TREE-RING RESEARCH, *Vol. 67(2), 2011, pp. 123–126*

RESEARCH REPORT

PREVENTING BARK-CAUSED INCREMENT BORER JAMS: A MODIFIED TECHNIQUE FOR CORE EXTRACTION

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ABSTRACT

When coring thick-barked trees, increment cores often become compressed and jammed inside the narrow region of the borer shaft. These jams can be problematic for two reasons: first, it often leaves the core unusable; second, the jam may be so tightly compressed in the borer that removal is difficult, especially in the field. Although procedures to evacuate these jams are documented in the literature, methods of prevention are not. Here, a modified manual method of increment boring that can reduce the likelihood of jams and, in addition, decrease the number of deformed core samples is described. Traditional and modified boring methods were randomly assigned to 40 Douglas-fir trees (80 cores) at a research site along the Oregon coast. Results show that jams were associated with traditional boring over six times more than with the proposed modified technique.

Keywords: Increment borer, jam, thick bark, tree rings, dendrochronology.

INTRODUCTION

Collecting high-quality cores from living trees is easily achieved with a straight, well-sharpened increment borer (Jozsa 1988). Often the removal of a broken, twisted, or rough core can be an indication of a dull or damaged increment borer tip. Borers often also become jammed because of the accumulation of rotten or low-density wood, sap, and bark in the narrower region of the borer (Figure 1). Various reports and articles have been published that provide a comprehensive review on the proper use and maintenance of the increment borer (see Maeglin 1979; Phipps 1985; Agee and Huff 1986; Jozsa 1998; Grissino-Mayer 2003; Ufnakski 2005). The literature also provides several descriptions of modifications that have been made to the physical structure of the increment borer and handle along with methods to remove stuck borers (Transtrom 1952; Yamaguchi 1991; Hallman *et al.* 2006; Brown 2007). However, most are directed toward the proper maintenance of the tip and thread surfaces, while few preventive methods for jamming are described.

The task of clearing a jammed increment borer is something that most dendrochronologists encounter at some point in their careers. Jams occur in excess when coring trees with a thick, corky bark like that of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), which can often be found with bark thickness of 15–20 cm (personal observation and Van Pelt (2007)). One method that is described for preventing a jam is periodical insertion of the extraction spoon into the borer every few turns and then using the spoon to measure the amount of wood being drawn into the borer relative to the length of the borer in the tree (Phipps 1985 and Jozsa 1998). This evaluation can be used early in the boring process to indicate if jamming has occurred. One other alternative is to place the borer tip in the bark's furrow; this not only helps to engage the borer threads but also to reduce the amount of bark that the borer penetrates, thereby reducing the possibility of jamming. However, this is not always practical or feasible.

In extreme cases, the extraction of the core from the borer shaft is impossible using the

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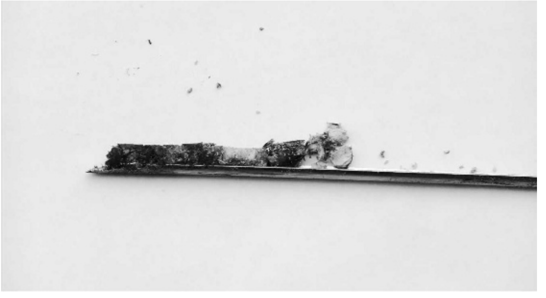

Figure 1. Compressed, gummy bark that was cleared from a jammed borer's shaft.

extractor spoon alone, and requires carefully hand-drilling via the borer's tip and evacuating the jammed wood and debris. Alternatively, the preferred and safer method for clearing jams is to use a drill bit that is at least the length of the borer shaft, and then to drill out the jam from the back end of the borer. If, however, you find that your cores have twisted during the actual boring, during desiccation, or become compressed inside the increment borer, the integrity of the core becomes questionable, as it is often twisted and deformed beyond use. However, if salvable, spiral deformity can often be removed using steam or a urea bath (Young and Cleaveland 2000). Additionally, the time and effort required to clear a jam can be excessive and, if unsuccessful, may yield a useless borer for the remainder of the field excursion. Unfortunately, when attempting to remove these jams, borer tips can become chipped and damaged. Although seasoned scientists may be well aware of these complications and have employed their own modifications, these adjustments have not been previously documented in detail. In response to the aforementioned complications, I present a modified boring technique that helps to reduce the number of jammed and damaged cores.

