# Vegetational Evaluation of Pinyon-Juniper Cabling in South-Central New Mexico

PAUL RIPPEL, REX D. PIEPER, AND GORDON A. LYMBERY

**Abstract**

**Vegetational comparisons were made between areas where pinyon-juniper vegetation had been cabled in 1954 and uncabled areas. Total tree density on the cabled areas was about 80% of that on control areas. Basal area and canopy cover of trees was substantially lower on control areas than on cabled areas. *Rhus trilobata* and *Xanthocephalum sarothrae* apparently were the only shrubby species that responded to the cabling treatment. Basal cover of *Bouteloua gracilis, Eragrostis erosa,* and *Muhlenbergia pauciflora* was significantly greater on the control areas than on the cabled area.**

About 27% of the land area of New Mexico is covered by pinyon-juniper vegetation (West et al. 1975). These woodlands provide forage for livestock and game, provide products such as fuel, Christmas trees, posts, charcoal, nuts, serve as major watershed areas; and provide recreational opportunities for many people (Hurst 1977). Some evidence indicates that pinyon and juniper are invading grassland vegetation (Johnsen 1962, Little 1977, Springfield 1976). Consequently, considerable effort has been spent to control pinyon-juniper vegetation in the Southwest. In Arizona alone, over 200,000 ha have been treated for juniper control (Skau 1961).

Chaining or cabling is a mechanical means of control whereby a large anchor chain or cable is dragged between two crawler-type tractors. Chaining is recommended for use on areas with mostly large, mature trees and few seedlings (Arnold et al. 1964, Jameson and Reid 1965, and New Mexico Interagency Range Committee 1968). Many areas in New Mexico have been cabled or chained, but few have then been evaluated to determine the vegetational response to the treatment. The objective of this study was to compare the vegetation on areas cabled two ways in 1954 with comparable, uncabled areas.

## Description of Area

This study was on the Fort Stanton Experimental Range in southern Lincoln County, New Mexico. Climatically, the area has cool, dry winters and warm, moist summers with cool nights (Pieper et al. 1971). Average annual precipitation is 34.8 cm. Precipitation extremes range from a low of 15.4 cm recorded in 1945, to a high of 72.9 cm in 1857. Approximately 65% of the annual precipitation falls in the summer months of July through September.

The average annual temperature is 11.1° C. The average maximum temperature is 18.6° C. January is the coldest month with a mean minimum temperature of -6.7° C. The mean maximum temperature for July, the warmest month, is 28.9° C (Pieper et al. 1971).

Elevations on the Fort Stanton Range from 1900 to 2300 m (Thetford et al. 1971). The topography is highly variable, with deep canyons, arroyos, mesas and rolling hills. Bottomland, mesa and canyon floor plant communities are dominated by grasses and forbs to the exclusion of woody species. Communities with pinyon and juniper trees, shrubs and a grass-forb understory are the prevalent vegetation on hill sites (slopes and rocky ridges). Emerson (1932) described the vegetation of the area as a "tension zone" between the grama grass and pinyon-juniper associations, commenting that extensive thickets of wavy-leaf oak (*Quercus undulata* Torr.) exist in higher, more xeric locations. Kuchler (1964) characterized the area as a transition zone between the grama-galleta steppe and the pinyon-juniper woodland.

The most common grass species are blue grama (*Bouteloua gracilis* H.B. K. Lag ex steud.), sideoats grama (*Bouteloua curtipendula* [Michx.] Torr.) and wolftail (*Lycurus phleoides* H.B.K.). Major forbs include wild buckwheat (*Eriogonum* sp. Michx.), bladderpod (*Lesquerella fendleri* [Gray] Wats.), Louisiana sagewort (*Artemisia ludoviciana* Nutt.), sunflower (*Helianthus annuus* L.), green thread (*Thelesperma filifolium* [Hook.] Gray) and in some years, showy goldeneye (*Viguiera multiflora* Nutt. Blake). Broom snakeweed (*Xanthocephalum sarothrae*) is a common half-shrub.

Common species in the shrub layer are wavy-leaf oak, skunkbush (*Rhus trilobata* Engelm.) and walking-stick cholla (*Opuntia imbricata* [Haw.] DC. var. *imbricata*). The predominant tree species are single-seed juniper (*Juniperus monosperma* (Engelm) Sarg.) and pinyon pine (*Pinus edulis* Engelm.). Alligator juniper (*Juniperus deppeana* Steud.) is also present, but in far fewer numbers.

