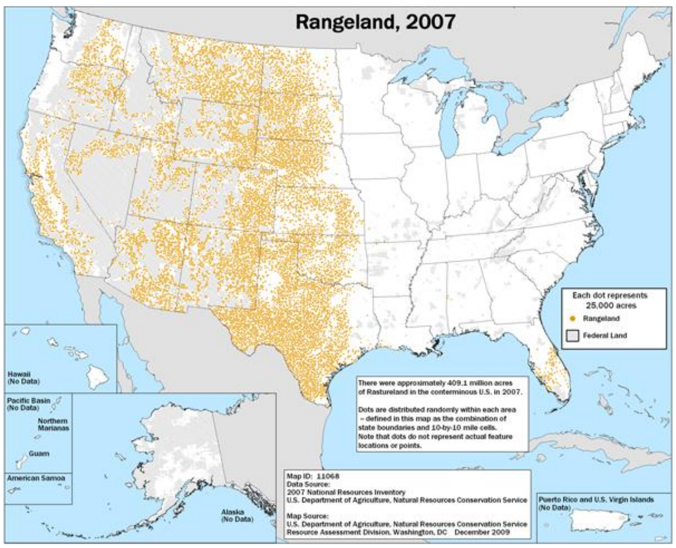
Figure 1. Broad Regions Described in these Interpretations.



Potential plant communities in most Southwest rangeland ecosystems include a significant shrub component and are usually dispersed at greater distances between plants than in other regions. The Chihuahuan Desert grasslands are susceptible to shrub invasion in the absence of fire, exotic grasses tend to become invasive with disturbance; and the Sonoran Desert is characterized by a high proportion of succulent species, where survival depends on the infrequency of sub-freezing temperatures. Common shrub species include creosote bush (*Larrea tridentata* (DC.) Coville), American tarwort (*Flourensia cernua* DC.), burrobush or bursage [*Ambrosia dumosa* (A. Gray) Payne], saltbush (*Atriplex* spp.), greasewood (*Sarcobatus* spp.), oaks (*Quercus* spp.), juniper (*Juniperus* spp.) and pinyon pine (*Pinyon* spp.).

Like the Intermountain West region, the Southwest includes large areas of non-surveyed public lands interspersed with non-Federal lands (Figure 2). The Mojave Desert, in particular, has very small proportions of non-Federal land. There are also significant areas of forest in the higher elevations, particularly in west-central New Mexico and east-central Arizona.

Figure 2. Acres of Non-Federal Rangeland, 2007.



Soil and Site Stability

Soil and site stability shows at least moderate departure from reference condition on 10-20 percent of the non-Federal land in much of the western portion of this region and on 20-30 percent in parts of eastern portion (Figure 3). As in the southern Intermountain region, aridity contributes to lower resistance and resilience of these areas. Increased density and cover on grasslands by persistent shrubs such as Southern juniper species (Figures 4-7) and mesquite (Figures 8-11) result in increased bare ground (Figures 12-15) and, more significantly, increased proportion of the soil surface exposed in inter-canopy gaps (Figures 16-17), and unstable soil aggregates (Figure 18). Exposed bare ground and loss of vegetation (above and below ground biomass), loss of organic matter, grazing impacts, and loss of microbiotic soil crusts contribute to much of the increased departure from reference conditions for soil stability in southern New Mexico and West Texas. High levels of bare ground can occur naturally on some ecological sties, particularly in the extremely arid parts of southwestern Arizona and western New Mexico.

Figures 3-5. Non-Federal Rangeland Where Soil and Site Stability, Hydrologic Function, or Biotic Integrity Show at Least Moderate Departure from Reference Conditions. (Source: Rangeland Health Table 2)

