

## Cross-Dating Tree-Ring Cores

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Cross-dating involves assigning absolute dates to each tree ring, by matching ring-width patterns among cores. (Simple ring counting may give erroneous results if the core has missing, or multiple rings.) Cross-dating would be simple if all trees in an area evidenced the same ring pattern, but they do not. Some similarities in the pattern are necessary, however, for cross-dating to work.

### Initial procedures

Select the best 10 or more representative samples (free of obvious suppression, injury, etc.); ideally these should be the oldest as well, so that you can develop as long an initial record as possible. Starting at the ring closest to the bark (i.e., this year's growth), count back toward the pith. Since we don't want to lose count, use a mechanical pencil to *lightly* (you may need to erase later!) place dots at certain calendar years:

1 dot - decade (e.g., 1990, 1980, 1970)

2 dots - mid-century (e.g., 1950, 1850)

3 dots - century (e.g., 1900, 1800)

4 dots - millennium (e.g., 2000)

With some cores with "difficult" rings, it may be useful to lightly delineate part of the ring boundary to help with your counting.

### Marker Rings

Cross-dating involves searching for marker rings, which are consistently small (or sometimes extremely wide), or which have identifiable characteristics that are consistent between different trees. Small rings may be formed due to stress experienced by a single tree (e.g., suppression caused by shading, or injury); for cross-dating, we are interested in patterns of small rings that are evident across *all* of our samples, due to widespread stress (e.g., drought, pest outbreaks, etc.). By matching the pattern of marker rings, we can assign absolute calendar dates, even if we do not know a starting date for some of our samples.

Cross-dating also ensures that we detect false rings or missing rings that might cause us to assign inaccurate dates if we were merely "counting rings." **Missing rings** are possible in a sample if the tree is extremely stressed. It is also possible to have incomplete/discontinuous rings, such that the annual growth increment is seen in only one core (e.g. core A), but not the other (core B); this is why we take two cores per tree. Other times we may see what appears to be two rings in the same annual increment – **false rings** – caused for example by the breaking of an early-season drought, or a late frost event. These false rings differ in appearance from a true ring, in that a true annual ring will appear more abrupt, with a clear boundary between earlywood and latewood.

### The List Method of Cross-Dating

This approach to cross-dating involves listing marker years for 10-20 cores, as demonstrated below. Frequently one searches for marker years "by decade" (which are now marked on your

core with dots), for example, first identify and write down the marker years from 2000-present, then 1990-1999, and so on. In general, you'll want to identify 2-3 marker years per decade. Although 2-3 consecutive marker years can be helpful for pattern matching, if a tree is showing serious suppression (e.g., 4 or more years in a row with narrow rings), choose the narrowest as the single marker year.

<u>ccmp1-23A</u>	<u>ccmp2-14B</u>	<u>ccmp3-7A</u>	<u>ccmp2-3B</u>
<b>2001</b>	2003	2005	2003
1999	<b>2001</b>	2003	<b>2001</b>
1997	<b>1995</b>	<b>2001</b>	1998
<b>1995</b>	1994	<b>1995</b>	<b>1995</b>
<b>1989</b>	<b>1989</b>	1993	1992
1986	1987	<b>1989</b>	<b>1989</b>
<b>1981</b>	<b>1981</b>	<b>1981</b>	1984
1968	1974	1975	<b>1981</b>
<b>1964</b>	1970	1970	1970
1960	<b>1964</b>		<b>1964</b>
			1959
			1958

*Marker rings recorded using the list method. Five rings (2001, 1995, 1989, 1981, and 1964) all appear as important marker rings that occur between all of the samples that are recording growth at that time. (Note that some trees' records extend back further in time.) You can list the inside ring date in a box at the bottom of each tree's list to indicate when the sample has stopped recording.*

It is important to watch out that none of your samples are consistently off from the others, which would represent an initial dating error. (Be sure that the "A" and "B" cores cross-date for each tree!) Once a list of marker rings is developed, you can utilize it to date the rest of your samples. When you are sure of your dates, you can mark the cores with dots as previously, as well as indicating on the mount the coring and pith dates, and decadal years. (See below; this will aid with the subsequent measuring of each ring.)

