RECENT TREELINE MIGRATION ON ROGERS PEAK, COLORADO

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INTRODUCTION

During 1989-91, David Yamaguchi noticed a recent treeline advance on Rogers Peak in the Colorado Front Range. Small bristlecone pine (*Pinus aristata* Engelm.) are growing among dead standing trees and downed remnants of an older forest up to 40 m above timberline (defined as the present limit of mature trees). This suggests that there has been a past retreat and recent advance of timberline at this site. Before the recent advance there was apparently no successful bristlecone pine colonization above timberline since the establishment of the relict forest. Explanations for this observation include a lack of seed source (unlikely in view of the many mature trees nearby) and/or a recent change toward climatic conditions that have favored seedling establishment.

We designed our study to address the following questions:
(1) When did the relict forest establish?
(2) How old is the modern timberline forest?
(3) How old are the saplings?
(4) Are climatic changes associated with the recent treeline advance?

Answers to the first two questions will determine if the upslope advance of bristlecone pine was limited by seed availability in the past. Answers to the second two questions will allow us to estimate when recruitment above timberline began and to identify any associations between sapling establis hment and recent climate trends.

STUDY SITE

The site is located above Lincoln Lake 1.5 km east of Rogers Peak (Fig. 1). Vegetation is subalpine forest and alpine tundra. The site lies on a steep (32°) open south-facing slope at an elevation of 3,560 to 3,660 m. Soils are derived from granitic bedrock and are shallow and poorly developed. Patches of elk turds, large boulders, and grus (disintegrating granite) are common. Timberline is at about 3,630 m.

METHODS

(1) Cores from dead trees above timberline were crossdated with each other and visually matched against a bristlecone pine master chronology from Mount Goliath, 2 km to the north (D. Graybill, unpublished data). Crossdating was aided by computerized cross correlation (Yamaguchi and Allen, 1992). Dates were confirmed by visual comparison of skeleton plots of the relict cores with that of the master chronology.

REFERENCES

LaMarche, V.C. Jr. and Mooney, H.A. 1972. Recent climatic change and development of the bristlecone pine (P. longaeva, Bailey) krumholz zone, Mt. Washington, Nevada. Arctic and Alpine Research 4: 61-72.

