Phipps, October 12, 1990

Long-Term Growth trends in High Altitude Red Spruce, Mt. Washington, New Hampshire

Background. Growth decline of red spruce has received considerable attention. Many studies have been involved with visual symptoms, and plot or stand data. Tree-ring studies of red spruce, for the most part, could not address growth quantity because they were based either on ring widths or on dimensionless tree-ring indices. Old-growth red spruce is known to exist at high altitude on Mt. Washington.

Objectives. The general objective was to describe the long-term growth trend of old-growth high altitude red spruce at Mt. Washington. A more specific onjective was to provide instruction and hands-on experience in field collection of increment cores, sample preparation, tree-ring measurement, and analysis of measurement results.

The Group. My group was composed of:

David Laing
Marie-Louise Smith
Marianne Burke
Peter Schoonmaker
Mark Twery
Skee Houghton

Approach. It was discovered that Ed Cook had a red spruce collection site just below timber line near the Auto Road. We decided to try to sample from his site. We were not convinced that we found Ed's exact site, but we think we were close.

Curiously, I do not have a record of the exact number of increment core samples taken by the group. We took two samples from each tree, with the samples being from opposite sides, parallel to the slope contour. From information that I retained, it *appears* that we sampled 19 trees.

Transverse surfaces were prepared on the cores, and the rings were measured to the nearest 0.01mm. In the interest of saving time, it was decided to not crossdate before measurement. Rather, we would graphically examine measurement results. A total of 22 cores were measured.

Basal area increments were calculated from ring-width measurements and examined graphically on micro-computers (PCs). Trends in total basal area increment (raw BAI) and the non-climatic component (smooth BAI) were examined for individual core data and for a variety of combinations (*e.g.*, size, location, age).

Results. Some of the people who were knowledgeable about red spruce dating (Ed Cook, Dave LeBlanc, and Charlie Cogbill) indicated the years of the smallest rings were either exactly or very close to what they should be. Comparisons of graphs of indices of individual cores showed that some of the earlier years of some cores appeared to be off by a year or two. For our purposes of looking at growth trends, this was OK, but the dating will have to be checked and corrected before anyone attempts any correlation with climatic data.

Attached are some tabular data:

- all the ring-width data as measured. The data are in mm x 100.
- radius values used to calculate ring area (BAI)
- mean chronology data for all cores measured

Also attached are 5 figures of graphed results. These are simply examples.

Figure 1. The ring-width series of sample 17s. The very tiny rings were quite difficult to distinguish. It is most probable that this sample contains dating errors. Note a sharp release around 1755, followed by a classical die-away curve. There appears to have been a gradual release in the early 1800s, followed by a very gradual decline since about 1830. Nothing about this series suggests anything abnormal.

Figure 2. The raw BAI of sample 17s. Raw BAI can be thought of as made up of two components: a climatic component superimposed on a non-climatic component.

Figure 3. Tree-ring indices of sample 17s. Indices represent the climatic component of growth. However, because indices are dimensionless, they are of little value in describing growth quantity.

Figure 4. Smoothed BAI of sample 17s. Smoothed BAI represents the non-climatic component of ring area. BAI is in cm^2. Note that after the big growth release in the early 1800s, growth stays fairly even until sometime in the 1940s.

