THE CARE AND FEEDING OF INCREMENT BORERS

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INTRODUCTION

An increment borer is a precision instrument specially designed to extract a thin cylinder of wood from a tree, shrub, log or pole. It is available in a variety of sizes ranging in length from 4 inches to 40 inches. Although the increment borer is essentially a very simple instrument, it is relatively expensive. Proper operation and maintenance can prolong the life of the increment borer and minimize problems. This manual provides tips on increment borer selection, operation, and maintenance to minimize problems in the field and maximize the utility of the borer. Experience in a specific field application is needed to develop the best and most efficient technique.

PARTS OF THE BORER

An increment borer has three pieces: a handle, the borer bit, and an extractor (Figure 1). The handle serves as a carrying case and as the grip by which the bit is inserted into the tree. The bit is a hollow cylindrical steel shaft. It is threaded on one end, and is square on the other end where it attaches to the handle. The extractor is a thin half cylinder of steel that is inserted into the borer bit to extract the wood core. The increment borer may be purchased complete with all three pieces, or each piece can be separately ordered to replace broken, worn, or lost parts.

INCREMENT BORER SELECTION

A single borer will not be suitable for all applications. In most situations, a variety of increment borer sizes are used. The four options available are brand, length, core diameter, and number of threads.

Brand preference depends on individual experience with different manufacturers. Since we cannot make direct or implied endorsements of particular brands in this publication, you should talk with people who regularly use increment borers to discuss brand satisfaction.

Borer length depends on the size of trees you will be boring and the heights at which you will sample them. In an even-sized stand, borer length should be about 75 percent of the average tree diameter. In most Pacific Northwest applications, a range of borer lengths is desirable: 6-inch borers for small trees, 12-inch borers for young-growth stands, and 18-inch borers for large trees. Borers in 30-inch and 40-inch lengths are also available, but the longer lengths are unwieldy, are more expensive

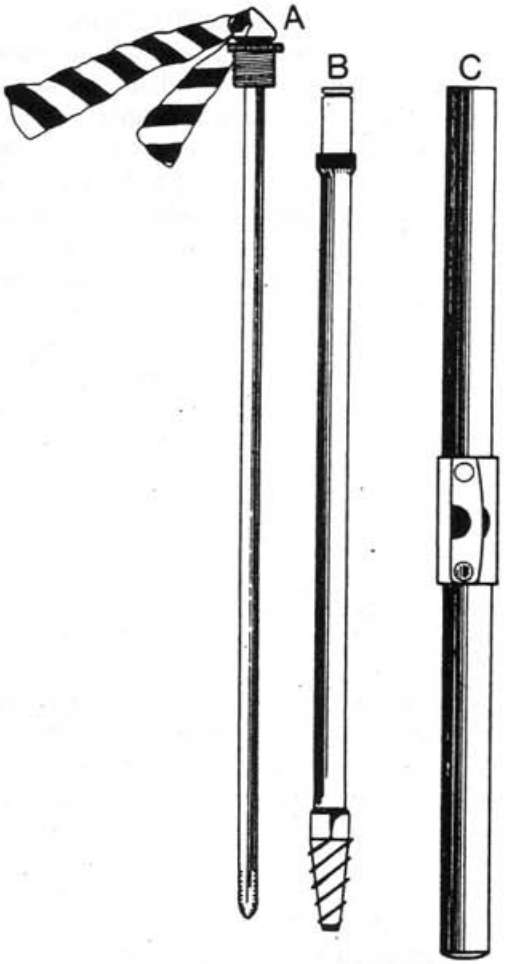

Figure 1. An increment borer has three pieces: the extractor (A), the borer bit (B), and the handle (C). Flagging the extractor makes it highly visible to help avoid losing it or stepping on it.

per unit length, and have a higher probability of getting stuck in a tree. The longer borers (>20 inches) do have some specific applications for large trees, but careful consideration should be given to their limitations before purchase. If tree age determinations are needed, boring close to the ground is desirable. Slow-growing trees may be several decades old at knee height, so determination of tree age requires cores near ground level. In such cases, the shortest borer that can reach to the pith of the tree is best. Longer borers have longer handles that cannot be turned if core height is too close to the ground, unless a small soil trench is dug.

