Stand age and species composition at Prairie Farm Creek, Oregon

A report submitted to the 1997 North American Dendro Fieldweek H.J. Andrews Experimental Forest, Blue River, Oregon

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Introduction

Stand development patterns, reflected by age and species composition distributions, are typically determined by on-site ring-counts. However, ring counts made in the field are inaccurate, because surfaces are rough, magnification is usually crude, and ring anatomy may require interpretation. Further, stand development patterns are often being compared to discrete disturbances such as fires. In such cases, it is necessary to know the precise calendar year during which an individual tree-ring was grown. In such cases, dendrochronological methods should be applied to the determination of stand structure. In this study, we use tree-ring analysis to determine the stand age and species composition structure of a stand of conifer species growing on a dry site in south-central Oregon.

Site Description

The Prairie Farm Creek (Township 12 South, Range 10 East, Section 11, southwest 1/4 of northeast 1/4) study site was located 25km north of Sisters, Oregon, on the Sisters Ranger District of the Deschutes National Forest. The elevation of the generally south-facing site ranged from 1035-1075m. Slopes within the study area varied between 0 and 45 degrees, with steeper slopes occurring in the lower half of the study area. The site was located in the ponderosa pine (Pinus ponderosa) Vegetation Zone (Franklin and Dyrness 1973). Other tree species on the site included Douglas-fir (Pseudotsuga menziesii), western juniper (Juniperus occidentalis), and incense cedar (Calocedrus decurrens). Common understory species included bitterbrush (Purshia tridentata), squaw carpet (Ceanothus prostratus), Idaho fescue (Festuca idahoensis), bluebunch wheatgrass (Agropyron spicatum). The site was underlain by a 4-7 million

year-old welded rhyolitic lapilli tuff and was locally capped by weathered basalt boulders (P. Pringle, personal communication).

Methods

Following an initial reconnaissance of the Prairie Farm Creek drainage, a 100m by 300m study area was established on the north side of the main drainage, just uphill from Road No. 11. Two upper-slope, one mid-slope, and two lower-slope 0.025ha circular plots (8.92 m radius) were systematically located at 75m intervals within the 3.0ha area. All live trees (dbh $\geq$ 10cm), saplings (dbh < 10cm and height > 1.37m), and seedlings (height < 1.37m) were tallied by species within each plot. Tree diameter at breast height (DBH, defined as 1.37 m) was recorded for each tree. Two increment cores were extracted at a height of 50cm from each tree. The increment cores were extracted from opposite sides of the tree and parallel to the slope contour, except where prevented by proximity of tree boles or other obstacles. The increment cores were prepared and cross-dated to estimate establishment dates using standard dendrochronological techniques (Swetnam et al. 1985). Tree ages reported are the number of years from pith to outermost ring at 50 cm.

Eleven cores (nine Douglas-firs and two ponderosa pines) were measured on a sliding scale micrometer. A standardized index series was generated with a negative exponential regression in the program ARSTAN using eleven tree-ring series. The program PRECON was used to determine climatic response functions and to generate a series of predicted tree-ring series as a function of climate.

Results

Tree basal area averaged across the plots was 27 m2/ha. Density of trees, saplings and seedlings was 456 per ha, 248 per ha, and 128 per ha, respectively.

From the sapling size class and larger, ponderosa pine exhibited a reverse-J diameter distribution (Figure 1). However there were few pines in the seedling size class. Tree-size Douglas-firs exhibited a unimodal size distribution; however, Douglas-fir was relatively abundant in the seedling and sapling size classes. Juniper was rare in all size classes. Incense cedar occurred only in the seedling and sapling size classes, but accounted for the second greatest number of seedlings.

Density of seedlings, sapling, and trees varied by slope position (Figure 2; data for trees similar but not shown). Juniper had its greatest relative abundance at lower and middle slope positions, where tree density was relatively low. On the upper slope, stems were more numerous and pine and Douglas-fir were the most common species. Incense cedar occurred only on the upper slope.

In general, tree diameter was a poor predictor of age (Figure 3). Tree DBH ranged from 10 to 65 cm and ages ranged from 50 to 270 years. Most trees were between 75 and 125 to 100 years old. Trees within this age range varied in DBH from 10 to over 60 cm. Small trees ranged widely in age, including a ponderosa pine with a DBH of 15 cm at an age of over 230 years.

During the interval of peak recruitment, ponderosa pine and Douglas-fir exhibited slightly differnt temporal patterns (Figure 4). Whereas recruitment of pine peaked between 1880 and 1899, Douglas-fir recruitment peaked between 1900 and 1919. Not shown on Figure 4 is one juniper individual that established in 1804.

