

Using tree rings as indicators of past climates

Environment and Disease Laboratory 3

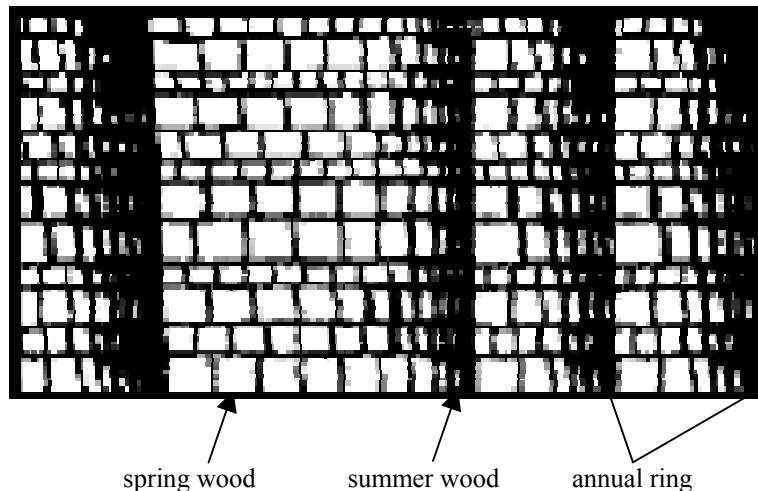
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Introduction:

Anyone who has seen the stump of a recently felled tree cannot help but have noticed the concentric rings that form the trunk. Trees grow both in height and width. The growth in width is known as secondary growth and the tissues being added are xylem, phloem and cork. Xylem is the tissue plants use to transport water and minerals from the roots to other parts of the plant; phloem is the tissue used to conduct sugars and other organic molecules from the leaves, where they are produced via photosynthesis, to other parts of the plant; and cork is the tough covering of stems and roots (the outermost tissue of bark).

In temperate climates like ours, secondary growth occurs during spring and summer and ceases in the winter. Moreover, secondary growth of xylem is not uniform during the growing season. In spring, the cells produced (Fig. 1, spring wood) are larger in diameter and have thinner walls in order to maximize delivery of water to new expanding leaves. Later in the season the cells produced are thinner and have thicker walls (Fig.1, summer wood). Although they cannot transport as much water, they are important for providing physical support to the tree. The outermost tissues that comprise the bark - the phloem and cork - do not tend to accumulate over the years. Instead they split and slough off the trunk as the tree grows. Because the annual production of xylem is non-uniform but follows a consistent pattern, one can use the annual rings (Fig. 1) as a means of determining the age of a tree.

Figure 1



Since they are laid down in annual cycles, the innermost rings may have been formed millennia ago for very old trees. Any environmental parameters that influence tree growth will influence the number of xylem cells produced and, therefore, the width of the rings. Some climatologists use the width of the rings as an indicator of, or "proxy data" for, past climates.

Before coming to lab, please read the review article, Jacoby, G.C. and D'Arrigo, R.D. Tree rings, carbon dioxide, and climatic change. *Proc. Natl. Acad. Sci. USA* **94**: 8350–8353 (1997), and try to answer the following questions. You don't have to work alone on this.

1. The article talks about using tree ring data as a means of measuring past variation in what environmental factors?
2. In the end, do the authors think tree rings provide good proxy data for variation in these factors?
3. Can you think of any other variable environmental factors that might influence the width of tree rings?
4. Do you think the species of tree one uses for this type of analysis makes any difference? Why or why not?
5. What is the point in comparing variation in tree ring width with variation in environmental factors for years and decades when we have direct measurements of those factors? If we already know how they have varied in that time period why would we bother looking at an indirect measurement of the same thing?