Figure 3. Soil and Site Stability

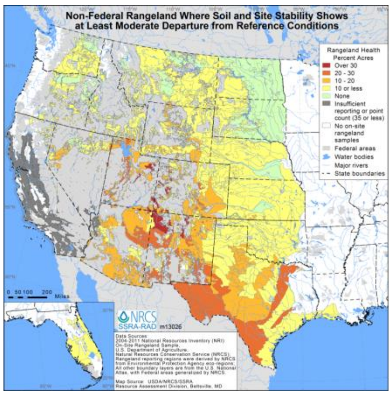


Figure 4. Hydrologic Function

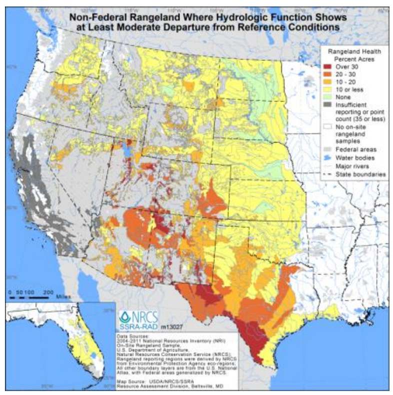
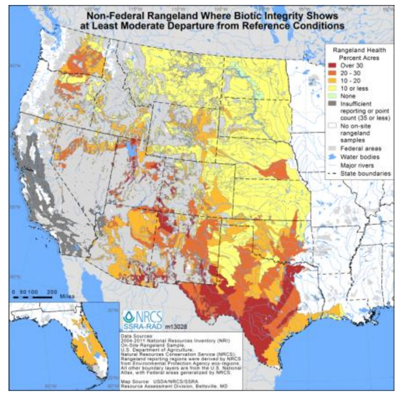


Figure 5. Biotic Integrity



Figures 6-9. Non-Federal Rangeland Where Southern Juniper Species Are Present and Where They Cover at Least 15, 30, or 50 Percent of the Soil Surface. (Source: Native Invasive Woody Species Table 6)