METHODS I: MODIFIED CORING TECHNIQUE

Start by pretreating the inside of the borer with a light application of WD-40®, then use the extractor spoon to spread the lubricant down the borer shaft. Next, when possible, estimate the thickness of the bark by placing the extractor spoon inside one of the bark furrows nearby your point of penetration. Now you should have a rough estimate of the bark thickness, and thus, be able gauge the distance to the xylem. You can also mark the bark depth on the borer shaft with a pencil, thereby making it easier to determine the wood depth relative to the surface of the bark (*i.e.* how much bark will the borer have to penetrate until the xylem is reached). Now, with the borer tip pushed tightly against the bark (or furrow), slowly begin rotating (clockwise) the borer until you feel the threads engage. In some cases, the initial 8–15 cm may be solely bark, and therefore, boring will be accomplished without much effort. Over time, you will begin to feel the changes in resistance to the borer created by the increase in material density and friction as you transition from the bark to xylem.

Continue to twist the increment borer until you have reached your estimated bark depth or until the resistance to the borer begins to increase. Additionally, during the bark-xylem transition it is possible that a squeaking or popping sound is created, signifying the shift into a denser material (*i.e.* the xylem). At this point, stop boring; you should be at the boundary between the bark and xylem. Next, insert your extractor spoon (apply a thin coat of WD-40® to the bottom of the spoon) and slowly slide it down the borer shaft. Once you begin to feel resistance, stop the insertion. Now, rotate the spoon slightly but enough to engage the teeth on the spoon's tip, and then extract the spoon as you normally would. Be observant when extracting, especially if the spoon is inserted completely, as a small section of wood (containing rings) may be attached to the cambium/bark. The bark that could potentially jam the borer shaft will now be contained on the spoon (Figure 2). At this point, coring can continue as is customary. One alternative to the previous method is to provide a one-half-counterclockwise turn to the increment borer prior to extracting the spoon; this will break the bond between the cambium and bark.

METHODS II: FIELD TRIALS

During the summer of 2009 as part of a dendroclimatology study, cores were collected from 40 mature Douglas-fir trees at the Oregon

Figure 2. The results from not clearing the borer of problematic bark; note the twisted (rotated), mangled, debris-coated core (top). Bark being evacuated from the borer's shaft by means of the modified coring technique described in the methods (bottom).

State Park, Cape Sebastian (42.357743°N, −124.41271°W), located in the Pacific Coast Range Mountains. Subsequently, these coring events were used for the following analysis. At each tree, using a coin toss, I randomly assigned which coring method (conventional *vs.* modified) would be used to extract two cores from that tree. I cored each tree at *ca.* 1.3 meters above ground level and avoided any trees with possible damaged and deformed (*e.g.* resin-pockets) lower stems. At each tree, I recorded two possible observed outcomes: *jam* and *no-jam*, for 80 trials (two cores per tree). Trials that were given the status "no-jam" had to be extracted easily from the borer shaft and be in a functional condition for high-quality and continuous crossdating, whereas a "jam" consisted of a core with any of the following or a combination of the following conditions: twisted, broken into several unusable sections, compressed, and physically jammed (Figure 2). Fisher's exact test was then used to determine if there was a nonrandom association between the coring technique used and the observed core state (*i.e.* jam or no-jam).

Table 1. Contingency table for the 40 conventional and 40 modified coring trials (n = 80).

	Jam (%)	No-Jam (%)	Total
Conventional extraction	21 (52.5)	19 (47.5)	40
Modified extraction	6 (15)	34 (85)	40

RESULTS AND DISCUSSION

Data indicate that conventional coring had 6.3 times the odds (two-sided $p < 0.01$) of jamming when compared to the suggested modified technique. Conventional coring produced jams during 52.5% of the trials, compared to 15% when the bark was pre-extracted (Table 1). Field observations along with the collected data suggest that core quality, and the number of coring attempts can be improved and reduced by combining coring within a bark furrow (when practical) and extracting the bark from the borer before the xylem is punched. The removal of the bark decreases the amount of resistance the core would generally encounter as it is drawn into the borer shaft. Secondly, it also prevents debris from gumming up the internal surface of the shaft, thereby, reducing any potential core twisting (Figure 2). Ultimately, time spent collecting and preparing cores in the laboratory can be more efficient, and additionally the cost associated with damaged equipment can potentially be abated. In conclusion, this modified technique was beneficial with coring Douglas-fir, but could easily be adapted to other species with thick, flaky bark, especially if jamming is evident.

ACKNOWLEDGMENTS

I would like to thank Thomas Laxson and Justin Maxwell for their suggestions and edits on this manuscript. I would also like to thank Peter Brown and an anonymous reviewer for their helpful suggestions.

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Received 14 February 2011; accepted 12 April 2011.