WESTERN JUNIPER, PONDEROSA PINE, AND GRASS

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Encroachment of highly competitive woody plants can be a serious problem throughout western rangelands. Western juniper (Juniperus occidentalis Hook) is such a competitor. It has moved into a wide variety of areas over the past 50 years. A number of factors have lead to the movement of western juniper off the less productive rocky ridge tops and scab areas, where it historically has been found, onto more productive lands. Reduction of natural fire frequency and introduction of domestic livestock are often pinpointed as the two main causes of western juniper expansion.

Concern is centered on encroachment of western juniper into highly productive areas of the sagebrush steppe in central and eastern Oregon. Western juniper's highly competitive nature permits it not only to move into an area but also to dominate it, and in the process substantially reduce understory herbaceous production. Bedell and Bunch (1978) found that removal of western juniper in central Oregon could increase associated understory production by almost 30%. Much of the past research associated with western juniper's competitive ability has centered around effects on understory vegetation; little work has been done on the effect of western juniper on other tree species.

Ponderosa pine (Pinus ponderosa Dougl.) can often be found in association with western juniper in the more mesic areas of western juniper's distribution. Ponderosa pine is a valuable timber species throughout drier areas of the western United States. In areas where western juniper and ponderosa pine occur together it is possible that pine growth is adversely affected. In the summer of 1984, this study was initiated to examine effects of western juniper on herbaceous understory and ponderosa pine growth. Objectives of the study are (1) determine the effect of western juniper on understory production, (2) determine the effect of western juniper removal on diameter and height growth of ponderosa pine.

METHODS

Study areas were near Prineville in Crook County, Oregon. One study area was approximately 12 miles east of Prineville on a northeast slope and the second was 15 miles northwest of Prineville on a south slope near Grizzly Mountain.

Western juniper and ponderosa pine occur intermixed as the overstory, with western juniper occurring more frequently. Density of ponderosa pine is approximately 150 to 200 trees/acre and density of western juniper is about 300 to 350 trees/acre. Soils range from a shallow rocky clay loam to a moderately deep sandy loam. No one soil type is dominant, and there are intergrades between the two. All areas are bordered on the upper slope by ponderosa pine forest and on the lower slope by a continuous juniper woodland. Dominant shrubs are: mountain big sagebrush (Artemisia tridentata spp. vaseyana Nutt.), green rabbitbrush (Chrysothamnus

viscidiflorus (Hook.) Nutt.), gray rabbitbrush (Chrysothamnus nauseosus (Pall.) Britt), bitterbrush (Purshia tridentata Pursh), and wax current (Ribes cereum Dougl.). Perennial grasses present include: Sandberg's bluegrass (Poa sandbergii Vasey), bluebunch wheatgrass (Agropyron spicatum Pursh) Scribn. & Smith), Idaho fescue (Festuca idahoensis Elmer) and junegrass (Koeleria cristata Pers.).

Four treatments were established:

1) Control- all trees left at original densities,
2) Ponderosa pine thinned to 130 trees/acre,
3) Western juniper cleared,
4) Western juniper cleared and ponderosa pine thinned to 130 trees/acre.

Western juniper and ponderosa pine were hand cut in the summer and fall of 1984. Before trees were removed, all western juniper were measured initially for basal diameter (at 12 inches), height, and canopy radius. Ponderosa pine were measured initially in the spring of 1985, before growth started, in the fall of 1985 after growth had stopped, and again in the fall of 1986 after growth had stopped. Diameter at breast height (dbh) and total tree height were taken in each year.

Understory herbaceous vegetation response was estimated from percent cover of individual species. Values are presented for groups of plants based on growth form and include: perennial grass, annual grass, perennial forb, annual forb, and shrubs.

RESULTS

Basal Area Growth

No significant response in basal area growth occurred one or two years after western juniper removal. Trends in the data showed that ponderosa pine trees in treatments where western juniper was removed had greater diameter growth in 1986. Basal area growth per tree was greatest in trees over 12 in dbh two years after western juniper removal (Figure 1). Ponderosa pine trees under 4" dbh had the smallest basal area growth. In the larger two diameter classes, pine trees in plots where western juniper was removed had higher diameter growth, regardless of thinning practice. Larger trees may be better suited to capture additional resources made available after western juniper removal.

Basal area growth was smallest in all diameter classes where only ponderosa pine trees were thinned to 130 trees/acre (treatment #2). Western juniper roots may be able to move into and exploit the additional resources made available by ponderosa pine removal. Rate of ponderosa pine root expansion may be slower than western juniper root growth, allowing western juniper to move its roots into areas once occupied by ponderosa pine roots.

Basal area growth per acre was greatest in plots where western juniper was removed. Similar trends can be seen when compared to growth per tree. Plots where western juniper was removed had greater diameter growth as compared to plots with western juniper present. Ponderosa pine trees in plots where pine was thinned to 130 trees/acre had the smallest total diameter growth.