Figure 6. Present

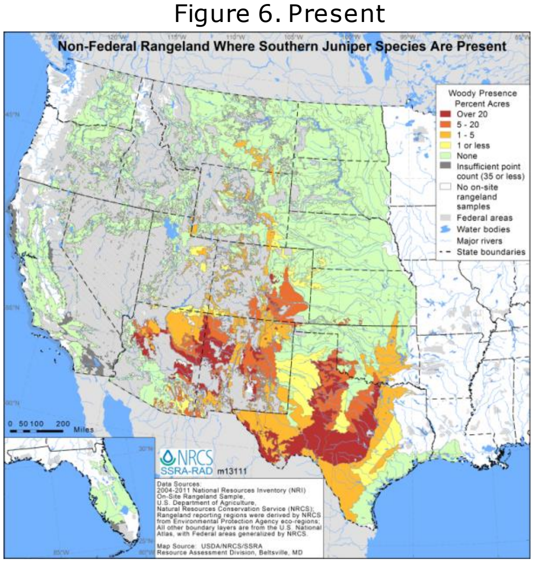


Figure 7. At least 15%

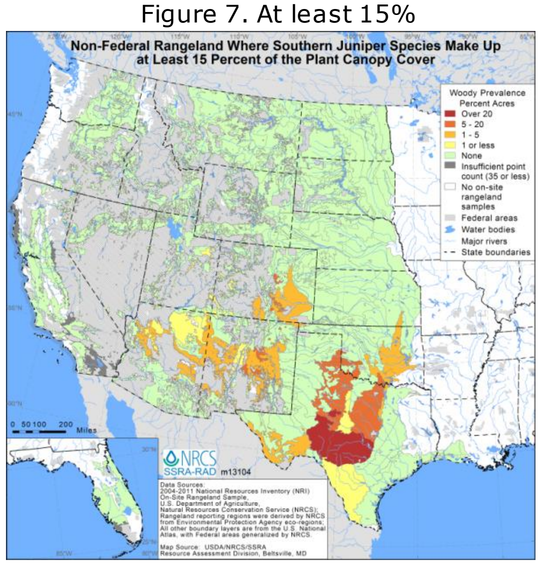


Figure 8. At least 30%

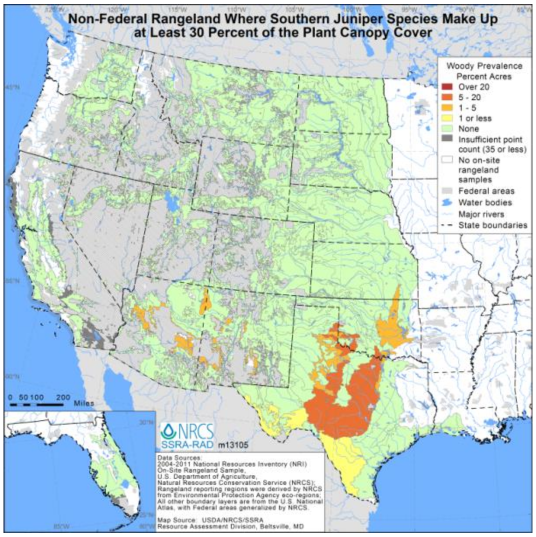
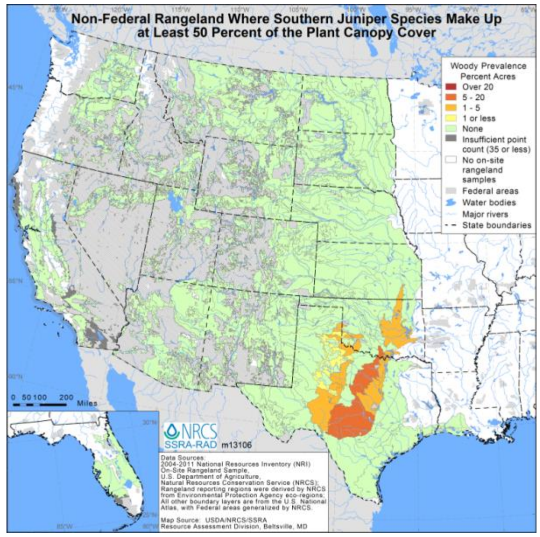


Figure 9. At least 50%



Figures 10-13. Non-Federal Rangeland Where Mesquite Species Are Present and Where They Cover at Least 15, 30, or 50 Percent of the Soil Surface. (Source: Native Invasive Woody Species Table 10)