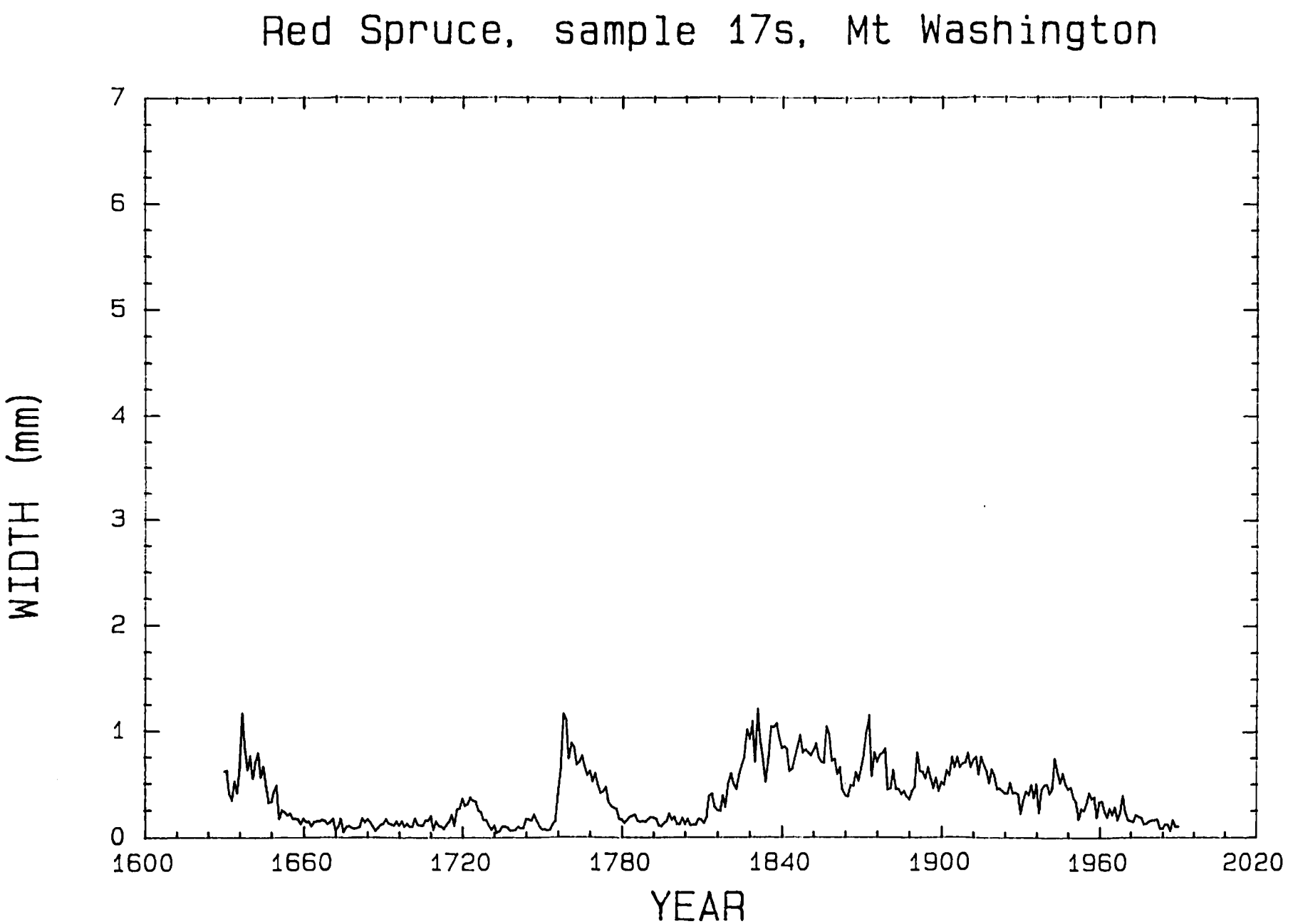
Figure 5. Smoothed BAI (red) and 95% confidnce limits (blue) of two combinations of cores. The collection of 22 measured cores were divided into an older group and a younger group. The older group was composed of the 8 cores dating to before 1850. The longer graphs (back to 1808) are of the 8 oldest cores, and the shorter graphs are of the 8 oldest cores of the younger group. Sample 17s (Fig. 1-4) is included in the older group. The earlier years have been truncated so that all that is shown are those years in common among each group. Note the close correspondance among graphs after about 1960.

