RESEARCH REPORT

PRESERVING DECAYED WOOD SAMPLES FOR TREE-RING MEASUREMENT

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ABSTRACT

Wood disks in various states of decay can be inexpensively preserved and prepared for accurate crossdating and precise tree-ring measurement by impregnation with commercial wood glue. The technique does not affect the dimensions or physiological features of samples preserved in this manner. Dead red spruce trees on Mt. Washington, New Hampshire, remain available for dendrochronological examination as long as 29 years after their last year of stem growth.

Holzscheiben mit unterschiedlich intensiver Fäulnis können mit einem handelsüblichen Holzleim imprägniert und auf diese Weise kostengünstig geschützt und zur Datierung und genauen Jahrringmessung vorbereitet werden. Dadurch werden die Dimensionen physiologischen Merkmale des Holzes nicht verändert. Tote Fichten (*Picea rubens* Sarg.) am Mt. Washington in New Hampshire bleiben so noch 29 Jahre, nachdem sie ihren letzten Jahrring gebildet haben, für eine dendrochronologische Untersuchung verfügbar.

Les disques de bois en divers états de décomposition peuvent être préservés de façon peu coûteuse et préparés pour effectuer des datations croisées fiables ainsi que des mesures de cernes précises, par imprégnation à l'aide de la colle à bois commerciale. La technique n'affecte pas les dimensions ou les caractéristiques physiologiques des échantillons préparés de cette manière. Des épicéas morts (*Picea rubens* Sarg.) provenant du Mont Washington dans le New Hampshire, sont restés disponibles pour un examen dendrochronologique au moins 29 ans après la formation du dernier cerne de croissance.

INTRODUCTION

Dendrochronologists often are confronted with samples in various states of decay. Decayed wood is not easily handled, and important cellular features can be difficult to discern. This paper reports a method for stabilizing and obtaining ring-width information from dead and decaying red spruce (*Picea rubens* Sarg.).

METHODS

In the autumn of 1986, a study site was selected on the eastern slope of Mt. Washington, New Hampshire, at an elevation of 800 m. Three sample types were selected from 20 dead red spruce trees. The first type included eight standing, whole stems with complete boles and branches that retained fine branchlets. The second type included eight standing snags, or trees broken at varying heights. The third type consisted of partially decayed stems lying on the ground.

Whole-stem disks 5- to 7-cm thick were sawed from each tree at 1.4 m above the base. To prevent breakage of disks cut from the more severely decayed trees, masking tape was wrapped several times around the circumferences. The disks were then labeled and bagged in plastic for transportation. Samples were refrigerated to curb the growth of fungi.

Prior to any treatment, all disks were rated by a decay class ranging from 0 to 4 (C.A. Federer, USDA Forest Service Durham, New Hampshire, personal communication) (Table 1). Preparation differed by the decay classification given to each disk. Samples from decay classes 0 to 2, generally sound wood with little or no decay, required the least preparation. These were smoothed with a hand-held motorized planer, and then sanded (Krusic et al. 1987). Samples from decay classes 3 and 4, containing advanced decay, were secured with adjustable metal retaining bands placed around the circumferences then impregnated with a solution of 70% water and 30% commercial wood glue, the main ingredient of which is polyvinyl acetate.

Sample disks <24 cm in diameter were impregnated with the wood glue solution under reduced pressure in a vacuum chamber. Disks were kept submerged by weights throughout the treatment process. Impregnation continued until unweighted samples no longer floated high on the surface of the impregnant. This process was generally completed within 48 hours. Samples that exceeded the size limit of the vacuum chamber were treated by submersion in the wood glue solution without vacuum for a longer period, usually two weeks. Disks treated in this manner were deemed sufficiently impregnated when they demonstrated a loss of buoyancy. Once removed from the vacuum chamber or soak, each treated disk was dried slowly at 36°C and then surfaced by the standard methods of planing and sanding.