Figure 10. Present

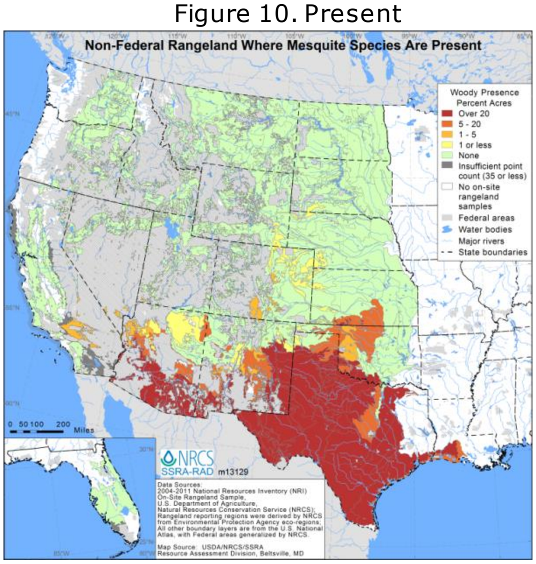


Figure 11. At least 15%

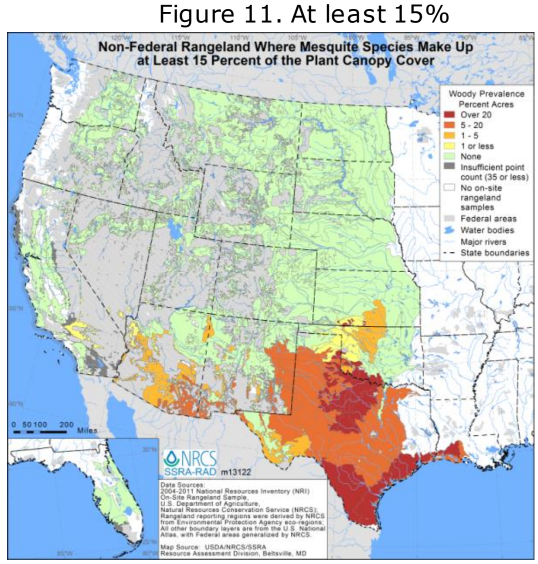


Figure 12. At least 30%

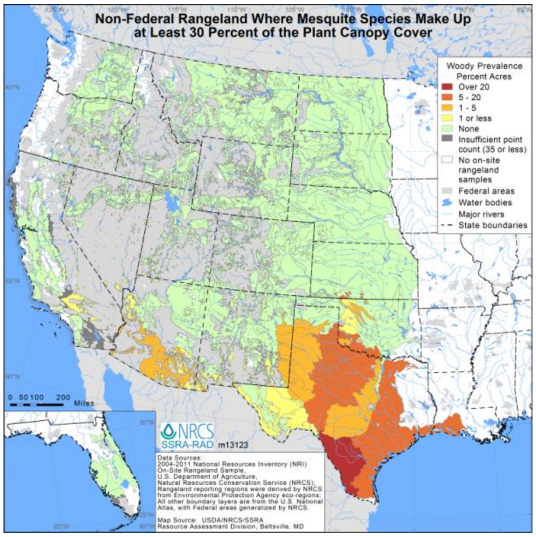
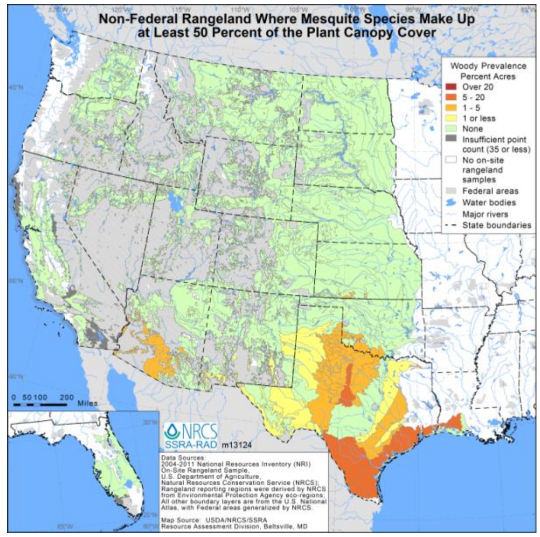


Figure 13. At least 50%



Figures 14-17. Non-Federal Rangeland that is at Least 20, 30, 40, or 50 Percent Bare Ground (Source: Bare Ground, Inter-Canopy Gaps, and Soil Aggregate Stability Table 2)