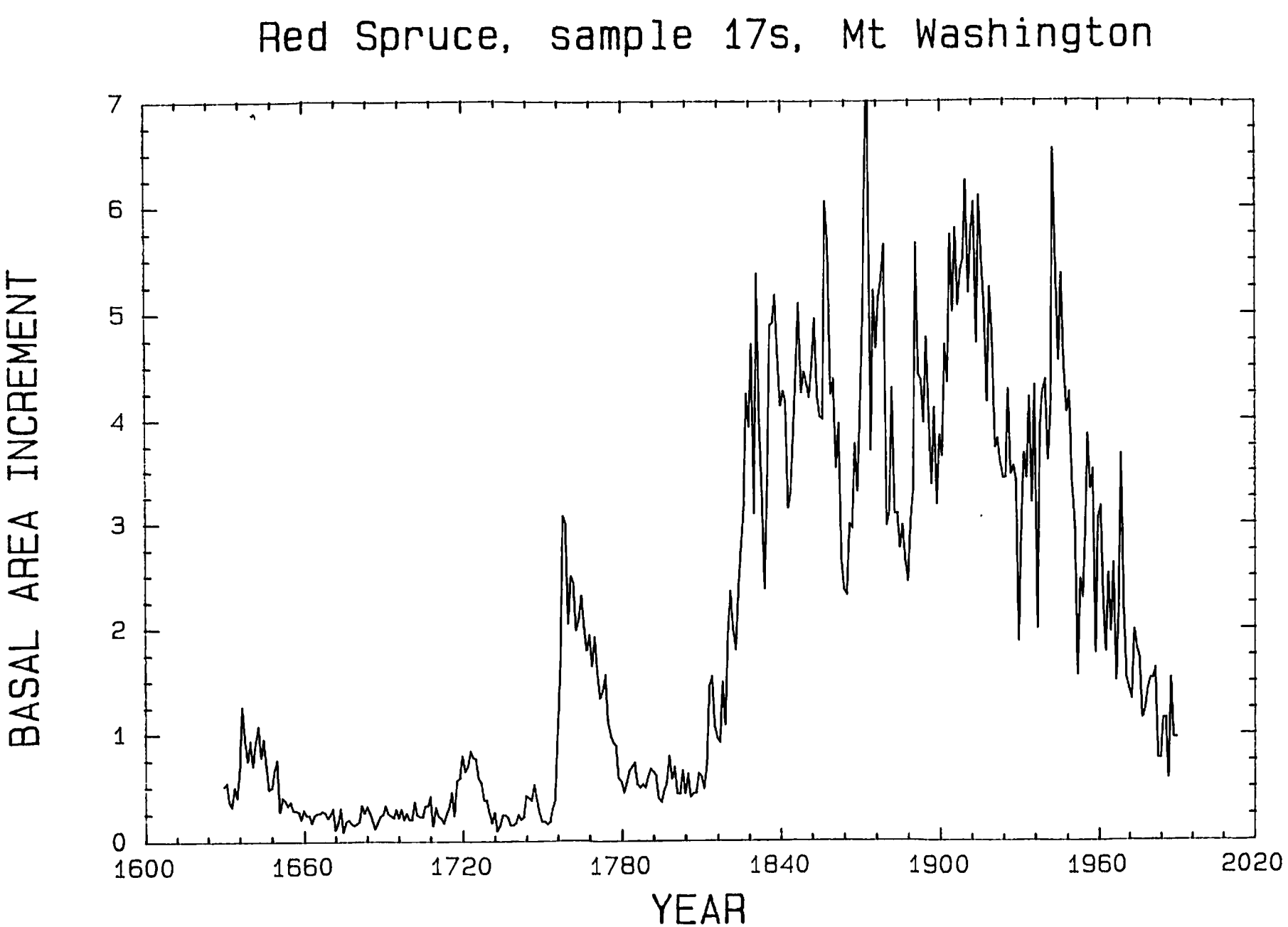
Though Fig. 1-5 are not intended to imply anything close to a comprehensive analysis, it is tempting to do a bit of speculating. It might be suggested that the older trees became canopy dominants around 1800. BAI of the older trees increased steadily from about 1800 to 1900, and has been declining since then. It would seem possible that the 100-year increase followed by a gradual decrease is the normal, expected growth trend of high altitude red spruce at Mt Washington. But what about the younger group? They seem to have taken off around 1900, but started to decline after only about 50 years. This, coupled with the remarkable correspondance between the two groups after about 1960, could be construed to imply that some factor hit both groups around 1950 and has affected decline. Very little weight should be placed on this speculation. Interestingly, though not shown in Fig. 1-5, graphs of some individual cores showed what might be interpreted as a suggestion of a recovery in the most recent years (shown in 2 of the 8 older cores and 5 of the 8 younger cores).