Core diameter is usually either 0.169 inch (4.3 mm) or 0.200 inch (5 mm). Either size is satisfactory for most uses. However, parts for borers of each diameter are not interchangeable with borers of the other diameter. If you are planning to order a number of borers of the same length, they will have interchangeable parts only if they are the same diameter and from the same manufacturer. An unusually large diameter borer of 0.500 inch (12 mm) is available from at least one manufacturer in selected lengths; such diameters are most useful where a large sample volume is needed, as in specific gravity or chemical studies.

Two- or three-thread style borers are available. Two-thread borers will move further into and out of the tree per rotation of the handle, but three-thread borers are generally easier to insert and will turn more easily once inside the tree. The two-thread borers are probably more efficient in the softer woods like ponderosa pine or white fir; the three-thread style is probably more suited to the hardwoods and harder conifers, such as Douglas-fir or mountain hemlock.

Some borers have threads that meld directly into the shaft towards the end of the threads, while others have a continuous raised metal lobe behind the threads sometimes called a "wood-spreader". The former style seems to grip better than the latter when the borer is backed out.

FIELD OPERATION

Transport

The increment borer always should be transported in the closed position, with the borer bit and extractor inside the handle. This is necessary between the office and the field, from site to site in the field, and often from tree to tree in steep terrain. The extractor is easily bent and needs protection inside the handle. The borer bit can be nicked easily and will produce unusable or jammed cores if the cutting edge is not true. While placing the bit into the handle, be sure not to touch the cutting edge against the handle body. Instead, place the threads of the bit over and against the lip of the handle hole and then slowly lift the bit into a position where it can be inserted with a minimum of handle contact with the bit tip.

Assembly

The increment borer is assembled by first unscrewing the extractor from the handle and placing the extractor in a

safe place. Because the extractor is used only after the tree is bored, it is easy to leave it on the ground and step on it. To avoid this problem, make sure the extractor is highly visible. Insertion of bright plastic flagging into the ring (or into the hole designed for the ring) will make it visible. Make a habit of leaving the extractor in a place safe from trampling and free of soil grit (such as in a deep vest pocket or on a day pack). Some people wedge it into the bark of the tree; this may work on some species, but not consistently on all tree species. If the extractor has to be forced into the bark or a bark fissure, it can also be bent in the process.

Once the extractor is safely placed, the borer bit can be removed from the handle. The square end is placed through the handle and fixed by a clip onto the handle. This clip is the weakest piece of metal on the increment borer, so treat it gently.

Borer Bit Preparation

As the bit moves through the tree, it is compressing the wood on its exterior. The core on its interior is stationary, so the bit must revolve around it until it is extracted. Proper lubrication of the borer bit is, therefore, essential to ease the insertion of the borer bit and to maintain the integrity of the wood core. Beeswax is an essential exterior lubricant that reduces friction as the borer is inserted into the tree. It should be applied to the threads and to the shaft of the borer bit every time the borer is inserted into a tree. If several trees are being cored, beeswax can be most easily applied right after extraction when the bit is hot and melts the wax. Beeswax is available from all suppliers of increment borers. Before the borer bit is inserted into the tree, the interior should be sprayed with a light oil lubricant such as WD-40*. This will allow easier rotation of the shaft around the wood core. It does produce a slightly oily core, but minimizes jamming of cores and has no deleterious effects on the core. If the core is to be chemically analyzed, however, the effects of interior lubricant should be carefully evaluated.

Judging how far to insert the borer into the tree can be difficult. One simple way to consistently bore just past the center of the tree is to place a small rubber band around

*Mention of specific compounds or trade names neither constitutes recommendation for their use, nor excludes the possibility that other products or treatments may be equally or more effective.

the borer bit. The bit is placed tangentially against the tree to your left or right, with the tip just past the center line of the tree, and the rubber band is adjusted to a point where it would touch the bark if the borer were inserted into the tree. When the bit is subsequently inserted in the tree, the rubber band marks the proper stopping point on the shaft.