Figure 14. At Least 20%

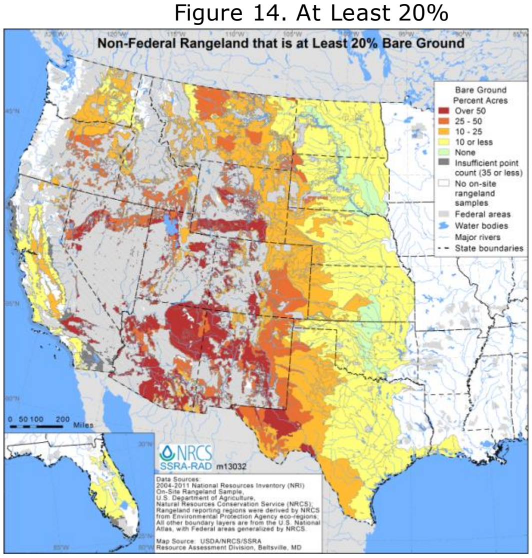


Figure 15. At Least 30%

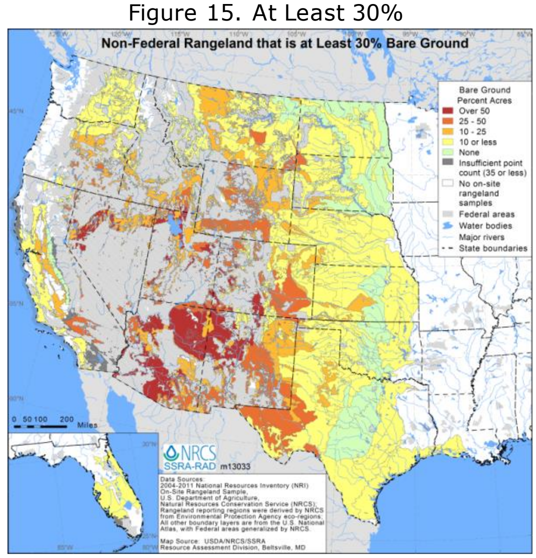


Figure 16. At Least 40%

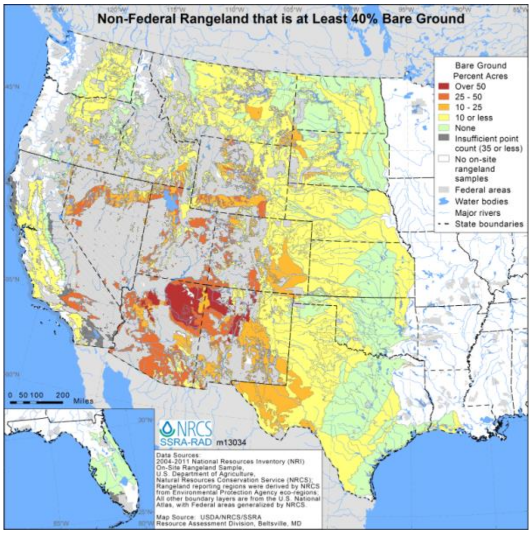
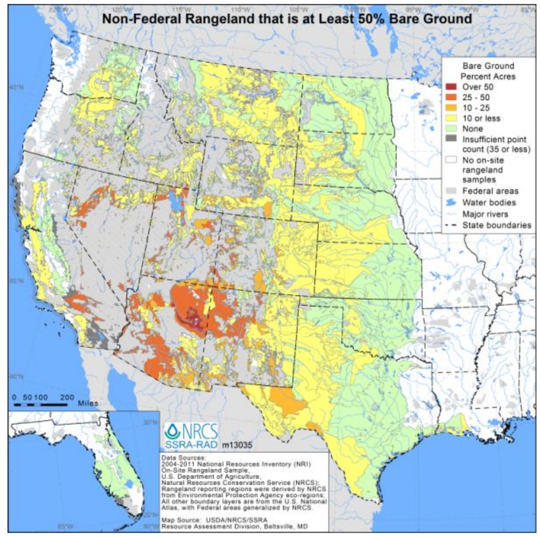


Figure 17. At Least 50%



Figures 18-19. Non-Federal Rangeland Where Canopy Gaps of at Least 1 or 2 Meters Account for at Least 20 Percent of the Land and Inter-Canopy Gaps are at Least 50% Bare Ground (Source: Bare Ground, Inter-Canopy Gaps, and Soil Aggregate Stability Table 3)