Prior to the vacuum impregnation of three decayed disks, randomly selected radial segments from near-pith, middle, and near-bark regions were marked and measured. These same segments were remeasured after impregnation of the disks to evaluate dimensional changes that may have occurred as a result of the preservation treatment.

In dating the samples, two to four selected radii were first compared to each other using skeleton plots, then compared to a master chronology. The master chronology used for initial dating was provided by the Appalachian Mountain Club and was compiled from living trees on an adjacent site (Keifer 1985). Dating was aided by comparison to the Nancy Brook, New Hampshire, chronology (DeWitt and Ames 1978), a site 20 km southeast of Mt. Washington. After nine trees were dated in this manner, a new site-specific master chronology was developed for all future dating. At this point, five of the 20 samples were rejected because of problems in dating, species identification, or due to damage while handling.

The remaining samples were measured on a digital micrometer accurate to 0.01 mm. Choosing the radii for measurement was based on three criteria. Foremost consideration was given to the radius with the greatest number of rings (highest ring recovery), second to the even spatial distribution of all potentially selectable radii about the disk, and finally to those radii traversing the fewest areas of severe decay. All selected radii were measured outward from the pith. Average

TABLE 1. Decay classes.

0	Sound wood
1	Slight sapwood discoloration
2	Sapwood decay
3	Sapwood and some heartwood decay
4	All decayed sapwood and heartwood

radial increments were then computed for two radii from each disk and plotted. The average raw ring-width series for one tree that stopped growing in 1957, 29 years before sampling, is shown in Figure 1.

RESULTS

In a comparison of linear distances on disks before and after preparation, changes due to impregnation were minimal. Radial shrinkage due to impregnation and drying ranged from 1 to 3% over measured radial segments of 1, 3, and 5 cm. Segments remeasured from the near bark region changed the most while near pith segments changed the least.

The dating of these dead trees, and particularly the last years of growth, is facilitated by the trees' continued sensitivity to environmental factors until death. Not more than one completely missing ring was found in any single disk. However, locally absent rings (incomplete growth rings) became increasingly common within the last years of xylem production as the trees approached death.

Table 2 summarizes the age information from the 15 measured trees, and shows the first and last year of growth, decay class of each sample, and sample type. A range of years under the last year of growth in Table 2 is an indication of missing and locally absent rings found in the last few years of growth within the disk. The age distribution of dead trees from this area ranged from 133 to 321 years. Sampled trees grew into the stand between the years of 1648 and 1848. The last measurable ring ranged from 1955 to 1984.