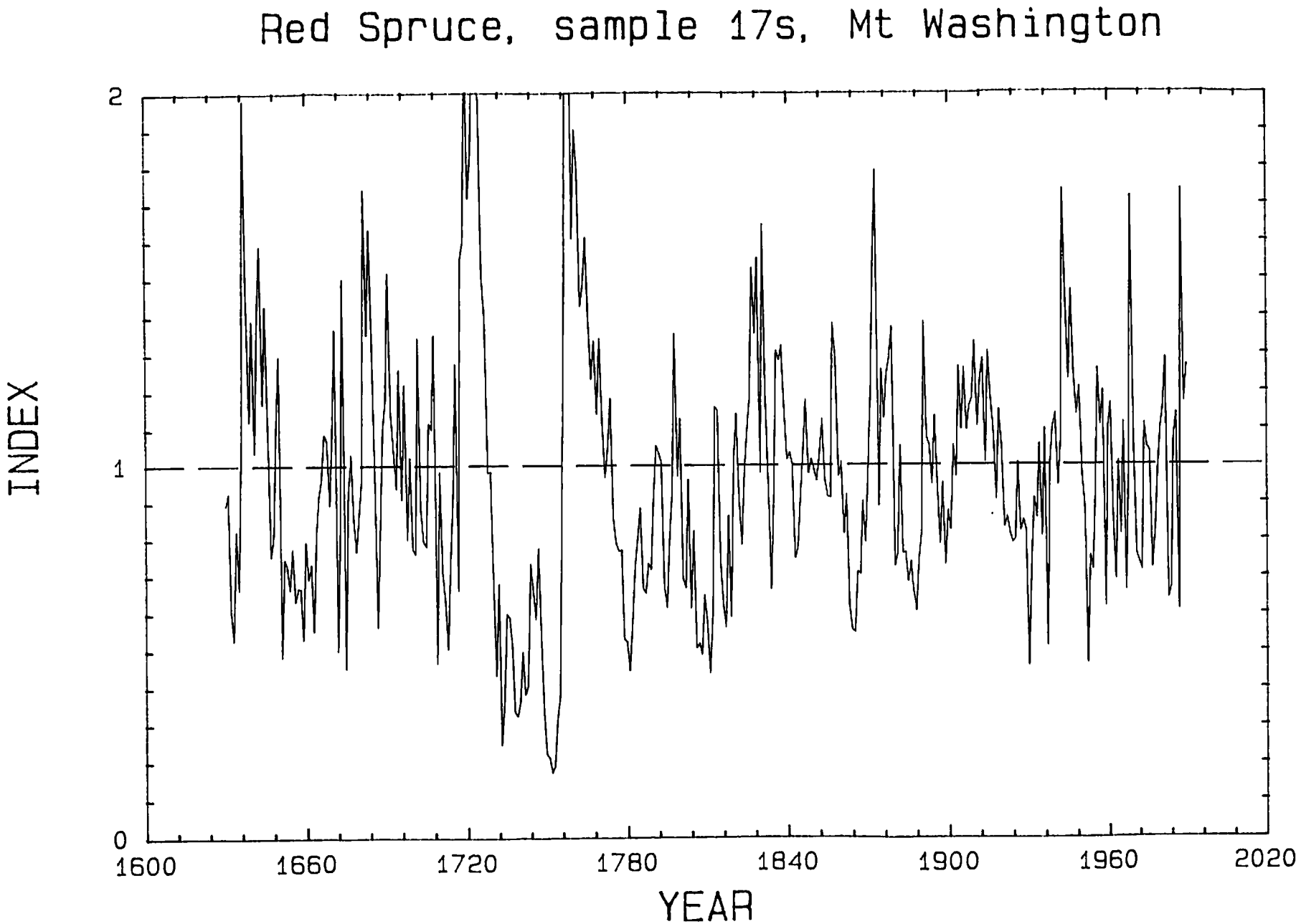
Comments. The increment cores have been saved. I forwarded them to David Laing. Field notes were taken by M-L Smith. I'm not sure if she kept the notes, or if Mark Twery has them. Mark was able to make floppy-disk copies for some of the group members of the basic data, some calculated results, and the programs used to make the calculations.