Selecting the proper height and location on the tree trunk for boring depends to some extent on the objectives of the project. Breast height (4.5 ft) may be desirable for growth and yield studies, but is usually too high if stand age analysis and regeneration patterns are desired. Growth analysis may require two or more cores from different locations on the tree, whereas tree age analysis usually requires only one core that includes or is near to the pith.

If you have a choice, select a tree that has a straight, nearly cylindrical trunk. There is a high probability that the pith will be in the geometric center of the tree and that growth ring distortion will be low (Figure 2). With larger trees, the probability of getting the bit stuck in the tree increases, because more surface area of the borer bit is inserted in the tree. Good lubrication usually alleviates

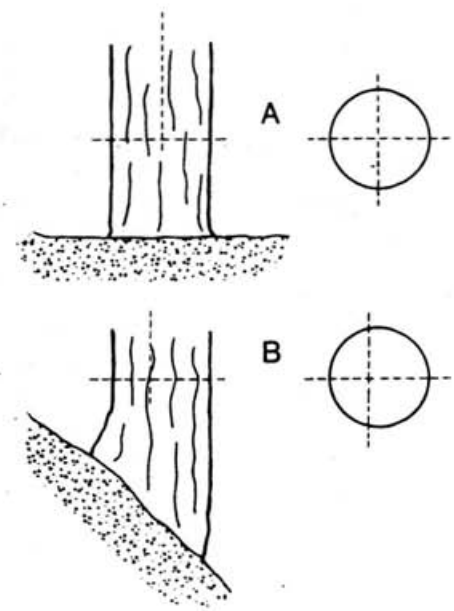

Figure 2. Trees growing on level ground with cylindrical trunks usually have a pith near the geometric center of the tree (A). Conifers growing on hillsides will usually have the pith offset to the uphill side of the tree (B).

the risk of a bit locking. A flat face on a tree often denotes a healed-over scar; such places are poor locations to bore, unless the scar itself is the object of attention. In mountainous terrain, the pith of conifers is generally offset slightly toward the uphill side because of wide-ringed compression wood on the downhill side of the tree. Boring from the center of the uphill side of the tree will usually intersect the pith. Boring from the sidehill will usually miss the pith by a considerable margin, but recent average annual growth may be less distorted than on the uphill or downhill sides of the tree. Conifers growing on a hillside will have compression wood on the downhill side, while hardwoods will generally have tension wood on the uphill side. Sometimes ellipsoidal trees will be found on flat ground. A core to the pith is usually successful if one bores along the long axis of the ellipse.

Inserting the Borer

The easiest place to insert the borer is at a thin place on the bark. Bark chips or flakes can jam inside the shaft; if this regularly occurs, the chips or flakes should be removed once the shaft has been inserted several turns. It is important to avoid wiggling the borer bit as you make the first rotations; such movement can cause elliptically shaped wood cores that can later jam in the interior of the borer. A good starting technique is to place one hand near the threads at the bark surface, steadying the shaft, while applying pressure to the borer bit and simultaneously turning the shaft clockwise with the other hand. After several turns, the bit should have penetrated enough that both hands can be placed on the handle. At this stage, step back from the borer to see if the bit is aligned in the desired direction. If not, it can be easily realigned without extraction. Once any realignment is complete, turn the handle evenly and allow the threads to pull the borer bit into the wood. Applying forward pressure is not only tiring, but may result in extraction problems. Try to use consistent turning pressure on both ends of the handle as the borer bit enters the tree. When the desired depth is reached, stop at a point where the handles are parallel to the ground. If the borer bit "squeaks" as it enters the tree, the bit was improperly waxed. If at any time during insertion the handle begins to turn very easily, rot has likely been encountered and the core should be extracted immediately.

