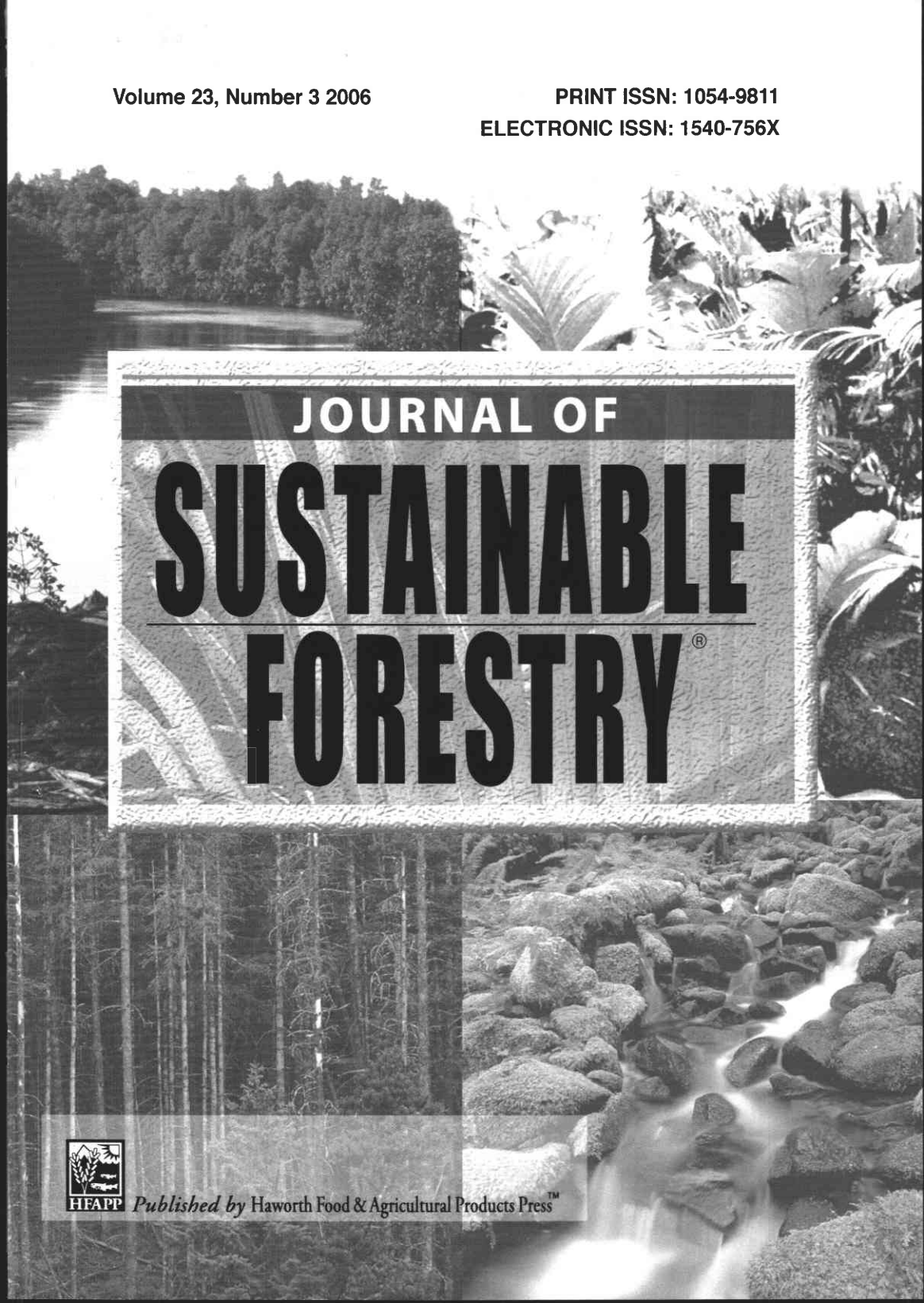


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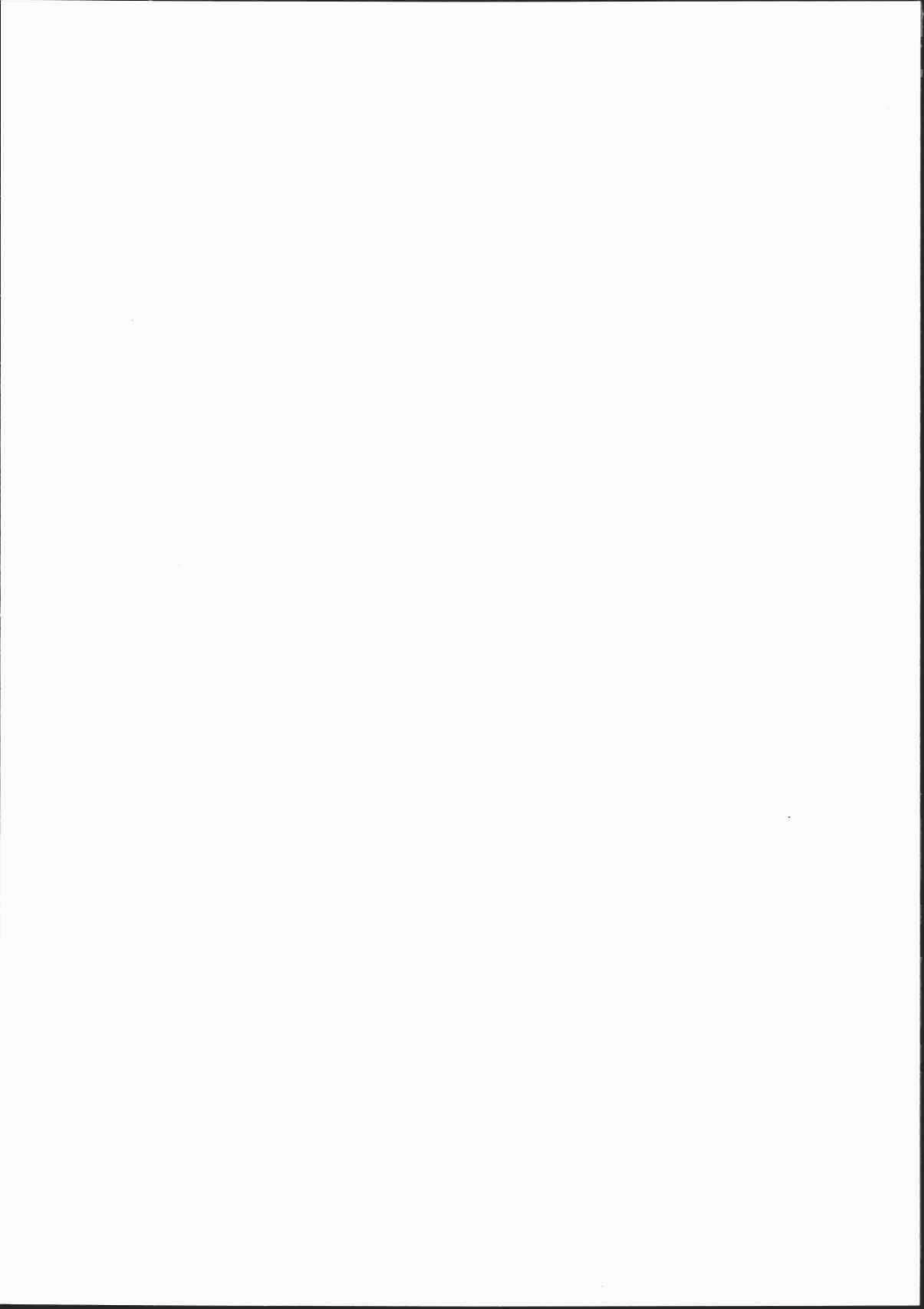
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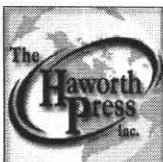
The cover features a collage of nature-related images. At the top left is a forest landscape with a body of water. To the right is a close-up of tropical foliage. The bottom left shows a dense forest of tall, thin trees, and the bottom right depicts a rocky stream with water flowing over the stones.

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Potential Contributions of Figured Wood to the Practice of Sustainable Forestry

Don C. Bragg

ABSTRACT. The birdseye grain of sugar maple (*Acer saccharum* Marsh.) can showcase the potential of figured wood in sustainable forestry. This poorly understood but valuable grain abnormality commands such a premium that its presence alone can influence timber management. Good forestry and logging practices can help assure that quality birdseye maple logs are not relegated to low-value uses. Birdseye specialty markets have also developed, creating opportunities for pieces of small or irregular dimensions. Even though few have the same promise as birdseye maple, figured grains are found in virtually every tree species, thus increasing the potential for other high-value niche markets. However, the relative rarity and slow formation of figured grains threaten their sustainability, until more research on their genetics, propagation, and silviculture becomes available. doi:10.1300/J091v23n03_03 [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <<http://www.HaworthPress.com>>.]

KEYWORDS. Birdseye, sugar maple, character-marked wood, alternative silviculture

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INTRODUCTION

Sustainable forestry emphasizes the long-term potential of natural and silvicultural systems by recognizing the consequences of human activities on the functionality of forests (Oliver, 2003; Wang, 2004). Although defining "sustainable" has been a long, arduous, and yet unfinished task (Floyd et al., 2001; Wang, 2004), conventional wisdom suggests that maximizing the economic potential of harvestable goods, while minimizing long-term negative impacts on the environment would be consistent with most interpretations (e.g., Helms, 1998).