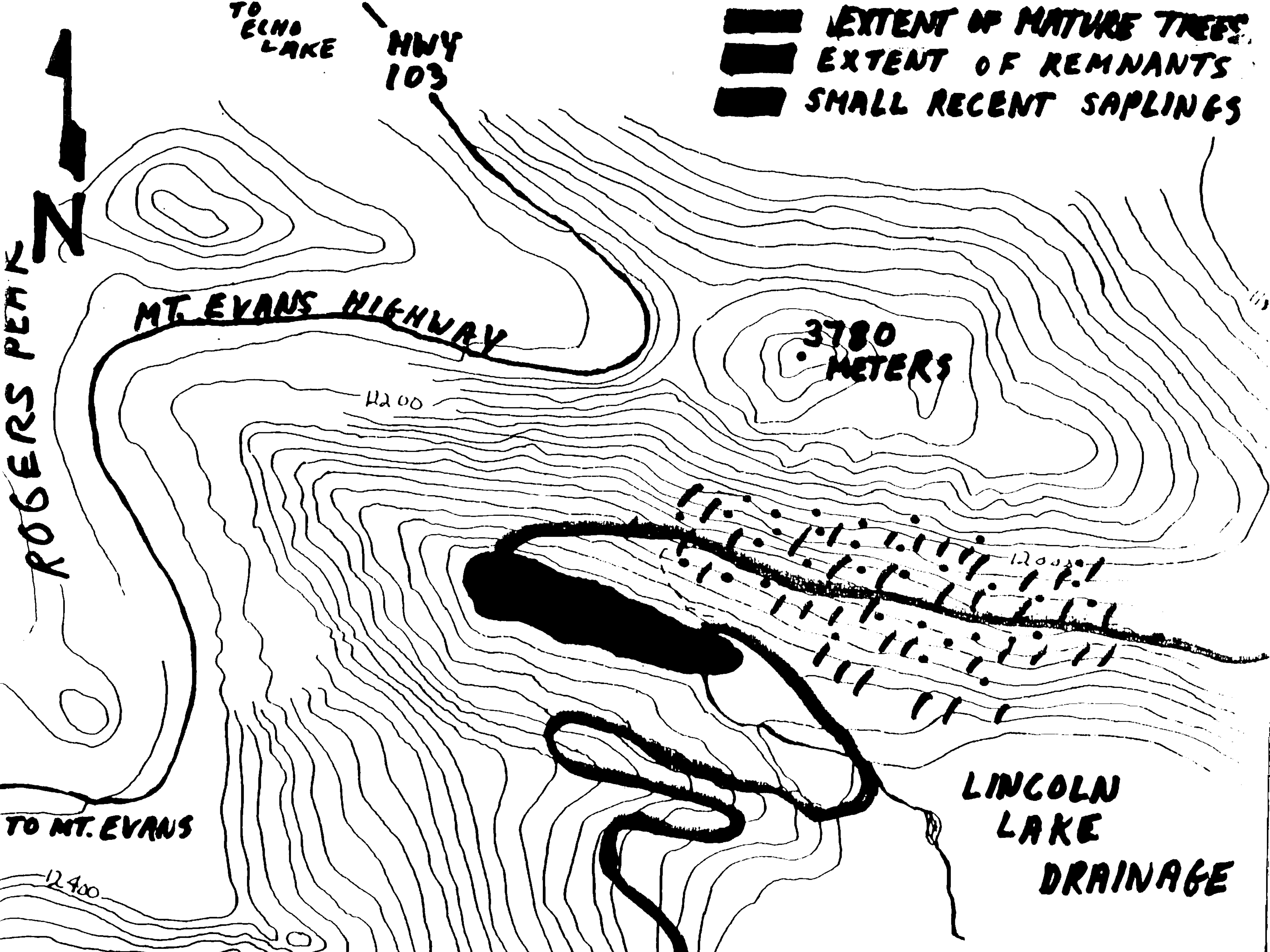
Yamaguchi, D.K. and Allen, G.L. 1992. A new computer program for estimating the statistical significance of cross-dating positions for "floating" tree-ring series. Can. J. For. Res. 22 (in press).

Figure 1. Study area.

Figure 2. Diagram of crossdating of remnant chronologies with the master chronology (D. Graybill, unpublished data; N = overlap size, R = correlation coefficient, T = Student's t value).

Figure 3. Scatter plot of height and diameter for all above-timberline saplings. Circled data points show saplings for which age estimates are available from ground-height increment cores.

Figure 4. Instrumental climatic records for which 1895-1945 means were significantly different from 1946-1988 values (t-test, $p<0.05$). (A) Colorado division 4 July temperatures. (B) Colorado Division 4 April precipitation. (C) Maximum, minimum and mean July temperatures at Dillon. (D) Maximum and minimum July temperatures at Fort Collins.



EXTENT OF MATURE TREES
EXTENT OF REMNANTS
SMALL RECENT SAPLINGS
TO ECHO LAKE
HWY 103
N
ROGERS PEAK
MT. EVANS HIGHWAY
12200
3780 METERS
12000
TO MT. EVANS
12400
LINCOLN LAKE DRAINAGE