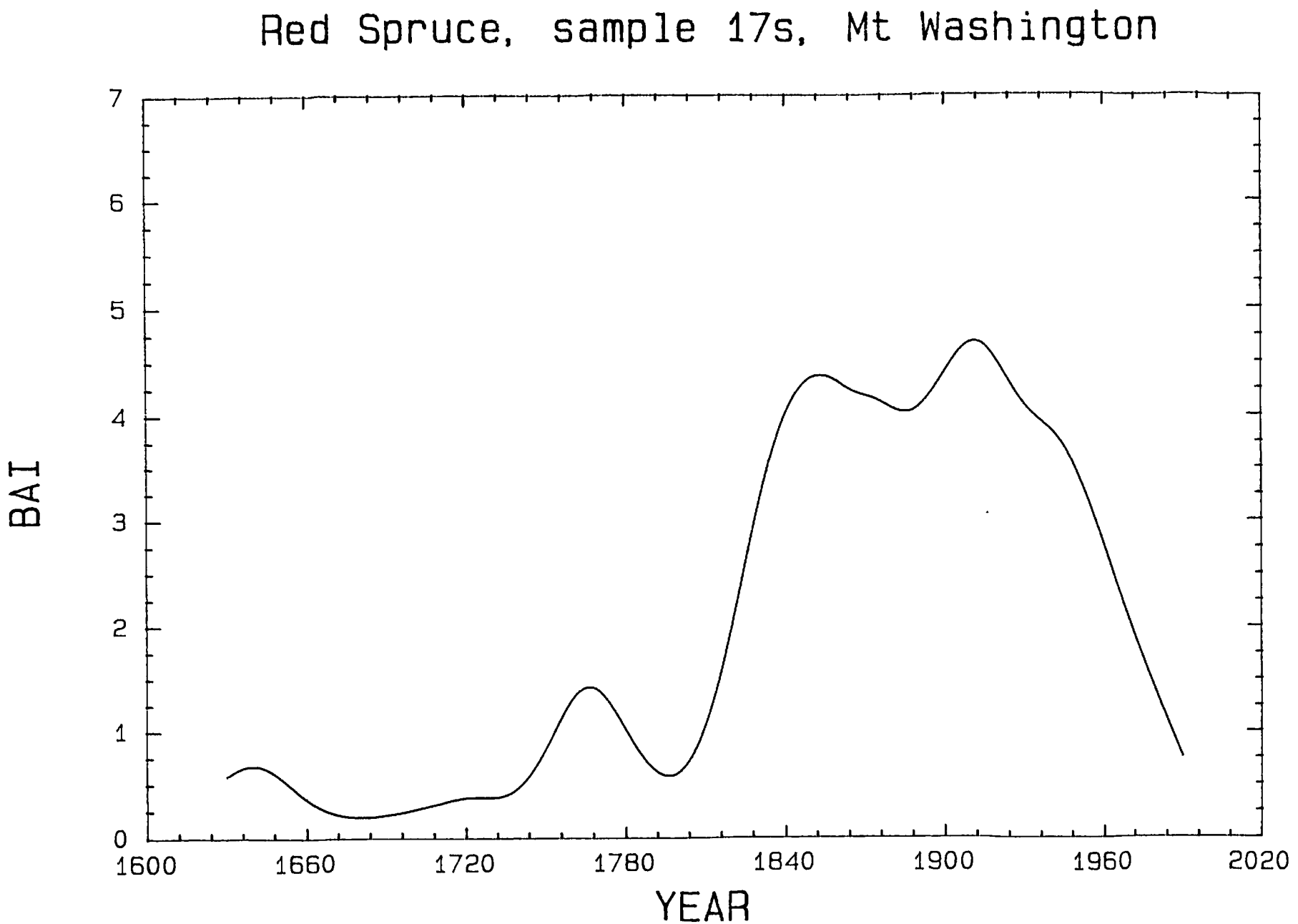
David Laing has shown interest in trying to correlate the red spruce data with temperature data. This, of course, will not be successful without very accurate crossdating.