Figure 16. 50% Bare Ground in Gaps of at Least 1 Meter

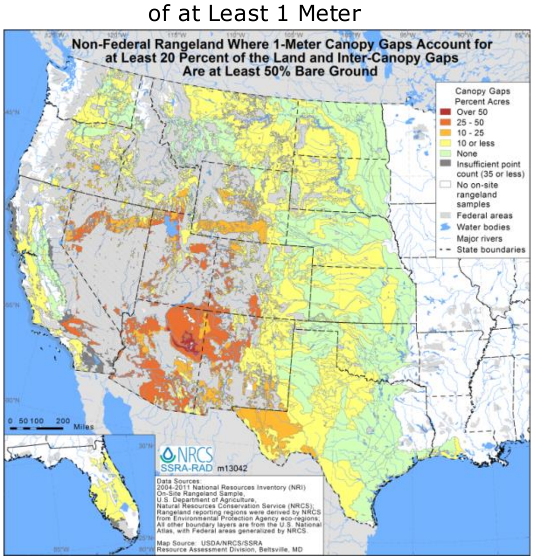


Figure 17. 50% Bare Ground in Gaps of at Least 2 Meters

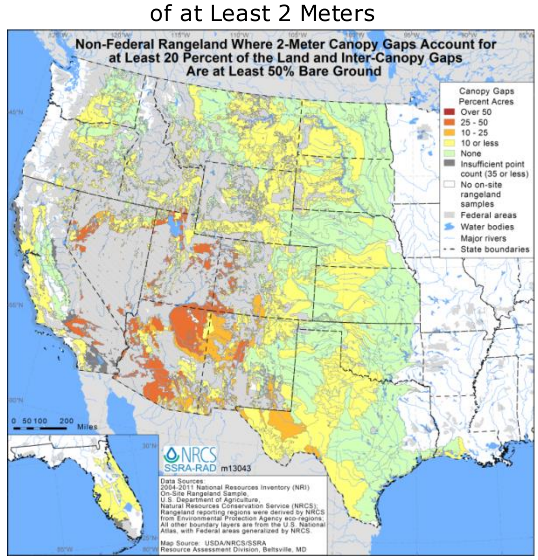
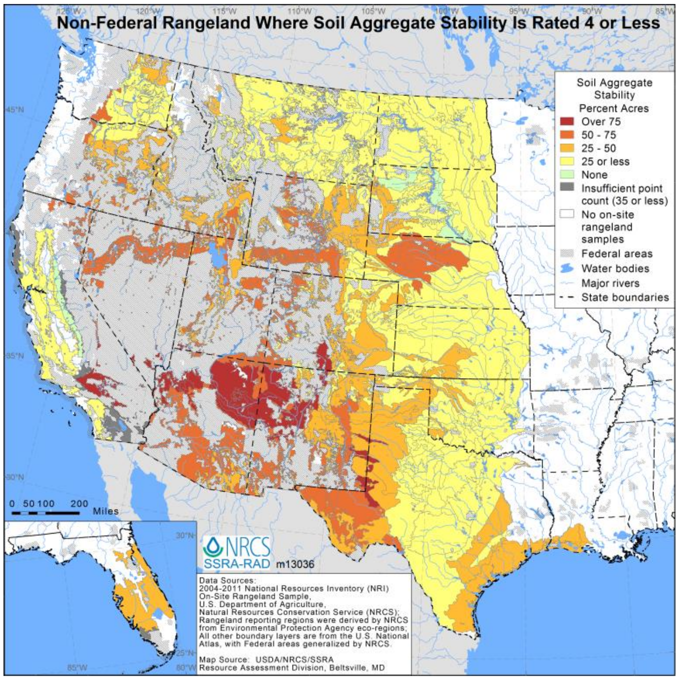


Figure 20. Non-Federal Rangeland Where Soil Aggregate Stability is 4 or Less Indicating Unstable Soil (Source: Bare Ground, Inter-Canopy Gaps, and Soil Aggregate Stability Table 4)



Hydrologic Function

The pattern of hydrologic function (Figure 19) and soil site stability are similar. A loss of herbaceous cover associated with replacement of grasses by shrubs leads to increased bare ground (Figures 12-15), the formation of vesicular crusts (e.g., physical soil crusts), and a higher proportion of bare ground in large inter-canopy gaps (Figures 16-17). These conditions are conducive to reduced infiltration capacity, accelerated runoff, and increased erosion (Blackburn et al. 1990). In the Southwestern region, and throughout most of the rangeland areas in the U.S., high intensity storms can generate substantial rainfall and raindrop energy that disturb and move soil surface particles. These storm intensities can result in considerable runoff and erosion in a very short period of time. If conditions have deteriorated, resulting in a high percentage of bare ground and loss of vegetative cover, these storms can initiate rills, gullies, eroded water flow paths, and loss of soil (Pierson et al. 2010; Weltz et al. 2014). High intensity storms associated with disturbed rangeland are the principle force associated with loss of soil surface stability and hydrologic function. All three of the rangeland health attributes (soil site stability, hydrologic function, and biotic integrity) are usually correlated with each other and as rangeland conditions degrade they all will eventually show signs of departure from reference conditions and transition to potentially less desirable states.