## Methods

Four sites were selected along the southern boundary of the Fort Stanton range where pinyon-juniper cabling had been conducted on U.S. Forest Service allotments adjacent to Fort Stanton in 1954. The sites on Fort Stanton, which served as control, were comparable to those on Forest Service allotments with respect to soil, aspect and topography.

Tree parameters estimated included basal area, aerial crown cover, height, and density. These estimates were made by measuring and counting every tree on 3 randomly located 18.3 m × 45.7 m plots in each treatment within each site.

Basal diameter measurements were made between ground level and 0.3 m on the tree stem. Large trees were measured with a forester's diameter tape and small trees with a sliding caliper. Tree trunks were assumed circular in calculating basal area ($m^2$/ha).

Aerial crown measurements consisted of readings on a conduit pipe with taped markings every 15 cm. The long and short diameters of the crown were measured to the nearest 15-cm mark. The circular-area formula was applied to the average radius, and final values were converted to percentages of crown cover. Tree heights were measured with the same pipe to the closest 15 cm. Density was estimated by counting every tree on the plots and converting the tally to numbers of trees per hectare.

Shrub densities were determined on the same plots as those used for trees. Aerial shrub cover data were collected by the line-intercept method (Canfield 1941). Ten 30.5-m lines were randomly located on each treatment and the total amount of live shrub

Authors are graduate assistant, professor of range science, and graduate assistant, New Mexico State University, Las Cruces 88003.

This report is Journal Article 921, Agricultural Experiment Station, New Mexico State University, Las Cruces 88003.

Manuscript received January 13, 1982.

material intercepting a vertical plane defined by the line was measured by species. These data included measurements for broom snakeweed.

Basal cover of herbaceous species was determined by the step-point method (Evans and Love 1957). Six 100-point-step transects per treatment area were made each year. The plant species, litter, rock or bareground encountered by the point of a 0.6 mm wire pin placed in a consistent position at the toe of the boot was recorded. If a plant were not hit, the species of the nearest plant to the pin in a forward direction and within a 180 degree exclusion angle was recorded (Owensby 1973).

## Results

### Tree and Shrub Density

Total tree density was significantly higher ($P<0.10$) on the 1954 cabled areas than on the control areas, although density of single-seed juniper and pinyon pine was not different between the two areas (Table 1). Thus the reduction in alligator juniper density by the cabling treatment was still apparent more than 20 years after the cabling. There were less than half as many alligator junipers on the 1954 cabled areas as on the control.

Skunkbush was the only shrubby species that appeared to respond to the cabling treatment. Skunkbush density was 435 plants per ha on the 1954 cabled areas and only 262 plants per ha on the control (Table 1). Apparently, cabling allowed skunkbush density to increase. Density of walkingstick cholla appeared to be reduced by the cabling, but the difference between treatments was not significant ($P>0.10$). There was very little difference in density of the other shrubby species on the 2 treatment areas.

### Tree and Shrub Cover

Basal area and canopy cover of the trees appeared to be more sensitive to the cabling treatment than density. Basal area and canopy cover of singleseed juniper trees were nearly twice as high on the control areas as on the areas cabled in 1954 (Table 2). Pinyon pine basal area and canopy cover were also significantly higher on the control than on the 1954 cabled areas. These data suggest that trees on cabled areas were smaller and presumably younger. Tree height data also showed that smaller trees occurred on the 1954 cabled areas. Seedlings that invaded the cabled areas seem to require more than 20 years to reach pre-cabled sizes.

Shrub canopy cover was also higher on the 1954 cabled areas than on the control areas (Table 3) and indicated some release of shrubs following the cabling. The only 2 species that exhibited statistically higher cover values on the 1954 cabled areas were skunkbush and broom snakeweed. The data on skunkbush support the density data for this species. It was somewhat surprising that wavyleaf oak did not respond to the cabling, but there was no significant difference ($P<0.10$) between the treatments for canopy cover of this species (Table 3).