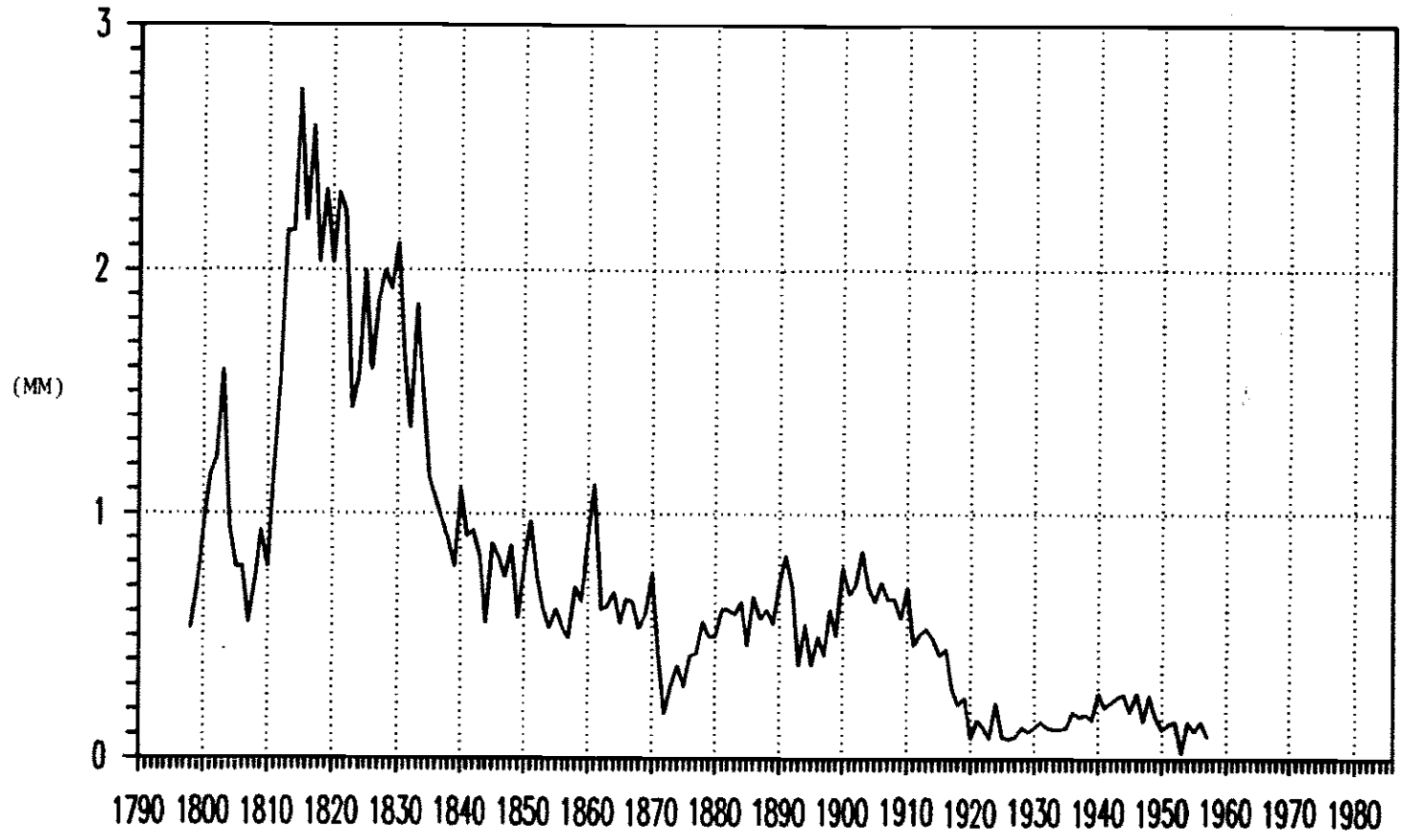

Figure 1. Average raw ring widths (mm) for tree 8, a fallen tree dead 29 years prior to sampling.

TABLE 2. Age and sample type information. All samples taken at 1.4 m, N = 15.

Age	Diameter (cm)	First Year of Growth	Last Year of Growth	Decay Class	Sample Type*
321	32	1648	1968-65	4	SS
312	27	1662	1973-68	2	SW
292	35	1691	1982-81	2	SS
253	52	1731	1984-81	4	SS
248	38	1726	1973-70	1	SS
233	39	1752	1984-83	0	SW
222	41	1760	1981	1	SW
212	22	1767	1978-77	2	SW
208	45	1772	1979	2	SS
160	23	1798	1957-55	3	F
159	18	1815	1973	4	SS
162	27	1821	1982	1	SW
161	22	1822	1982	3	SW
156	19	1823	1978	2	SS
133	22	1832	1964-63	4	F

CONCLUSIONS

Tree-ring information can be obtained from fallen and standing dead trees for at least 29 years after death in northern New England forests. Treating decayed woody material by impregnation with wood glue renders samples strong enough to be surfaced and polished. Ring-width measurements as small as 0.01 mm can be made by the greatly improved visibility of individual xylem cells. Decayed red spruce disks treated by impregnation did not appreciably change in dimension.

The use of this technique may be valuable to researchers looking to extend the length of existing chronologies, to study patterns of tree growth prior to death, and to date deteriorating architectural structures.

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