Biotic integrity

The reduction in biotic integrity in much of this region (Figure 20) is due to the invasion of native, rather than non-native shrub species. Mesquite species (Figures 8-11), for example, can be highly invasive on many sites in the Chihuahuan and Sonoran Deserts. Southern juniper species (Figures 4-7) are also highly invasive throughout this region. Although mesquite and juniper are native shrubs on many rangeland ecological sites in the region, they are expanding their range to areas where they have not been part of the reference conditions (Figures 21-22). In addition, there are significant effects of non-native species including buffelgrass (*Pennisetum ciliare* (L.) Link) in west Texas (Figure 23) and annual bromes (*Bromus* spp.) in Arizona (Figure 24). This shift in species composition negatively impacts nutrient cycling and the quality of wildlife habitat, both directly and through its effects on the fire regime (fire intensity and frequency often increases with higher densities of certain invasive plant species) where wildfire can threaten urban areas (DiTomaso 2000; Mack et al., 2000; Evans et al. 2001; Pierson et al. 2002; Brooks et al. 2004; Norton et al. 2004; Ogle et al. 2004; Boxell and Drohan 2008; Mack 2010). This shift also affects soil surface and soil-plant-water relations, which affects all three rangeland health attributes. These feedbacks occur in all regions, but are particularly important in the Southwest and Intermountain West regions.

Figures 21-22. Non-Federal Rangeland Where Mesquite Species or Southern Juniper Species Are Present but Excluded from Reference Conditions. (Source: Native Invasive Woody Species Table 16)

Figure 21. Mesquite Species

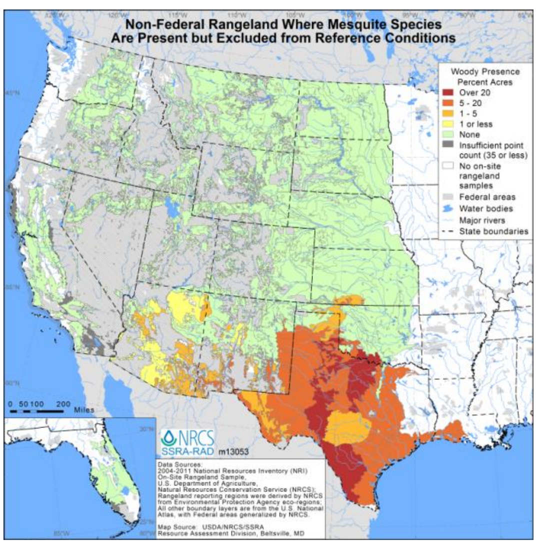
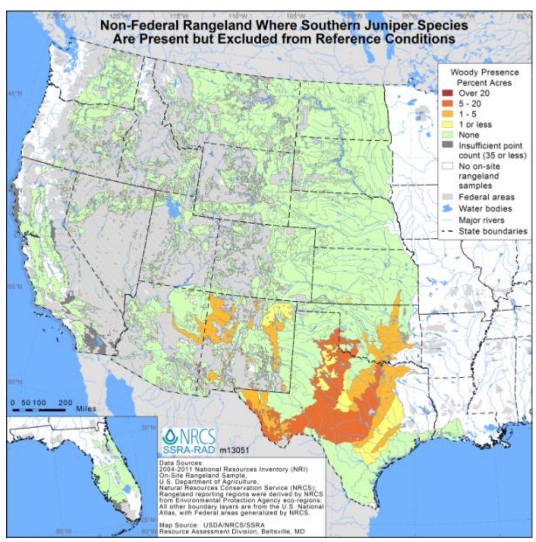


Figure 22. Southern Juniper Species



Figures 23-24. Non-Federal Rangeland Where Buffelgrass or Annual Bromes Are Present. (Source: Non-Native Plant Species Tables 11 and 3)

