SOME ECOLOGICAL ATTRIBUTES OF WESTERN JUNIPER

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Western juniper (Juniperus occidentalis ssp. occidentalis) is a long-lived short to medium height tree present in almost all eastern Oregon counties. The center of its distribution and largest continuous expanse is in the central part of the state. Estimates of aerial extent range from 1,773,000 acres to more than 2,816,000 acres.

Since the turn of the century, western juniper has been actively invading previously unoccupied rangelands in central and eastern Oregon and although the rate of expansion has not been determined, the present area may be as much as double that present in the late 1800's. Expansion is usually attributed individually to reduce fire frequency, climatic changes, heavy grazing or to some combination of the three.

Increasing juniper density and size has the apparent effect of reducing understory plant cover and productivity, with forage grasses being most severely reduced. Also, water infiltration rates are reduced while sediment yield is increased. Understory plants may be negatively affected by juniper induced reduction in light, soil moisture, and soil nutrients and by allelopathic factors (plant toxins) in juniper litter and root exudates.

Research on the western juniper type has not been extensive. Available data do not provide adequate guidelines for control or management. Therefore, during the summer of 1982 studies were begun on the biology and ecology of western juniper. Long term objectives are to determine geographic distribution of invasion stands, magnitude of spread and site conditions conducive to invasion. Current primary effort is centered southeast of Prineville in Crook County where site-specific effects of juniper on associated vegetation and soils are under investigation.

PROCEDURE

Several sites have been selected in the Comb's Flat area and adjacent slopes for measuring relationships of tree density and size to understory vegetation patterns. Particular emphasis is being placed on forage plants. Understory plant cover and productivity are being determined from belt transects which radiate out from tree boles. Tree measurements include age, height, canopy spread, and distance from other trees. Attributes of the physical environment being measured include precipitation, soil moisture, temperature, and light.

Paired areas are being selected, one of which is to be cleared of juniper trees after completing tree measurements. In cleared areas understory plant response to tree removal will be measured and compared to uncleared areas. Measurements will be similar to those used on the uncleared plots.

Western juniper litterfall exceeds decomposition. Therefore, a buildup of leaves and twigs in various stages of decay is evident beneath the canopy. Roots extend well beyond the canopy; however, depth and distance of spread is not known. These roots may be removing minerals from the open areas between canopies and concentrating them within the tree. Litter which is composed of leaves and small twigs transfer some of these minerals to the soil surface beneath the canopy.

The possibility of nutrient impoverishment in the interspaces and nutrient enrichment beneath the tree is being studied by nutrient analyses of soils from these areas and by measuring plant growth response of the same soils in greenhouse experiments. Leachate obtained from the litter fraction is being used to water some of the plants for evaluating the presence of water soluble phytotoxic compounds.

RESULTS

Research just began in the summer of 1982. However, certain aspects provide insight into western juniper ecology.

Distinct vegetation zones appear about the bole of western juniper trees. Larger trees, more than 70 years of age, generally have a bare zone next to the bole followed by an outer bunchgrass zone. Some trees, however, have a cheatgrass (Bromus tectorum) zone inside that of bunchgrass and an outer zone from which larger bunchgrasses are absent. Vegetation beyond the canopy edge is usually quite different from that beneath the canopy. Frequently, plant species are different under the southwest portion of the canopy as compared to those under the northeast portion of the canopy.

Rain gauges located between and beneath tree canopies indicate that the canopies of larger trees intercept nearly 74 percent of the precipitation. Rainfall at Comb's Flat totaled 14.3 inches from October 1, 1982, to April 29, 1983. Beneath juniper canopies only 3.6 inches reached the surface. In particular, the litter surface on the northeast side of the tree received the least moisture. Only 1.3 inches of precipitation were measured in this quadrant for the above period; indeed, for several months the northeast canopy segment appeared to intercept 98 to 100 percent of the total rainfall.

Maximum juniper canopy cover encountered on the areas examined was 38 percent and the maximum number of stems per acre was 283. Forage plants present beneath the juniper canopy are not readily available to the grazing animal and, although not all such forage is unavailable, a 38 percent canopy cover would represent a sizable loss of grazable area for livestock. If, in addition, the canopy intercepts 74 percent of the rainfall, then a 38 percent canopy cover could reduce rainfall reaching the soil surface on each acre by as much as 28 percent. This latter value is an overestimate due to unaccounted for stem flow of rainfall and also due to many canopies being of less height than those under which interception was measured.

Areas under study have been invaded by juniper during the last 100 years. The mean age of juniper trees on the lower slopes was 43 years, while that of the upper slope was 64 years. Plots in the lower flat indicate that more than 80 percent of the trees became established between 1935 and 1950, while on the upper slopes more than 70 percent became established between 1908 and 1925.

Average height growth of the older trees (60-70 years old) was four inches per year, and these had an average bole diameter growth of 0.16 inches per year. Dominant and unsuppressed trees in the stand did not grow any faster in height but did increase their bole diameter as much as 0.6 inches per year. Individuals which appeared late in the invasion phase exhibited suppression by larger, older trees. Height growth for these younger trees frequently was less than one inch per year, and bole diameter growth was less than 0.03 inches per year.

SUMMARY

Impacts of western juniper appear evident since the trees markedly change patterns of vegetation and moisture at the ground surface. Research is to continue on nutrient redistribution, magnitude of forage loss, juniper root development, soil moisture use patterns, and several biological aspects such as phenology, sex development in invading stands, and physiology.