**Table 2. Average basal area ($m^2$/ha) and canopy cover (%) for tree species on areas cabled in 1954 and control areas.**

| Species | Basal area ($m^2$/ha) | | Canopy cover (%) | |
|---|---|---|---|---|
| | 1954 Cabling | Control | 1954 Cabling | Control |
| Single-seed juniper | 2.27[a1] | 4.47[b] | 6.0[a] | 11.4[b] |
| Alligator juniper | 0.61[a] | 1.61[a] | 1.3[a] | 3.8[b] |
| Pinyon-pine | 0.89[a] | 3.07[b] | 2.3[a] | 11.1[b] |
| Total | 2.77[a] | 10.88[b] | 9.9[a] | 26.3[b] |

Means followed by different letters are significantly different ($P<0.10$)

### Herbaceous Cover

Total grass and forb basal cover was higher ($P<.10$) on the control areas than on the 1954 cabled areas (Table 4). This is contrary to results of some studies that indicated an increase in cover and production of herbaceous species following pinyon-juniper control (Arnold et al. 1964, Clary 1971, and Springfield 1976). In this study, most of the response apparently came from shrubby species, which may have suppressed herbaceous species. Cover of blue grama, Chihuahua lovegrass (*Eragrostis erosa* Scribn.) and New Mexico muhly (*Muhlenbergia paulitlora* Buckl.) were all higher ($P<0.10$) on the control areas than on the cabled areas (Table 4). Wild buckwheat (*Eriogonum* sp. Mich.) was the only forb with a basal area higher ($<0.10$) on the 1954 cabled area than on the control, while Louisiana sagewort basal cover was higher on the control areas than on the cabled areas.

## Discussion

Evaluation of a cabling treatment after more than 20 years indicated little benefit remained if the major objective had been to reduce tree and shrub density and to increase herbaceous cover. Tree density was about the same as on the uncabled control areas, although basal and aerial cover were lower than on the control areas.

Skunkbush density and cover were higher on the cabled areas than on the control areas, but it is doubtful that this species contributes much to enhancement of habitat for game or livestock. Broom snakeweed density and cover was also higher on the cabled areas than on the control. The presence of broom snakeweed represents poor habitat conditions for most game and livestock.

Basal cover of both grass and forbs appeared to be reduced by the cabling. Although it was not possible to measure herbage production on the cabled areas because they were being grazed at

**Table 1. Average density (no./ha) for tree and shrubby species on areas cabled in 1954 and control areas.**

| Species | Treatment | |
|---|---|---|
| | 1954 | Control |
| Trees | | |
| Single-seed juniper | 265[a1] | 312[a] |
| Alligator juniper | 22[a] | 57[b] |
| Pinyon-pine | 242[a] | 305[a] |
| Total | 529[a] | 673[b] |
| Shrubs | | |
| Skunkbush | 435[b] | 262[a] |
| Mountain mahogany | 17[a] | 15[a] |
| Walkingstick cholla | 35[a] | 85[a] |
| Algerita | 15[a] | 13[a] |
| Fendler bush | 12[a] | 10[a] |
| Total | 514 | 384 |

[1]Means followed by different letters are significantly different ($P<0.10$).

**Table 3. Means and standard errors for canopy shrub cover (%) by species determined by the line-intercept method.**

| Species | Treatment | |
|---|---|---|
| | 1954 Cabling | Control |
| Wavy-leaf oak | 12.27±.41 | 11.10±.45[a] |
| Broom snakeweed | 5.06±.16[a1] | 2.74±.13[b] |
| Skunkbush | 3.14±.11[a] | 1.35±.07[b] |
| Mountain mahogany | 0.06±.01 | 0.03[2] |
| Algerita[5] | 0.12[2] | 0.19±.05 |
| Fendler bush[4] | 0.03±.01 | 0.06±.01 |
| Single-seed juniper | 0.89±.09[3] | — |
| Pinyon pine | 0.14±.02[3] | — |
| Totals | 21.91±.72 | 15.50±.64 |

[1]Means in the same row followed by different letters are significantly different ($P<0.1$).
[2]No variance, inadequate number of observations.
[3]Trees that are laterally inclined by the 1954 cabling.
[4]*Fendlera rupicola* Gray
[5]*Berberis haematocarpa* Wooton