Extracting the Core

The extractor should first be well-lubricated with a light oil, then inserted along the bottom of the shaft until the

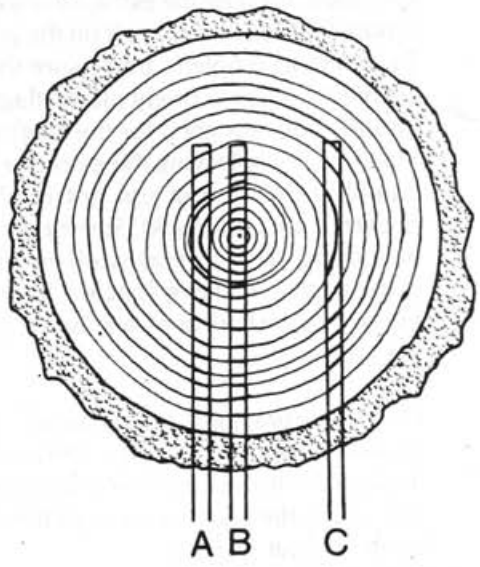

Figure 3. If proper techniques are used, the position of the extracted core will be the same as its position in the tree. If the core has missed the pith, the direction of the pith and its approximate distance can be estimated from the ring pattern on the extracted core.

bark of the wood core is reached. The extractor can be moved along the lower side of the wood core until it is completely inserted. Give the extractor a final light tap with your palm, and make one complete reverse (counterclockwise) rotation of the handle to break the at the borer tip. Pull the extractor from the borer bit. The wood core will be lying in the extractor trough, held by the teeth on the end of the extractor, with the rings in exactly the same position that they were in the tree. If you missed the pith but have followed these directions, you can easily tell in which direction the pith lies, in case a second core is desired (Figure 3). An exception to this procedure is necessary in trees known to have pitch pockets. Pitch will flow out the shaft and make an incredible mess. In such cases, it is advisable to insert the extractor and remove the borer from the tree before extracting the core. This procedure is also recommended for trees where the shaft has a tendency to bind in the tree if not being inserted or extracted.

Extracting the Borer

The borer bit should be extracted as soon as possible, after the core has been removed, unless the core is in several pieces and needs immediate attention. Each second the bit stays in the tree increases the probability that

the bit will become locked. Once the bit is removed, the tip should be checked for any remnants of the wood core. Such remnants can usually be removed with a punch made of hardwood. The punch should be about the diameter of a pencil, several inches long, and taper down to a diameter slightly smaller than the bit. A quick push will generally dislodge any remnant of the wood core. Be very careful when using a wood punch, because it is easy to slip and gouge your hand. Never use a metal instrument near the tip of the borer bit—you will probably nick the cutting edge. Sometimes reboring a short distance into a tree will dislodge the previous core remnant and allow it to be easily extracted.

HANDLING THE CORES

Once a core has been judged acceptable, it is carefully lifted out of the extractor and placed in one or more straws, after which all joints and ends are taped. Either plastic or paper straws make good containers, although there is much personal preference involved. Plastic straws can be sealed with a butane lighter, or taped which is common practice for paper straws. Each straw should be double labelled for subsequent identification and correlation with other tree characteristics recorded in a notebook: tree species, height, dbh, diameter at core height, core height, bark thickness, etc. Some people prefer to label the core itself and put an ink mark on the bark side in case the bark falls off. Sapwood identification, if desirable, is easily done by holding the core to the sky and marking the edge of the translucent wood, which is the sapwood-heartwood boundary. Individual straws can be carried about in a short map tube, or a plastic fishing rod container.

