

## Rangelands

### USING GOATS AND SHEEP TO CONTROL JUNIPER SAPLINGS: WHAT WE'VE LEARNED

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Andrés Cibils<sup>1</sup>, Santiago Utsumi<sup>1</sup>, and Richard Estell<sup>2</sup>

<sup>1</sup>*Department of Animal and Range Sciences, New Mexico State University*

<sup>2</sup>*USDA-ARS, Jornada Experimental Range*

**CORRESPONDING AUTHOR:** Andres Cibils, (575) 646-4342, acibils@nmsu.edu

**THE STORY IN BRIEF:** This abstract synthesizes the main findings and conclusions of a series of papers published between 2006-2014 from studies conducted at CRLRC and the NMSU Campus Farm that sought to determine the feasibility of using sheep and goats to suppress one-seed juniper sapling encroachment. We found that protein supplements and polyethylene glycol (PEG) can be used to boost juniper intake of goats and sheep (especially goats) in all seasons except fall. Co-grazing of sheep and goats (approximately 50% of each) at high stocking density was the grazing prescription that achieved highest juniper sapling utilization. Browsing of small saplings was most frequent in summer, whereas debarking of branches on taller saplings was the most common impact in spring. Browsing-induced sapling mortality was approximately 5%; however, branch mortality due to debarking ranged from 13-22%. We observed no adverse effects of this grazing treatment on understory herbaceous vegetation.

**THE PROBLEM:** Juniper woodland encroachment poses serious management challenges to ranchers in central New Mexico and throughout the southwest. Improved tools are needed for cost-effective rangeland restoration in the region.

**OBJECTIVES:** The overarching goal of this project was to determine the feasibility of using targeted grazing with goats and sheep to control juniper saplings. Specific objectives included: a) identifying plant secondary metabolites (PSM) in one seed juniper saplings; b) understanding how plant toxins and dietary nutrients interact to influence animal preference for juniper saplings; and c) finding an effective targeted grazing prescription.

**APPROACH:** Our project consisted of four related experiments. In an initial pilot study we determined PSM composition of CRLRC one seed juniper saplings in relation to plant material handling protocols (Utsumi et al. 2006). Our next experiment was conducted at the NMSU Campus Farm and consisted of feeding goats and sheep juniper sapling branches harvested at CRLRC to determine whether voluntary intake of juniper could be boosted by supplementing animals with either rumen degradable or bypass protein. Feeding trials were conducted in summer, fall, winter, and spring (Utsumi et al. 2009). A third experiment was conducted at CRLRC to determine the effects of grazing by goats alone or goats + sheep at high or low stocking densities in either summer or spring on the degree of utilization of juniper saplings and understory vegetation (Utsumi et al. 2010; Estell et al. 2014). The final experiment was conducted at the NMSU campus farm and consisted of pen feeding goats and sheep diets including juniper needles and different levels of protein, tannins, and polyethylene glycol to understand the physiological mechanisms that limit voluntary intake of juniper in ruminants (Utsumi et al. 2013).

**EXPECTED OUTCOMES:** We determined PSM composition of one seed juniper plant materials; identified possible physiological mechanisms limiting voluntary intake of juniper by goats and sheep; tested the efficacy of protein supplements and additives (PEG) as a means of

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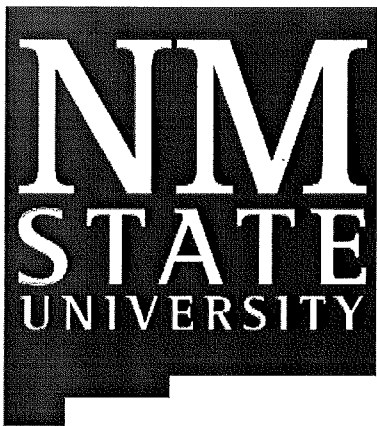
boosting voluntary intake; and determined the strengths and limitations of targeted grazing as a means of suppressing one seed juniper sapling invasion.

**RESULTS:** Our pilot study (Utsumi et al. 2006) showed that PSM in one-seed juniper needles consisted of a mixture of phenolics and more than 50 different terpenoids that varied in concentration both seasonally and among plants. Together, total phenolics and terpenoids accounted for 8–10% of needle DM. In general, concentrations of these compounds peaked in the fall, were lowest in summer, and were intermediate in winter and spring. Our first pen feeding trial (Utsumi et al. 2009) showed that averaged across seasons, goats that received protein supplements consumed approximately twice the amount of juniper of non-supplemented controls whereas supplemented sheep consumed about 50% more juniper than their non-supplemented counterparts. Overall, juniper intake of goats was 2.5 fold higher than that of sheep. Supplements containing bypass protein showed more consistent effects on voluntary intake than supplements containing rumen degradable protein. Average voluntary intake of juniper rarely exceeded 5% of an animal's diet. Intake was lowest in fall (when PSM were highest) regardless of supplement fed. Our grazing study (Utsumi et al. 2010; Estell et al. 2014) showed that under the encroachment conditions we studied (approximately 200 juniper saplings per acre averaging about 2.5 feet in height), mixed grazing with goats and sheep (approximately 50% of each) at a rate of 1 animal/100 square feet/day produced the highest levels of juniper sapling utilization. In summer animals mainly consumed thin branches of short saplings (< 1.5 feet tall), whereas in spring, animals primarily debarked branches of tall saplings (> 3 feet tall). Small saplings had lower PSM concentrations during summer (the season of lowest overall juniper PSM levels in our earlier study). Juniper sapling bark appeared to have less than half the PSM concentration of needles (measured only in spring). Browsing-induced sapling mortality was approximately 5% (highest in summer) and branch mortality due to debarking ranged from 13-22% (highest in spring). We observed no adverse effects of this grazing treatment on understory herbaceous vegetation. Our final pen study (Utsumi et al. 2013) showed that juniper intake depressed levels of a number of plasma amino acids (AA). Feeding protein supplements and PEG appeared to restore plasma levels of several essential and non-essential AA which are needed for terpene detoxification. This study suggested that increased voluntary intake of juniper in supplemented animals is associated with this phenomenon.