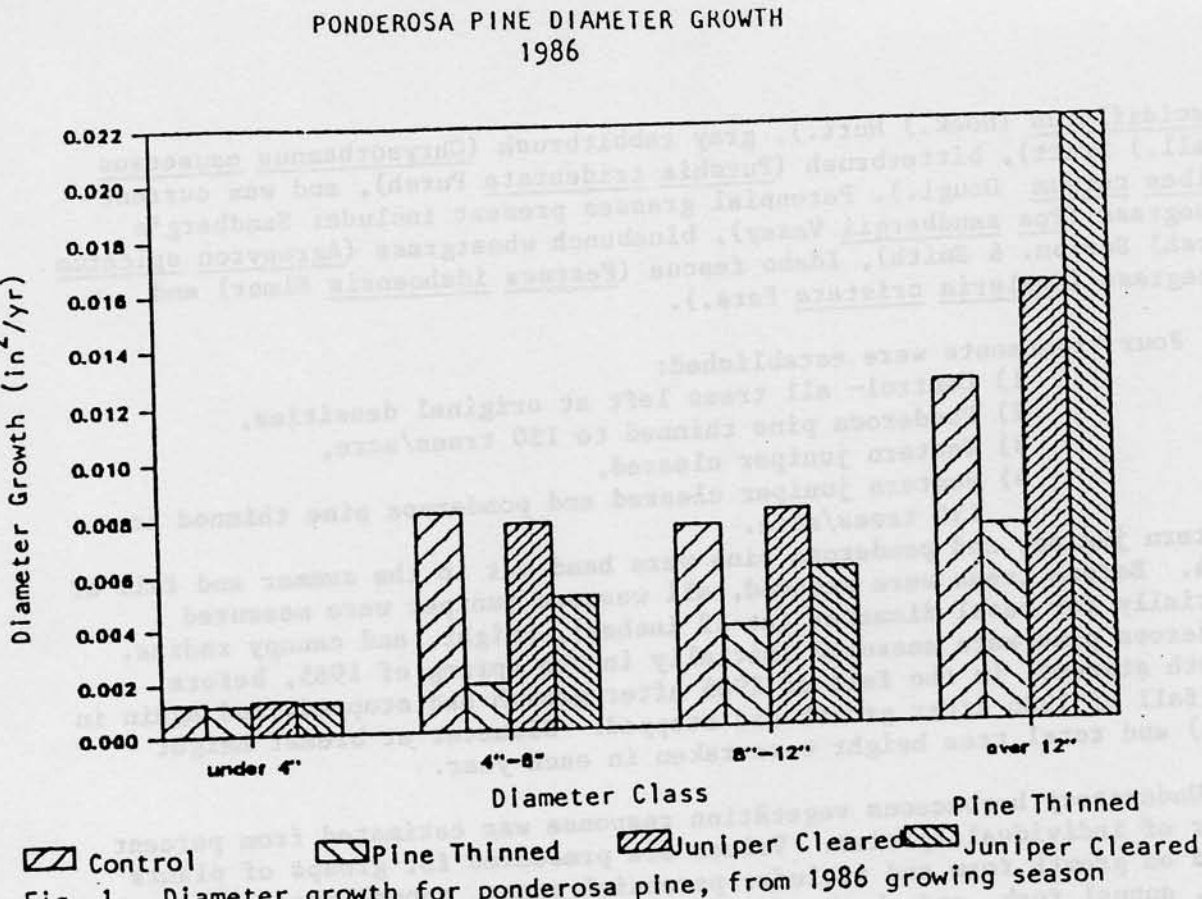

Fig. 1. Diameter growth for ponderosa pine, from 1986 growing season

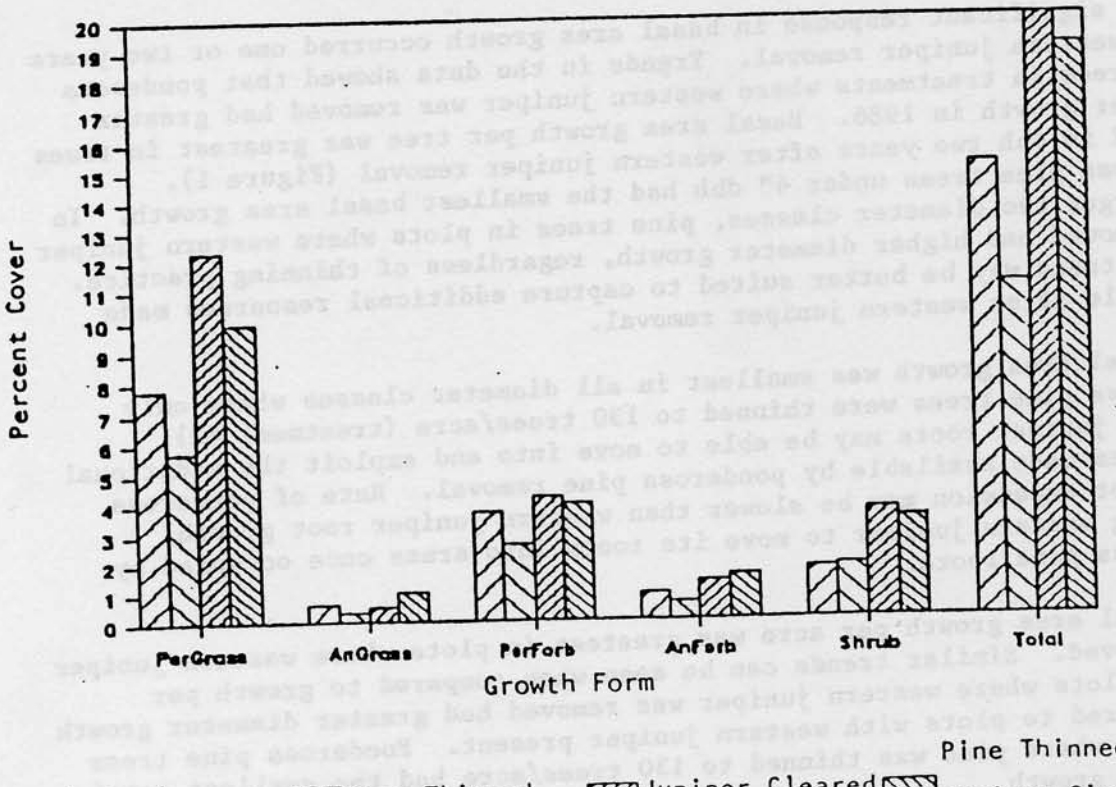

Fig. 2. Percent cover of understory vegetation grouped by growth form, PerGrass (perennial grass), AnGrass (annual grass), PerForb (perennial forb), AnForb (annual forb), Shrubs, and Total cover.

Understory Production

Percent cover estimates were used in 1986 to determine understory response. Plants were grouped according to growth form for analysis. In all groups cover was greatest in plots where western juniper had been removed (Figure 2). Total plant cover was significantly higher in treatments where western juniper was removed (treatments 3&4). Total cover was 15% in the control (treatment 1) where no trees were removed and 11% in treatments where only ponderosa pine was thinned (treatment 2). With juniper removal, total cover was 20% in treatments where only western juniper was removed (treatment 3) and 19% in treatments where western juniper was removed and ponderosa pine thinned to 130 trees/acre (treatment 4). Perennial grass cover was 12% in treatment 3, western juniper removed, and 6% in treatment 2, pine thinned. Idaho fescue, bluebunch wheatgrass, and bottlebrush squirreltail comprised a large majority of the perennial grass group. Perennial forbs, largely composed of lupine and milkvetch, also had higher cover values in treatments where western juniper was removed. Annual plants had higher cover values in plots where both pine thinning and juniper removal occurred. Over all groups, annual plants had the smallest cover values regardless of treatment. Perennial plants with larger root systems may be able to capture additional resources made available by tree removal.

A trend similar to that found in ponderosa pine basal area growth is that understory cover values were least in all groups, except shrubs, where only ponderosa pine was thinned. Reduced cover values may also indicate that western juniper is capable of exploiting resources made available by pine removal. Reduced cover values may indicate that understory plants may not be able to move into these "opened" areas as fast as western juniper.

CONCLUSIONS