In the laboratory, each core can be mounted and labelled individually or in groups on routed grooves in inexpensive 1-inch lumber. Each core should be mounted such that its radial surface is at the top; tracheids or vessels should be perpendicular to the mounting surface (Figure 4). The teeth marks from the extractor will be at the sides of the wood core. Such mounting presents the clearest surface for aging and ring-width measurement. White wood glue can be used to affix the cores in the grooves. While drying, each core should be taped down into the groove to prevent warping as the core and glue dry. Once dry, the tape can be removed and the core sanded with coarse and fine sandpaper. A belt sander works well for

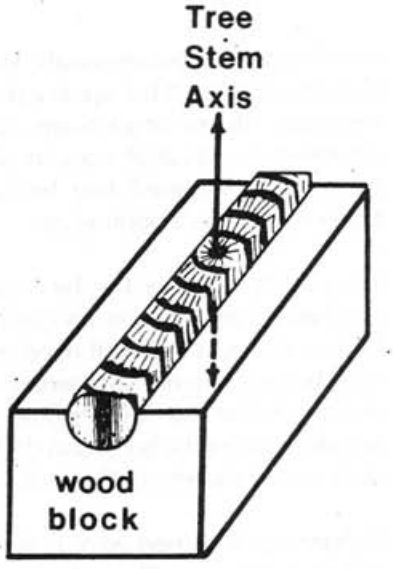

Figure 4. The core should be mounted such that the pith is vertically aligned; tracheids or vessels will be perpendicular to the mounting block surface.

this step. When sanded, the dry, mounted core will be a permanent record of the tree radius that was increment bored.

BORER MAINTENANCE

Cleaning

A borer that is in use daily should need occasional removal of wax and pitch from the borer bit. Lubricating the bit interior at each tree should negate the need for additional lubrication at the end of each day. When the borer is to be stored for an extended period of time, it should be cleaned thoroughly. All wax, resin, pitch, etc. should be removed with a solvent. A rifle-cleaning kit (.22 caliber fits most borers) is very useful for cleaning the interior of the borer bit. After cleaning, the entire instrument should be lubricated with WD-40 or other oil.

Sharpening

A borer bit needs sharpening if the wood cores are rough-edged, have spiraling striations, or if they appear slightly helixical rather than cylindrical in shape. An adequately sharp borer should be able to cut a sharp-edged circular hole in a sheet of paper. Minor sharpening can be attempted by the amateur, but major reconditioning should

be left to skilled professionals. Overly frequent sharpening will ruin a good bit; apply a stone to any bit only when necessary. Sharpening kits are available from suppliers of increment borers and contain oil, a cork on which to work, a flat, tapered fine India stone, and a conical tapered engraver's point stone.

The cutting edge of the bit must be flat; this can be checked by placing the tip gently against a known flat surface. If flat, it may still need sharpening; if not flat, it must be trued before sharpening is done. Truing can be done with the flat India stone, moving the stone flat against the tip of the borer and slightly rotating the tip after each pass of the stone (Figure 5, A).

Sharpening of a trued edge is done with the India stone and the point stone. The India stone is used to sharpen the outside cutting edge (Figure 5, B). As the stone is held in one hand, the bit is held in the other hand and pressed against the stone parallel to the beveled edge of the bit. The bit is then slowly rotated maintaining the same angle, until any small nicks are gone. If large nicks are present, a major factory rehabilitation is required.

Once the outside edge is sharpened, the inside can be honed with the conical tapered stone (Figure 5, C). The stone should be oiled and placed into the tip, but never to the point where it is snug. The bit should be lightly rotated against one edge of the stone, keeping the axis of the stone parallel to the axis of the bit. The beveled portion of the outside cutting edge can also be honed with the tip of the conical stone (Figure 5, D). With the tip of the stone parallel to the edge of the bevel, the bit can be rotated until the beveled edge has been honed.

The extractor should occasionally be sharpened, too, so it will easily pass along the core inside the bit. A few passes of the conical tapered stone on the extractor tip should suffice.