**POTENTIAL APPLICATION:** Protein supplements and PEG have the ability to boost voluntary intake of juniper by goats and to a lesser extent by sheep in all seasons except fall. Multi-season grazing strategies (summer-spring) may be most successful in suppressing juniper sapling encroachment.

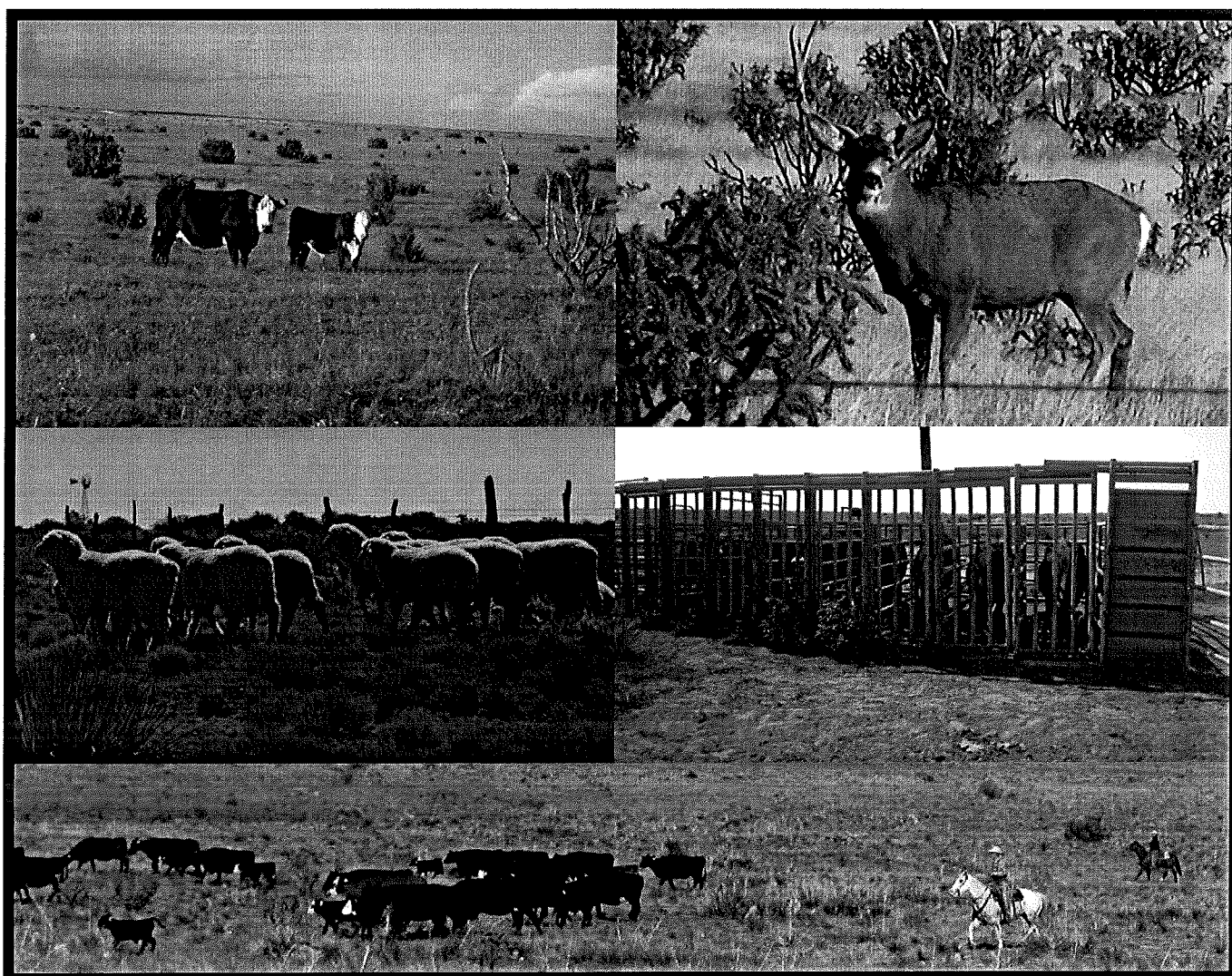
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