The 10-year average series is correlated with the detrended series but filters out the high frequency responses. The climatic analyses of standardized ring-widths is significantly correlated with November, December, March, and April precipitation. Growth in the current year is highly correlated with prior years' growth. Estimated indices are based on regional precipitation and temperature. Fourteen cores from plot 4 and 6 cores from plot 5 were ocularly examined for growth releases and suppression periods. Point A corresponds to time of growth release in 6 of 14 cores from plot 4 and 1 of 6 cores from plot 5. We attribute this release to effects of disturbance in plot 4, probably logging. Point B corresponds to a time of growth releases in both plots 4 and 5. Part of the unassessed variance is attributable to prior growth. Point C shows growth decline observed in the chronology is believed to be a response to competition in plot 4. Note that trees in plot 4 are about 90 years old (76-111 rings at 50 cm aboveground).

Discussion

There were four tree species at this site, and few were older than 100-125 years. There is physical evidence of at least one and probably more logging events at the site; it is likely that some of the larger trees, especially the ponderosa pines, were removed at the end of the nineteenth and during the twentieth century.

Diameter is rarely a good predictor of age, and these data fully demonstrate that observation. Figure 3 we sampled a tree over 200 years old, but only 15 cm DBH and at the same time, another two trees of the same age, but almost 60 cm DBH. It is not unlikely that the ponderosa pines that we classified as saplings due to their size are actually 50-100 years old.

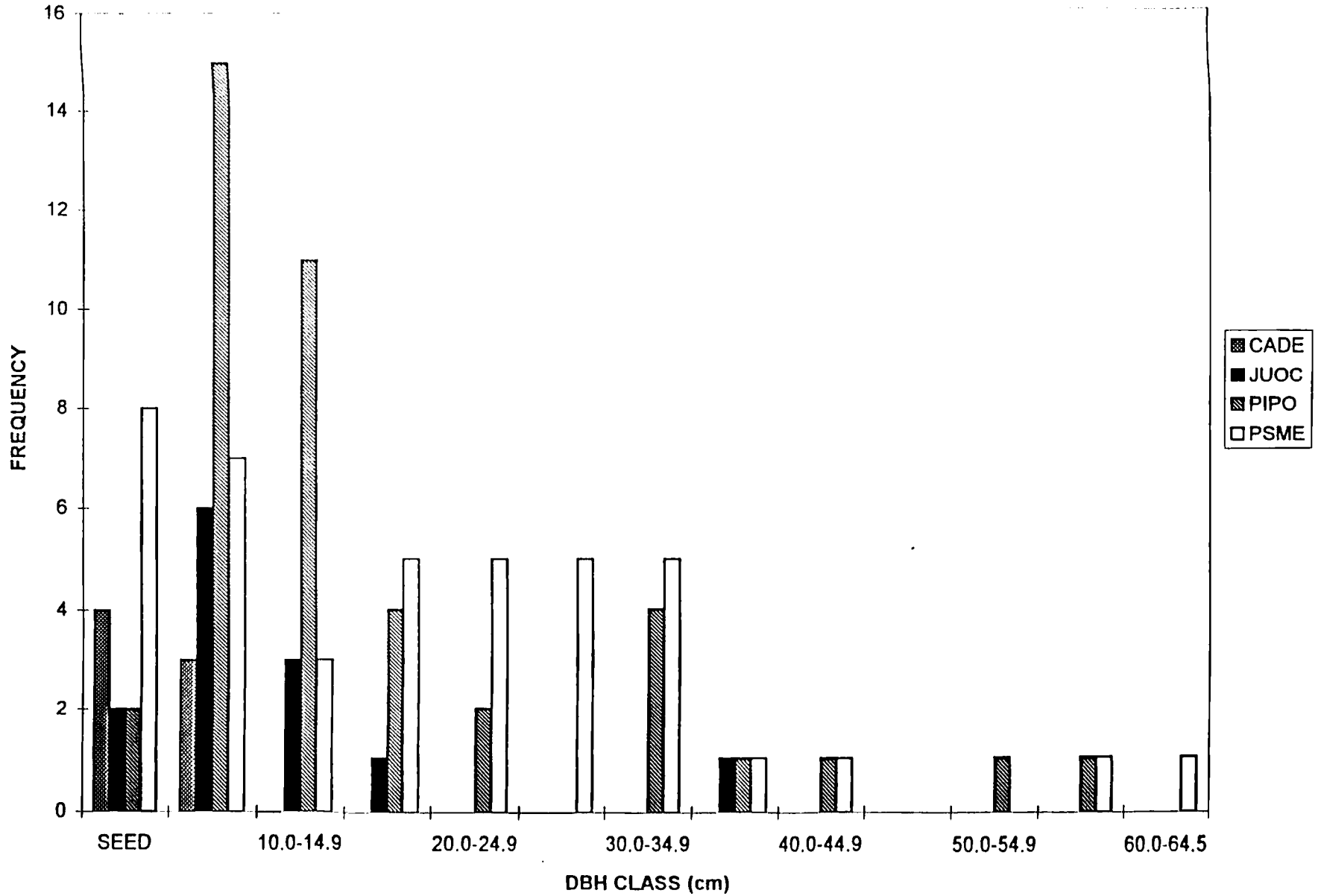
Most trees occurred at the top of the slope, and were mostly young Douglas-firs. Most of the larger trees were at the mid-slope position, which might be a less convenient locale from which to log trees. The seedling class is dominated by incense-cedar and and Douglas-firs; there are few ponderosa pine and juniper seedlings. Incense cedar occurs only at the top slope positions (lower slope and more mesic) while juniper tends to occupy the bottom slope positions (relatively drier).