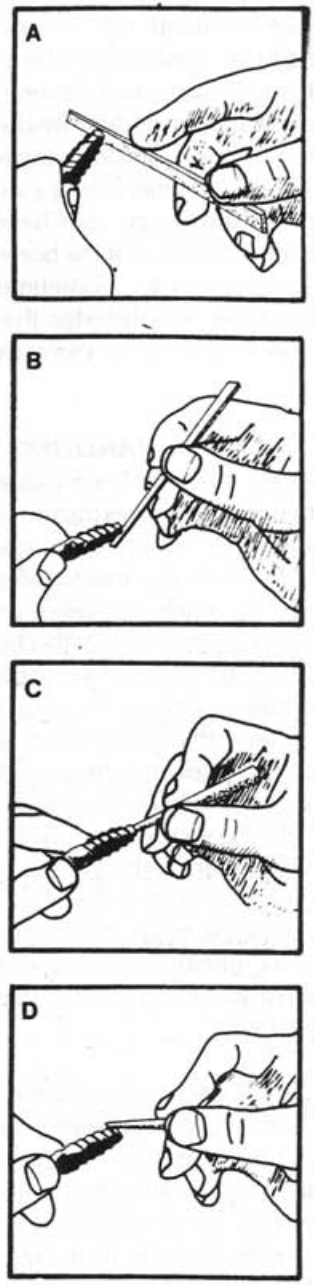

Figure 5. Sharpening the borer tip. A. The flat India stone is used to flatten the tip, if necessary. B. The India stone is also used to sharpen the trued edge. C. The round point stone is used to hone the inside edge of the bit. Avoid inserting the stone so far that it is snug. D. The point stone is also used to hone the beveled portion of the outside cutting edge.

COMMON PROBLEMS

Anyone who consistently bores trees will encounter problems from time to time. Several common ones are described below with solutions. While these instructions will be helpful, experience is also important to most efficiently use field time.

Rough-edged or "Popcorn" Cores

If a core has rough edges or if the core emerges as a slight helix, the tip of the borer is not true, or has been nicked. Refer to the maintenance section. A "popcorn" core is one that expands and tends to shatter upon removal. This is due to compression of the core inside the bit. The compression is usually caused by a damaged borer tip that is cutting a non-cylindrical core, which then occasionally jams down the shaft. A corroded or dirty shaft interior can also cause jammed cores. Continued coring compresses the new portion of the core near the tip of the borer bit, and upon extraction the core will expand and usually fracture. The next stage of this problem is a totally jammed core. The solution is to sharpen the borer bit or temporarily retire it until it can be properly rehabilitated.

Core Stuck in Shaft

A core can become stuck in the shaft of the borer bit if: (1) the shaft is dirty with pitch or resin, (2) the tip is damaged, or (3) the extractor is very dull. The result is a wood core that cannot be removed intact. At this stage, forget about saving the core and concentrate on removing it from the shaft in bits and pieces. The extractor can often be used to remove very small pieces of the core, perhaps an annual ring at a time. This is generally successful, but care must be taken to avoid damaging the extractor. Do not, for example, try to force an extractor in by pounding on its end with a rock or hammer. Instead, place the extractor in the shaft against the jammed core and slightly twist it back and forth, periodically removing freed sections of the core. Since the extractor is not designed for twisting, this technique should be used sparingly and with great care.

The wood near the borer tip is compressed more than anywhere else, and the extractor technique may not work here. Generally, if the remaining jammed portion is less than an inch long, removal of the core can be approached from the tip end of the borer bit. Start with a wood punch (see "Extracting the Borer"), and place it on the tip. It can be gently tapped with a rock or hammer. If you are unsuccessful at dislodging the core using this method, the core is probably even more compressed. Two last-ditch approaches are: (1) to place the borer bit in a vise, thread end up, and dislodge the wood core with a metal rod and hammer, or (2) to use a small-diameter electric drill and carefully drill out the core from the tip at the bit. Even with care, some damage to the tip of the borer is likely to result, and professional reconditioning should be considered once the core is removed.

If a borer that tends to jam cores must be used, one way to avoid core jamming is to sequentially remove the core in sections. The first section is removed after the borer has been inserted a couple of inches; then bore the next couple of inches and remove the next section of wood core, etc., keeping all pieces in proper order.