Fig 1

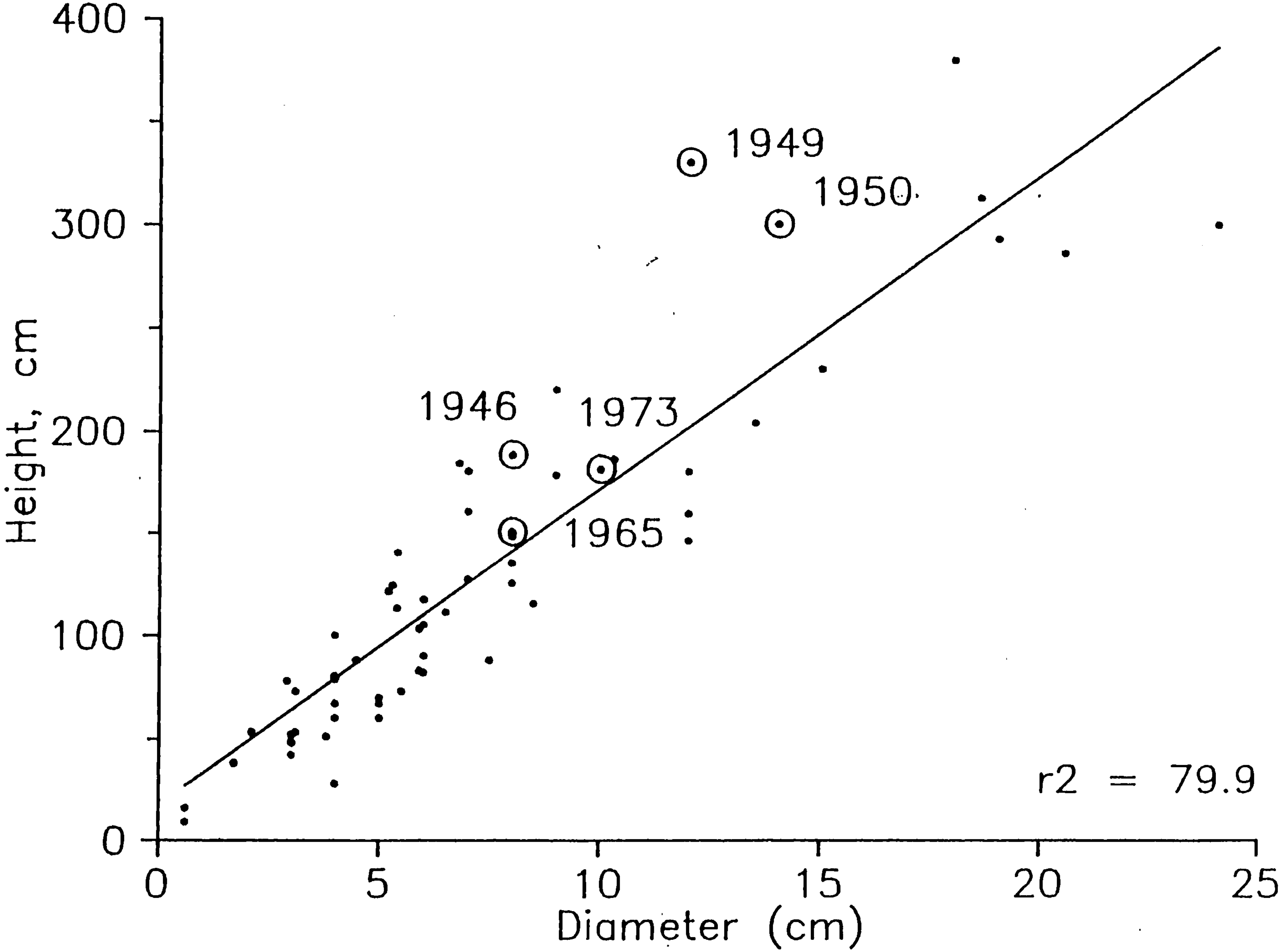

400
300
200
100
0
Height, cm
0
5
10
15
20
25
Diameter (cm)
1949
1950
1946
1973
1965
r2 = 79.9