Removal of western juniper appeared to benefit larger ponderosa pine trees (more than 12" dbh) more than other diameter classes. Larger trees may have been more capable of capturing the additional resources made available by removal of western juniper. Roots of larger trees occupy large volumes of soil, giving them a better opportunity to access resources freed by western juniper removal. As ponderosa pine diameter class declined the response to treatments also declined.

Reduced growth in ponderosa pine in plots where thinning occurred and western juniper was left at the original density may be explained by the aggressive nature of western juniper. Western juniper is capable of establishing under existing trees and shrubs and in bunchgrasses. It is also capable of turning on its photosynthetic machinery when environmental conditions become favorable which is an effective competitive mechanism allowing western juniper to utilize resources before other plants become active. The window of activity is often much later for many associated plants including ponderosa pine and perennial grasses. When pondersoa pine is removed, western juniper may be able to move into unoccupied areas with its root system thereby closing the site to other species including ponderosa pine. Thinning alone in ponderosa pine/western juniper stands may only benefit western juniper and actually be detrimental to ponderosa

pine. To gain full potential growth of ponderosa pine, western juniper may need to be removed, or substantially reduced.

Understory response to treatment, as measured by percent cover, indicated that western juniper removal benefits understory plant growth regardless of thinning treatment of pine. Perennial grasses seemed to benefit the most from western juniper removal; annual plants showed little change regardless of treatment. Low natural levels of annual grasses and forbs in this area may account for the lack of response. Total cover was greatest in plots where only western juniper was removed.

Management of mixed ponderosa pine and western juniper for both timber and forage may best be accomplished by removal of western juniper and retention of ponderosa pine at original densities. Areas with greater densities of ponderosa pine than those present on the study sites may require thinning and western juniper removal to obtain maximum production of both forage and timber.

LITERATURE CITED

Bedell, T. E., and T. R. Bunch. 1978. Effects of western juniper on forage production and livestock grazing management. IN: Proceedings of Western Juniper Ecology and Management Workshop. Bend, Or. pp. 11-29. USDA Forest Service General Technical Report. PNW-74.