Figure 23. Buffelgrass

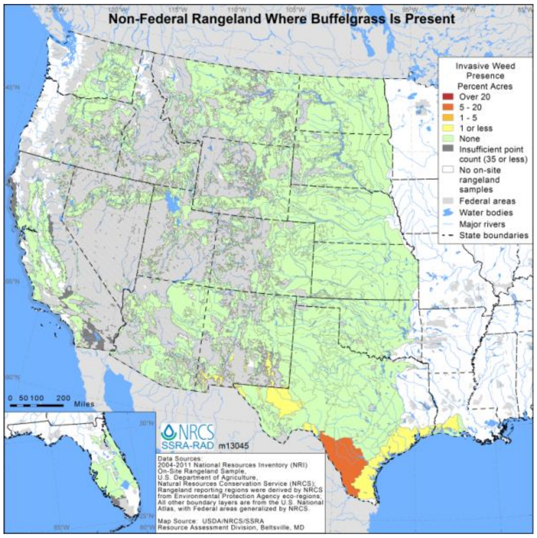
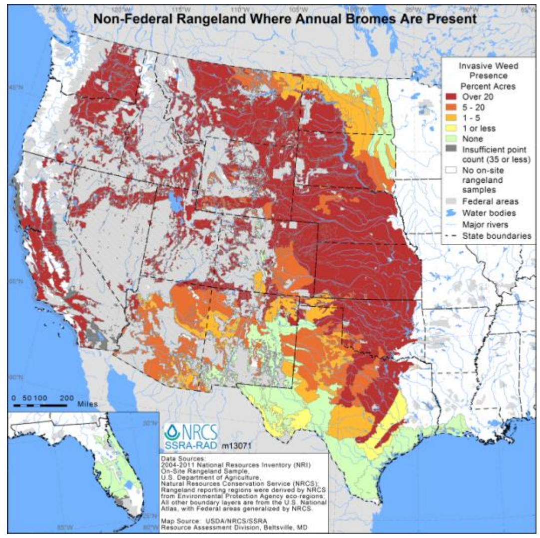


Figure 24. Annual Bromes



More Information

Blackburn W.H., F.B. Pierson, and M.S. Seyfried. (1990). Spatial and temporal influence of soil frost on infiltration and erosion of sagebrush rangelands. Water Resources Bull. 26:991 997.

DiTomaso J.M. (2000). Invasive weeds in rangelands: species, impacts, and management. Weed Science 48:255-265.

Mack R.N., D. Simberloff, W.M. Lonsdale, H. Evans, M. Clout, and F.A. Bazzaz. (2000). Biotic invasions: causes, epidemiology, global consequences, and control. Ecological Applications 10:689–710.

Evans R.D., R.Rimer, and S.P. Belnap. (2001). Exotic plant invasion alters nitrogen dynamics in an arid grassland. Ecol. Appl. 11:1301-1310.

Pierson F.B., D.H. Carlson, and K.E. Spaeth. (2002). Impacts of wildfire on soil hydrologic properties of steep sagebrush-steppe rangeland. International Journal of Wildland Fire 11: 45-151.

Ogle S.M., W.A. Reiners, and K.G. Gerow. (2003). Impacts of Exotic Annual Brome Grasses (Bromus spp.) on Ecosystem Properties of Northern Mixed Grass Prairie. American Midland Naturalist 149: 46-58.

Brooks M.L., D'Antonio CM, Richardson DM, et al. (2004). Effects of invasive alien plants on fire regimes. BioScience 54: 677–88.

Norton J.B., T.A. Monaco, J.M Norton, D.A. Johnson, and T.A. Jones. (2004). Soil morphology and organic matter dynamics under cheatgrass and sagebrush-steppe plant communities. Journal of Arid Environments 57: 445–466.

Boxell J., and P.J. Drohan. (2008). Surface soil physical properties and hydrological characgteristics in Bromus tectorum L. (cheatgrass) versus Artemisia tridentata Nutt. (big sagebrush) habitat. Geoderma 149:305-311.

Mack R.N. (2010). Fifty years of "Waging war on cheatgrass": research advances, while meaningful control languishes. "Fifty Years of Invasion Ecology" (D. Richardson, ed.). Pp. 253-265. Wiley-Blackwell Press, Oxford.

Pierson F.B., Williams, C.J., Kormos, P.R., Hardegree, S.P., Clark, P.E., & Rau, B.M. (2010). Hydrologic vulnerability of sagebrush steppe following pinyon and juniper encroachment. Rangeland Ecology & Management, 63: 614-629.

Davies K.W. (2011). Plant community diversity and native plant abundance decline with increasing abundance of an exotic annual grass. Oecologia 167:481-491.

Weltz M.A., K. Spaeth, M.H. Taylor, K. Rollins, F. Pierson, L. Jolley, M. Nearing, D. Goodrich, M. Hernandez, S.K. Nouwakpo, and C. Rossi. (2014). Cheatgrass invasion and woody species encroachment in the Great Basin: Benefits of conservation. J. Soil and Water Cons. 69:39A-44A.

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