The last fire at this site occurred in 1886 (see Brown and others, report of the 1997 Fieldweek). While ponderosa pine and large junipers and Douglas-firs are relatively fire-resistant, incense cedars are not. In the absence of fire, it seems likely that the next forest at this site will be dominated by Douglas-fir and incens-cedar.

Literature Cited

Swetnam, T.W., M.A. Thompson, and E.K. Sutherland. 1985. Spruce Budworms Handbook: Using dendrochronology to measure radial growth of defoliated trees. USDA Forest Service Agriculture Handbook No. 639. Washington, D.C. 39 pages.

SPECIES - DIAMETER DISTRIBUTION



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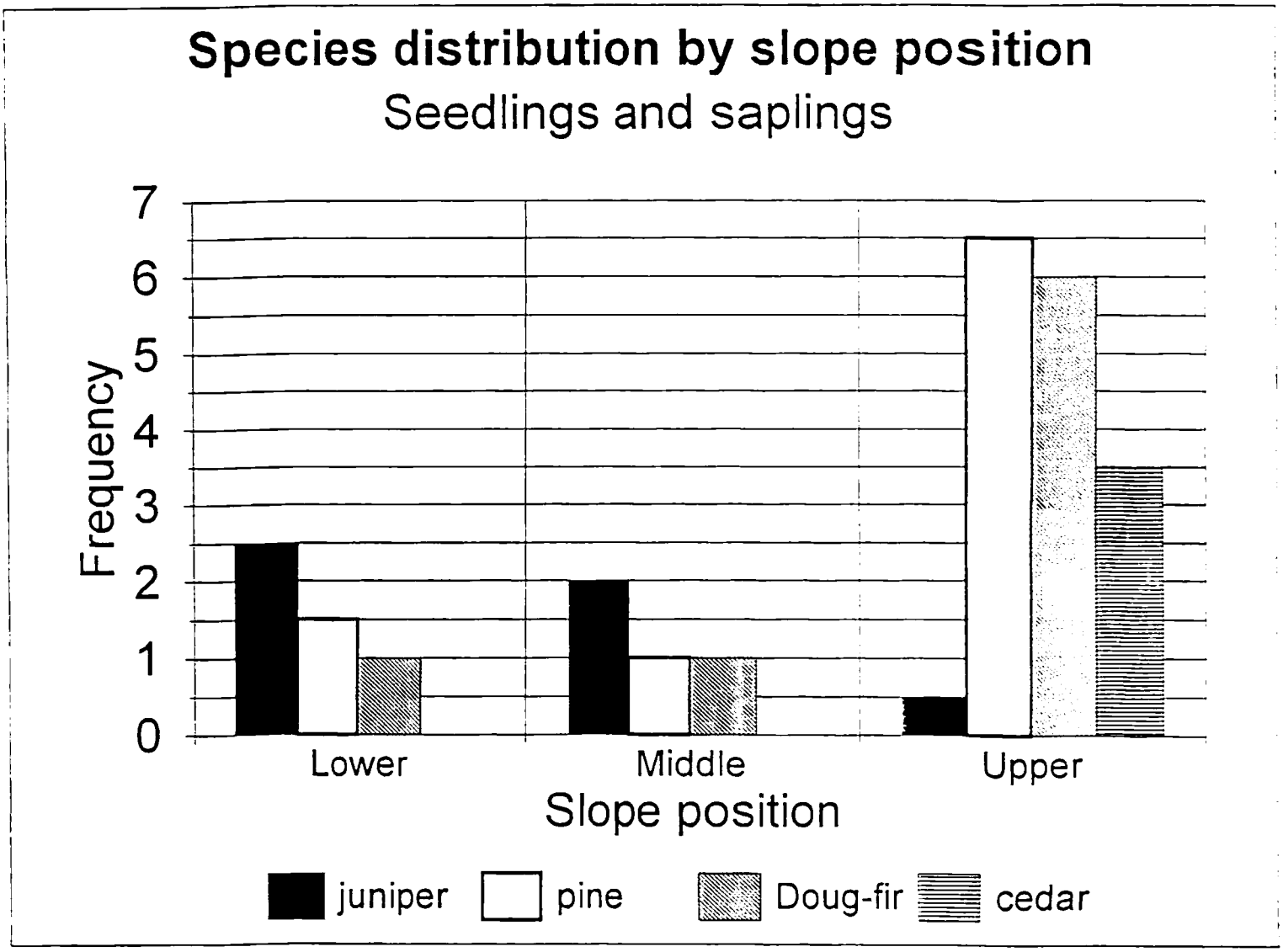
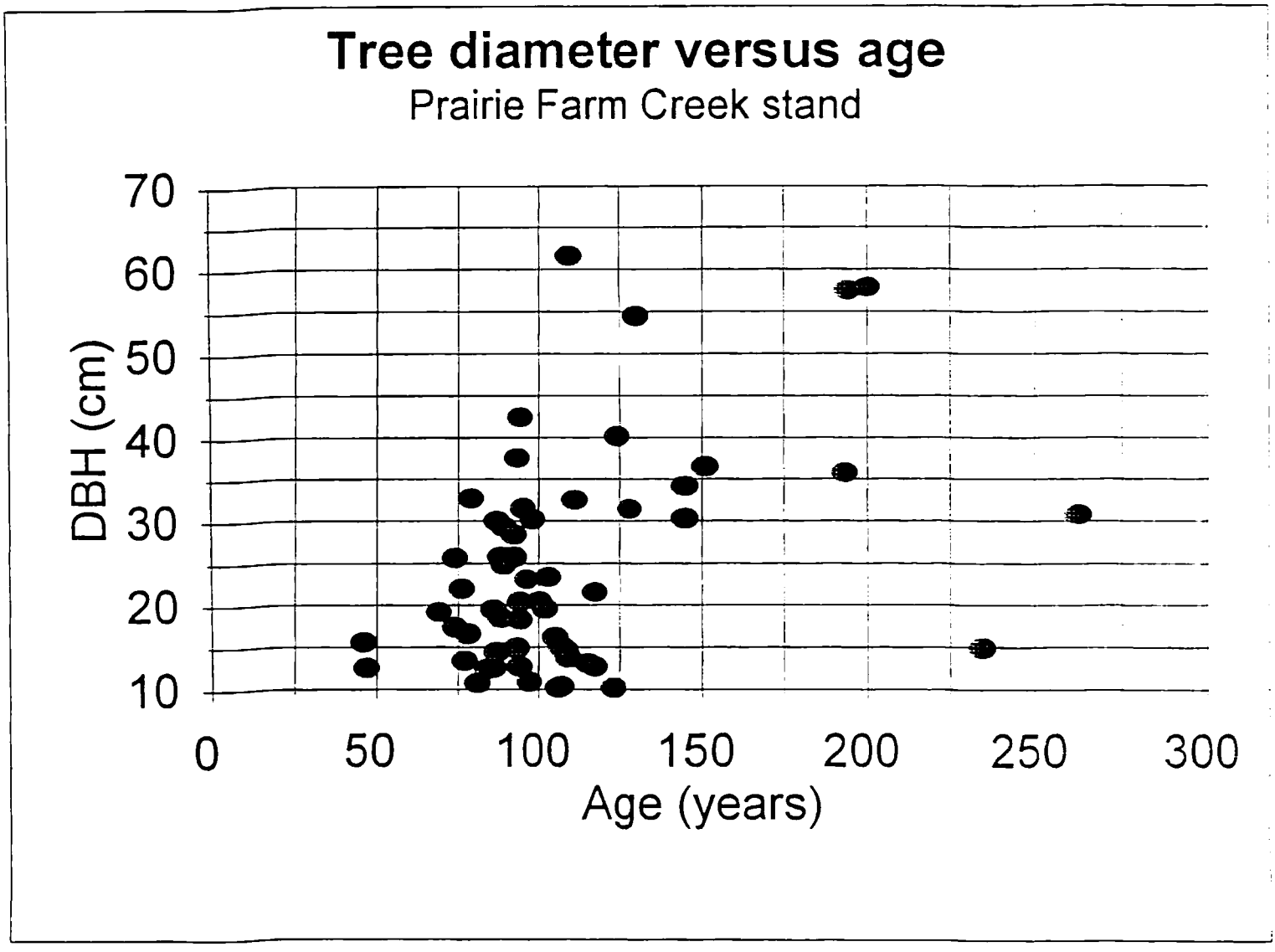
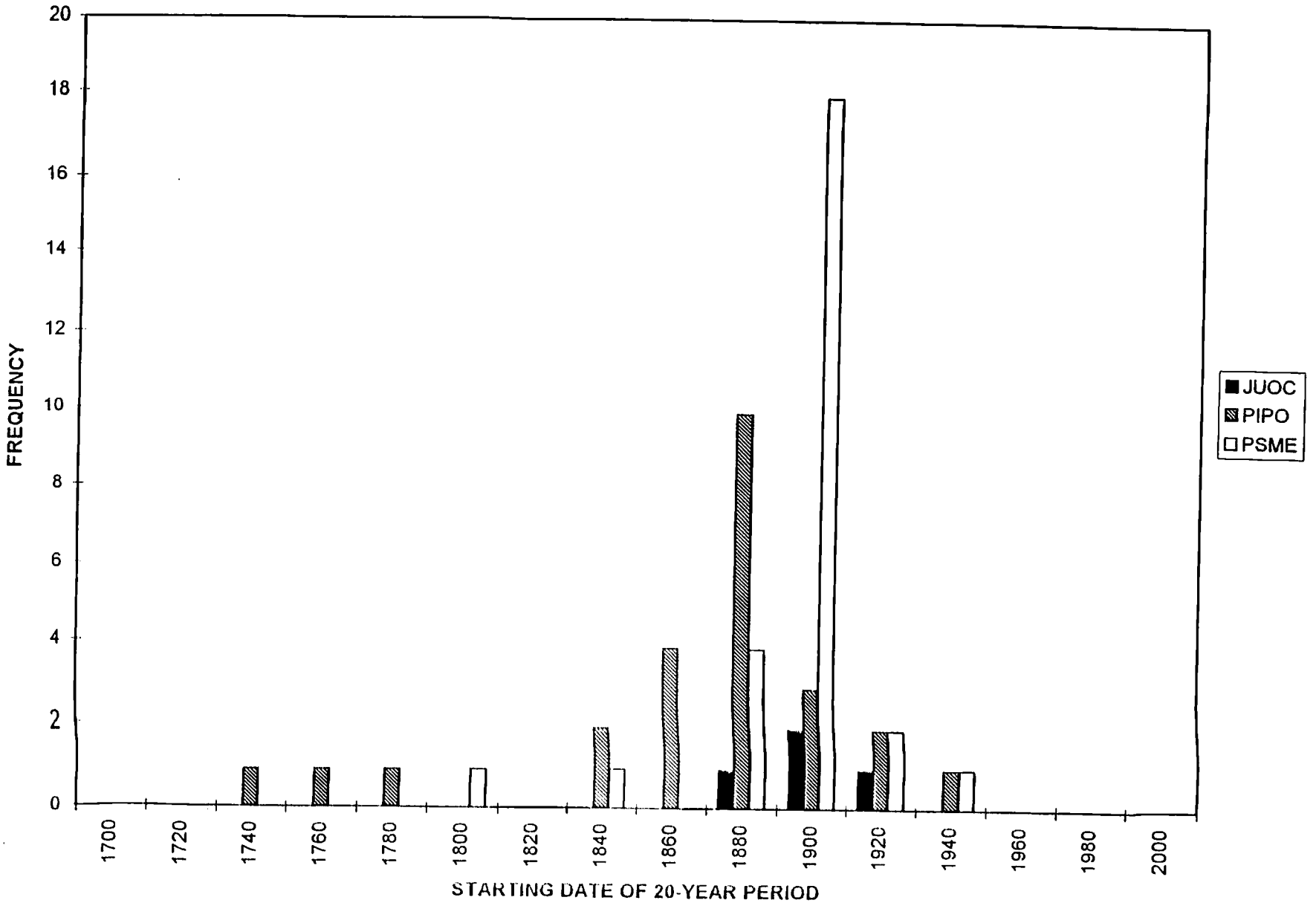