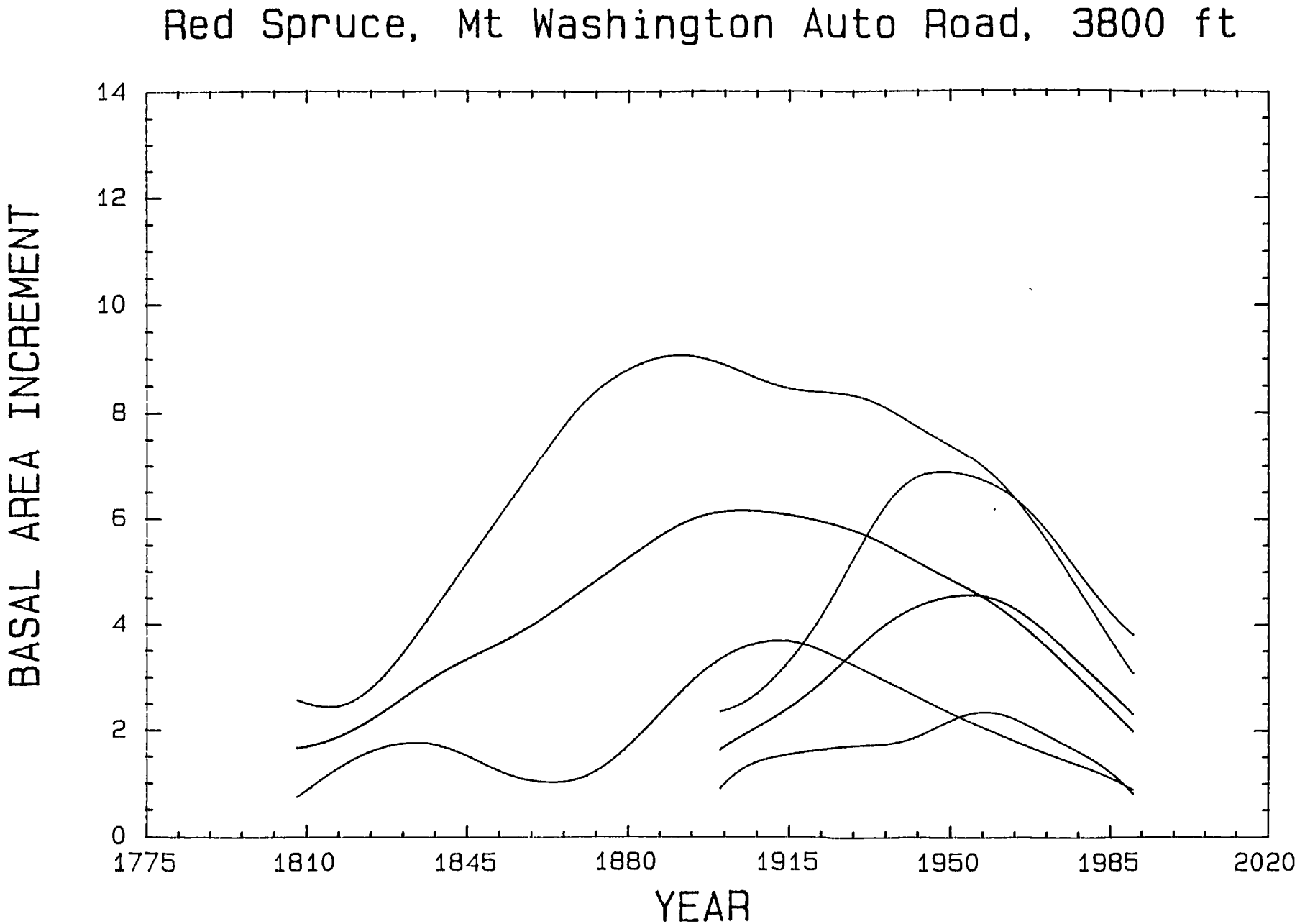
It might be interesting to do a more complete analysis of the data. I would suggest 1) thorough crossdating and complete re-measurement of the cores (that David may be doing), and 2) inclusion of Ed Cook's red spruce data from same general site. Mark Twery has expressed interest in further analysis, and I have indicated willingness to help in any way I can.


Red Spruce, sample 17s, Mt Washington
WIDTH (mm)
0
1
2
3
4
5
6
7
1600
1660
1720
1780
1840
1900
1960
2020
YEAR


Red Spruce, sample 17s, Mt Washington
BASAL AREA INCREMENT
0
1
2
3
4
5
6
7
1600
1660
1720
1780
1840
1900
1960
2020
YEAR


Red Spruce, sample 17s, Mt Washington
INDEX
2
1
0
1600
1660
1720
1780
1840
1900
1960
2020
YEAR


Red Spruce, sample 17s, Mt Washington
BAI
0
1
2
3
4
5
6
7
1600
1660
1720
1780
1840
1900
1960
2020
YEAR


Red Spruce, Mt Washington Auto Road, 3800 ft
BASAL AREA INCREMENT
0
2
4
6
8
10
12
14
1775
1810
1845
1880
1915
1950
1985
2020
YEAR