Borer Bit Stuck in Tree

A borer bit can get stuck in a tree in two ways: it will turn, but not back out, or it is totally locked in place. The chances of successful removal are better if the borer turns. If it is totally locked in place, it will likely break as torque is applied to it. The only options left are to cut it out of the tree with a chainsaw, or to abandon it. Assuming the bit will rotate, usually a little back-pressure as the handle is turned will be enough to start the threads backing out. This is a common occurrence in trees with rot, as the threads lose their channels in the rotten wood and need to be forced back into the channels made in sound wood during the extraction process. The problem with applying back pressure is that the clip attaching the handle to the borer bit must withstand all the pressure. The clip may break or bend; apply a minimum of force directly on the handles.

An alternative way to provide pressure is to attach a rope to the borer bit shaft at the point where it changes from round to square. This is normally a two-person job. A good climber's rope can be attached by a double half-hitch and attached to a comealong. Limited back pressure can be applied by tightening the comealong while beginning to rotate the borer. If a comealong is not available, the rope can be attached to itself after being looped around a nearby tree. The rope must be placed around a tree directly in line with the borer bit and secured several feet in front of the tree to the rope segment tied to the borer with a nonslip knot (a bowline works well). Then a sound branch (or a second increment borer) is inserted into the loop and turned, creating tension on the rope and back pressure on the borer bit. As the handle of the borer is turned, the tension from the rope usually is sufficient to help extract the borer bit. The rope must be attached to the borer shaft, not to the handle; the handle is held on only by a weak clip and will easily fail. The extraction process is a dangerous one because of the tension being

created. Use the minimum amount of tension possible to help extract the borer. If excessive rope tension is required, it is recommended that the borer be abandoned rather than risk injury by the rope breaking or rapidly untwisting.

CONCLUSION

Successful operation of increment borers requires consistent technique and consistent maintenance of the equipment. Shortcutting either of these generally results in damaged equipment and project delays. Using the guidelines in this manual, a safe and effective set of procedures can be applied. Whether sampling one or a thousand trees, you can depend on minimizing avoidable problems. Have a boring time!

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Information on the purchase of increment borers can be obtained from:

BEN MEADOWS COMPANY
3589 Broad Street, Atlanta, GA 30366
2601 - B West Fifth Ave., Eugene, OR 97402

FORESTRY SUPPLIERS, INC.
205 Rankin Street, Box 8397, Jackson, MS 39204

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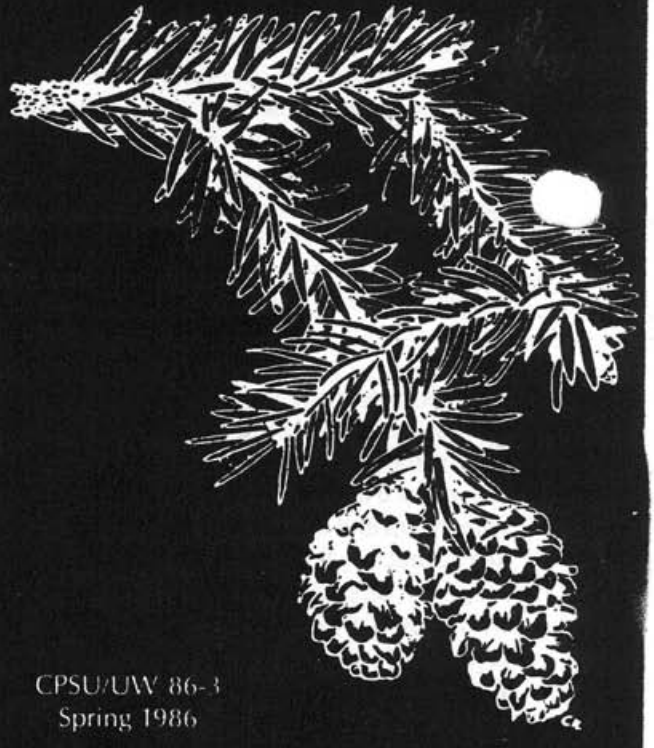

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