Fig 3

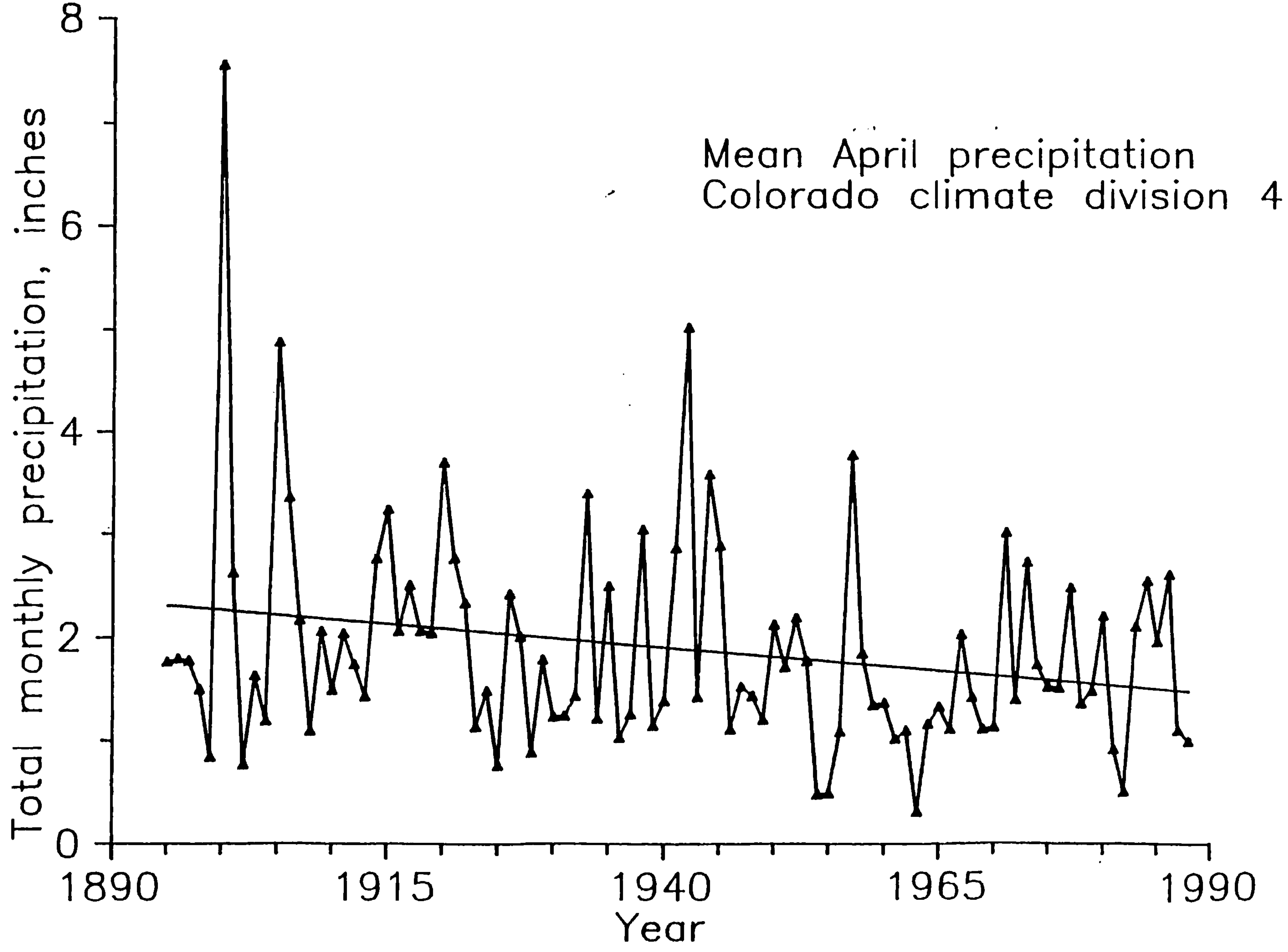
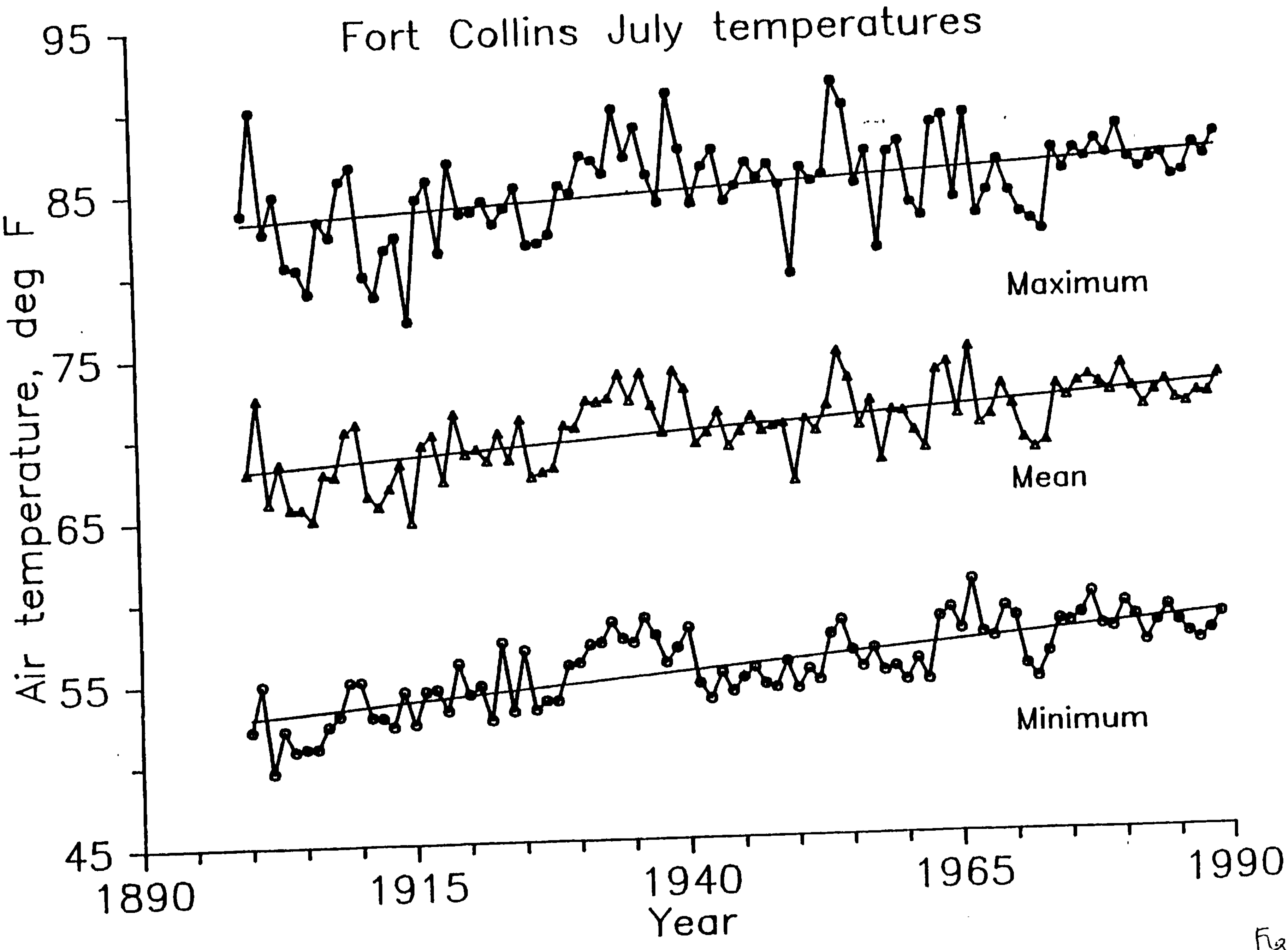

Mean April precipitation
Colorado climate division 4
Total monthly precipitation, inches
0
2
4
6
8
1890
1915
1940
1965
1990
Year

Fig 9.13


Fort Collins July temperatures
Air temperature, deg F
95
85
75
65
55
45
1890
1915
1940
1965
1990
Year
Maximum
Mean
Minimum
Fig. 4 D