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Using dendrochronology to reconstruct annual growth and mortality rates in boreal forest stands

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Most growth and yield programs rely on periodically re-measured permanent sample plots (PSPs) to monitor stand growth and mortality rates. PSPs have two weaknesses. First, plots that are established today will only yield useful information on growth and mortality rates when they can be reasonably re-measured. Re-measurement intervals of five or more years are needed in boreal forests because instruments like clinometers and diameter tapes are not precise enough to detect changes in diameter or height over shorter time periods. Second, periodic re-measurement does not provide annual data on growth or mortality. Annual data are needed to model growth and stand dynamics responses to factors like variation in precipitation and temperature or defoliating insects that occur at an annual time scale. In this note, we report on our efforts to adapt dendrochronology techniques to reconstruct annual growth and mortality rates of individual trees and stands in jack pine plots over a 50 year period.

Methods: We mapped and cored every living and dead tree at several jack pine stands along a transect, from Prince Albert, SK to Thompson, MB. Tree rings were measured on all trees, and the dead trees were cross dated against the dominant trees of each stand to determine when they died. We used these data to annually reconstruct volume growth and mortality. Height to diameter relationships, volume and bark thickness equations were used in the estimates.

Results: We found that we can reliably reconstruct the annual growth and mortality rates of jack pine stands about 50 years into the past. Fig. 1 shows our annual reconstruction of volume increment and mortality for one of our study plots and compares this to what we would know if this plot had been established as a PSP in 1950 and measured every 10 years. The dendrochronology technique provides a much higher level of resolution of growth and mortality data than could be obtained by periodic re-measurement.

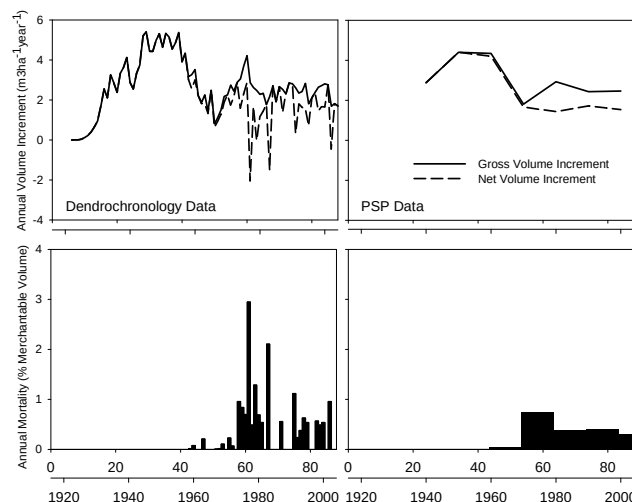


Fig. 1. Growth and mortality data sets generated on a sample jack pine plot if it was measured every 10 years using PSP techniques or if it was reconstructed using dendrochronology techniques.

Implications: Dendrochronology techniques are more costly in the short-term than establishing a PSP, but offer the advantage of being able to yield useful data within a matter of months instead of decades if no data are available today. Even more importantly, the dendrochronology data could be used to model processes that act on an annual scale like weather variation or defoliation, while the PSP data cannot.

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Further Information:

Metsaranta JM, Lieffers VJ, Wein RW (2008) Dendrochronological reconstruction of jack pine snag and downed log dynamics in Saskatchewan and Manitoba, Canada. *Forest Ecology and Management* 255:1262-1270.

Metsaranta JM, Lieffers VJ (2009) Using dendrochronology to obtain annual data for modeling stand development: a supplement to permanent sample plots. *Forestry*. In Press.

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