Species distribution by slope position
Seedlings and saplings
Frequency
0
1
2
3
4
5
6
7
Lower
Middle
Upper
Slope position
juniper
pine
Doug-fir
cedar

3

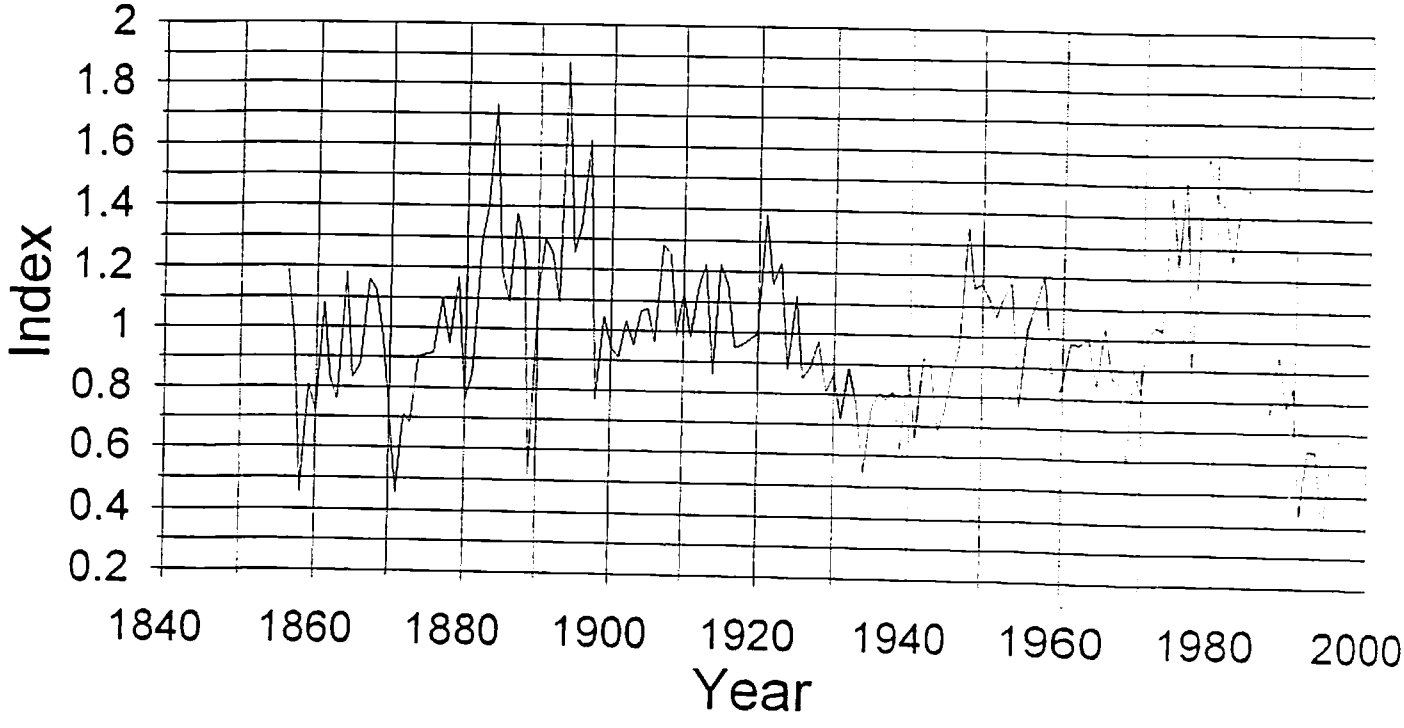

Tree diameter versus age
Prairie Farm Creek stand
DBH (cm)
70
60
50
40
30
20
10
0
50
100
150
200
250
300
Age (years)