**Table 4. Average basal cover (%) by treatment and herbaceous species.**

| Species | Treatment | |
|---|---|---|
| | 1954 Cabling | Control |
| Grass | | |
| Blue grama | 13.21[a][1] | 17.40[b] |
| Wolftail | 1.71[a] | 1.21[a] |
| Sideoats grama | 2.29[a] | 2.25[a] |
| Chihuahua lovegrass | 0.56[a] | 1.46[b] |
| Metcalf muhly | 0.69[a] | 0.96[a] |
| New Mexico muhly | 0.33[a] | 1.33[b] |
| Grass Total | 20.48[a] | 25.58[b] |
| Forbs | | |
| Wild buckwheat | 2.42[b] | 0.71[a] |
| Bladderpod | 1.25[a] | 0.96[a] |
| Showy goldeneye | 3.21[a] | 4.33[a] |
| Louisiana sagewort | 0.29[a] | 1.79[b] |
| Gerard rockcress[2] | 0.67[a] | 0.50[a] |
| Sunflower | 0.54[a] | 1.17[a] |
| Forb Total | 9.46[a] | 13.63[b] |

[1]Means in the same row followed by the same letter are not significantly different ($P<0.1$).
[2]*Arabis gerardi* L.

the time, other studies indicate that herbage production may not be increased appreciably following cabling on these sites.

These data indicate that careful evaluation should be made before a cabling operation is planned. Vegetational response may not give desired results on similar sites, and the treatment may not last long enough to offset initial costs.

## Literature Cited


**Arnold, Joseph F., Donald A. Jameson, and Elbert H. Reid. 1964.** The pinyon-juniper type of Arizona: Effects of grazing, fire and tree control USDA Prod. Res. Rep. No. 8.

**Canfield, R.H. 1941.** Application of the line intercept method in sampling range vegetation. J. Forest 39:388-394.

**Clary, Warren P. 1971.** Effects of Utah juniper removal on herbage yields from Springerville soils. J. Range Manage. 24:373-378.

**Emerson, Fred W. 1932.** Tension zone between grama grass and pinyon-juniper association in northeastern New Mexico. Ecology 13:347-358.

**Evans, R.A., and R.M. Love. 1957.** The point-step method of sampling-a practical tool in range research. J. Range Manage. 10:208-212.

**Hurst, William D. 1977.** Managing Pinyon-juniper for multiple use. *In:* Aldon, Earl F. and Thomas J. Loving (Tech. Coord.). Ecology, uses, and management of pinyon-juniper woodlands. U.S. Forest Sec. Gen. Tech. Rep. RM-39.

**Jameson, D.A., and E.H. Reid. 1965.** The pinyon-juniper type of Arizona. J. Range Manage. 18:152-153.

**Johnsen, T.N. 1962.** One-seed juniper invasion of northern Arizona grasslands. Ecol. Monogr. 32:187-207.

**Kuchler, A.W. 1964.** Potential natural vegetation of the conterminous United States. Amer. Geog. Soc., New York.

**Little, E.L., Jr. 1977.** Research in the pinyon-juniper woodland. *In:* Aldon, Earl F. and T.J. Loring (coord.). Ecology, uses and management of pinyon-juniper woodlands: Proc. Workshop USDA-FS Gen. Tech. Rep. RM-139.

**New Mexico Interagency Range Committee. 1968.** Improving pinyon-juniper range in New Mexico. Rep. No. 2. N.M. Agr. Exp. Sta. Agr. Res. Serv., Las Cruces.

**Owensby, Clenton E. 1973.** Modified step-point system for botanical composition and basal cover estimates. J. Range Manage. 26:302-303.

**Pieper, Rex D., James R. Montoya, and V. Lynn Groce. 1971.** Site characteristics on pinyon-juniper and blue grama ranges in south-central New Mexico. N.M. Agr. Exp. Sta. Bull. 573.

**Skau, C.M. 1961.** Some hydrologic influences of cabling juniper. USDA-FS Ser. Res. Note RM-62.

**Springfield, H.W. 1976.** Characteristics and management of southwestern pinyon-juniper ranges: The status of our knowledge. USDA-FS Res. Paper RM-160.

**Thetford, Frank O., Rex D. Pieper, and Arnold B. Nelson. 1971.** Botanical and chemical composition of cattle and sheep diets on pinyon-juniper grassland range. J. Range Manage. 24:425-430.

**West, Neil E., Kenneth H. Rea and R.J. Tausch. 1975.** Basic synecological relationships in juniper-pinyon woodlands. *In:* Gifford, G.E. and F. E. Busby (eds.). The pinyon-juniper ecosystem: A symposium. Utah State Univ., Logan.