SPECIES RECRUITMENT BY 20-YEAR PERIOD

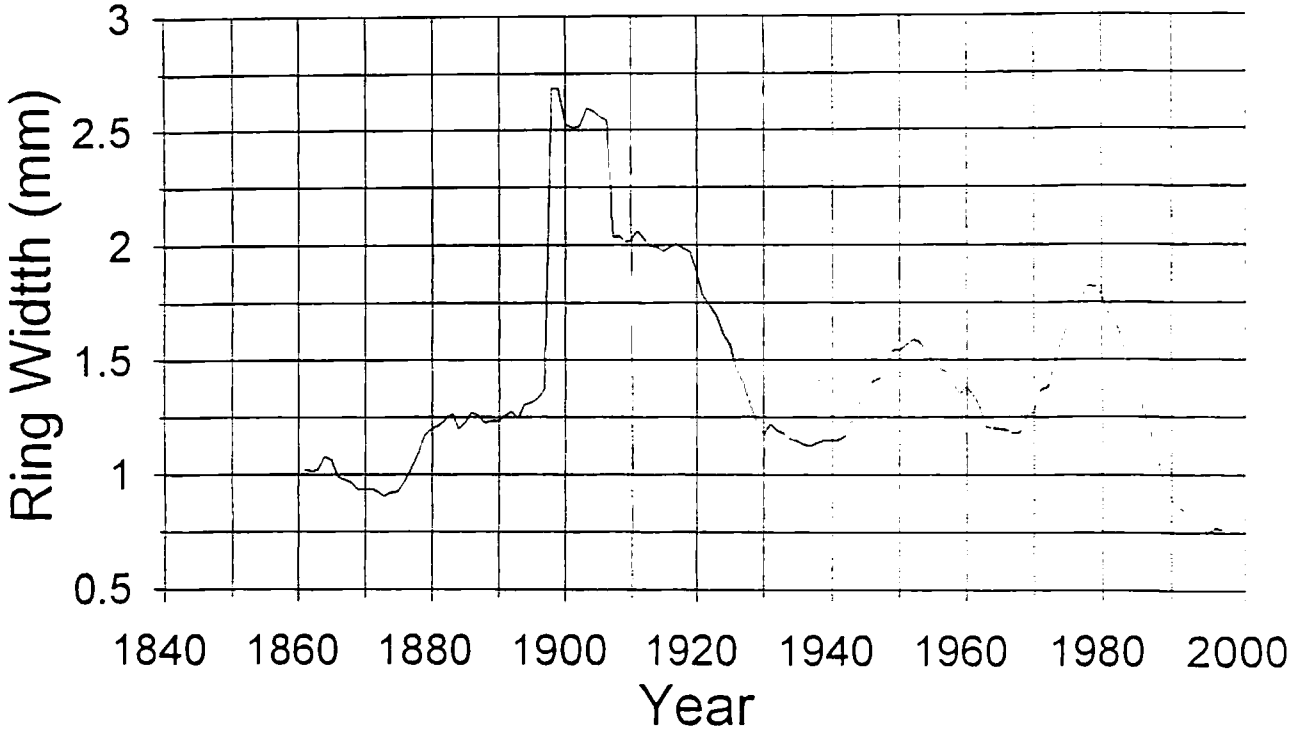


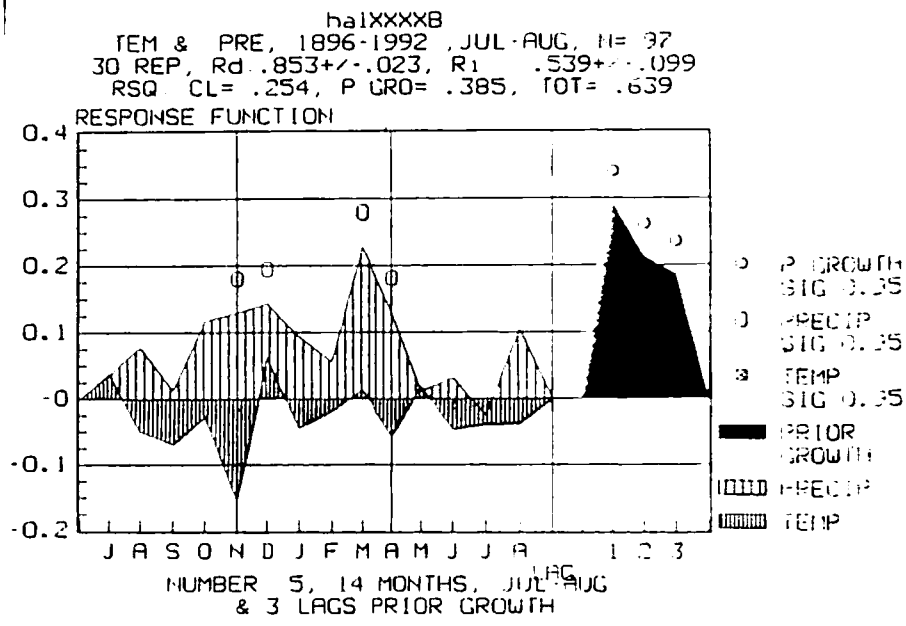
Standardized Ring Widths

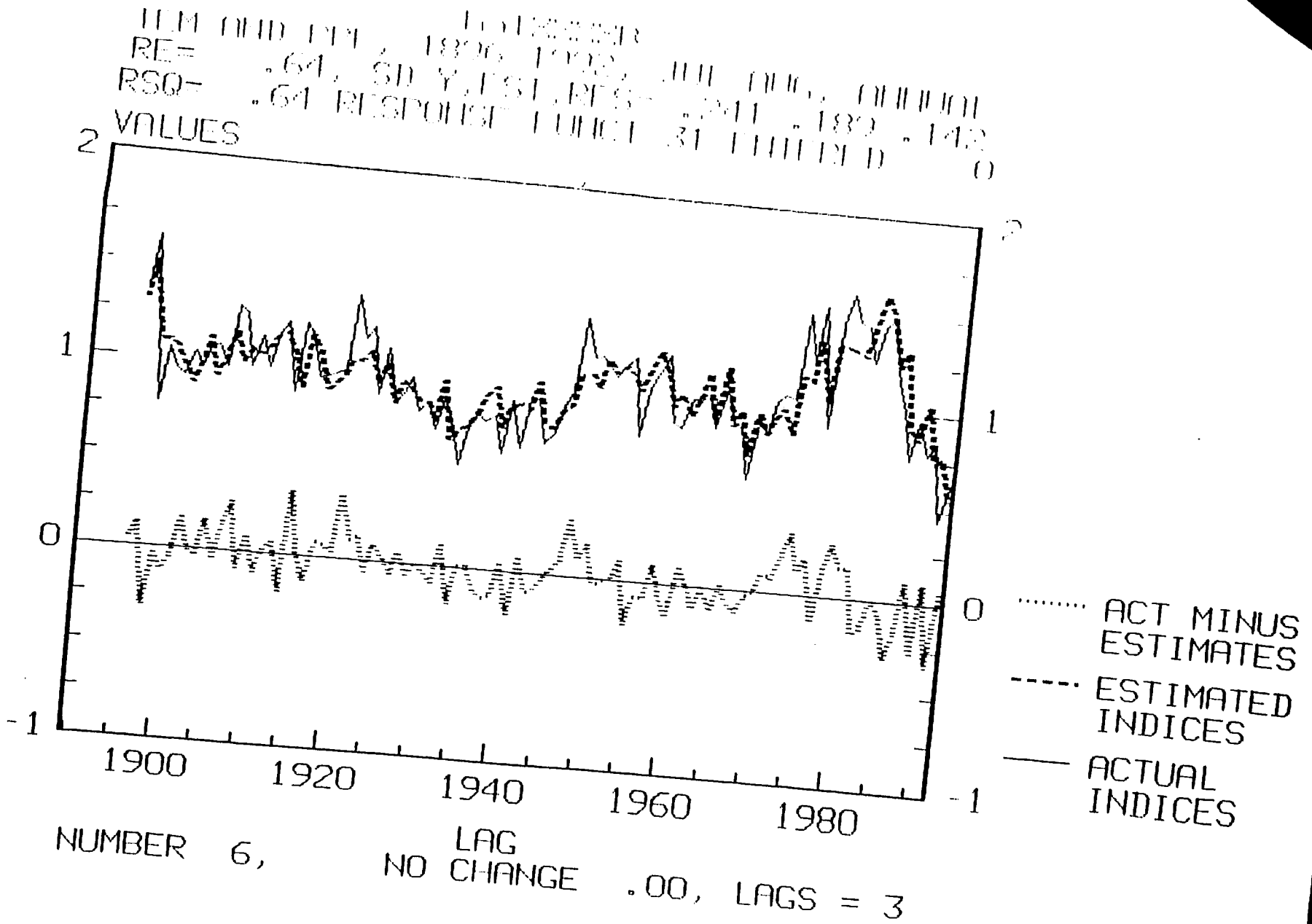
Arstan



Moving Average
10 - Year




hal XXXXB
TEM & PRE, 1896-1992 ,JUL-AUG, N= 97
30 REP, Rd .853+/-.023, R1 .539+/-.099
RSQ CL= .254, P GRO= .385, TOT= .639
RESPONSE FUNCTION
0.4
0.3
0.2
0.1
-0
-0.1
-0.2
J A S O N D J F M A M J J A 1 2 3
LAG
P GROWTH SIG 0.05
PRECIP SIG 0.05
TEMP SIG 0.05
PRIOR GROWTH
PRECIP
TEMP
NUMBER 5, 14 MONTHS, JUL-AUG
& 3 LAGS PRIOR GROWTH



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