A promising avenue for increasing return on silvicultural investments that does not require more intensive manipulation of ecosystems, is the improvement of resource merchantability. All too often, the production, identification, and segregation of different types of wood products into multiple end-use categories at the log deck, or "merchandizing," fail to capture the highest value products possible from the trees being harvested. For example, considerably more return from hardwood sawtimber can be realized if those bucking the logs have been adequately trained on lumber grade recovery (Pickens et al., 1992; Boston and Murphy, 2003). Better merchandizing is especially important to small timber operations since their profit margins tend to be more dependent on the actions of their loggers.

Recognizing the potential value in harvested timber also requires an awareness of all of the marketing options available. Specialty goods, though a niche market, can add considerably to the value of a forest if properly developed. In recent years, more attention has been paid to non-traditional forest products (e.g., Tewari, 2000; Davidson-Hunt et al., 2001; Chamberlain et al., 2001; Seth, 2003), including those that affect the appearance of the wood (e.g., Solomon, 1986; Bumgardner et al., 2000). Many different features can lend "character" to wood, including certain types of insect and bird injury, knots, decay, burls, or grain coloration or patterns (Paul, 1962; Bumgardner et al., 2001). Figured wood can be peeled into high-value veneers, turned on a lathe, carved, or cut into pieces designed to accentuate their appearance (Paul, 1962; Beals and Davis, 1977; Cook and Adamson, 2001). Unfortunately, many loggers consider character-marked wood to be defective or not worth the time invested in their identification and marketing, and frequently delegate these logs to lesser-value uses or disposal (Hoffman, 2004). As an example, "spalted" (partially decayed but still solid) sawlogs are often placed in the pulp or chipwood pile, or abandoned in the woods, regardless of their ornamental potential.

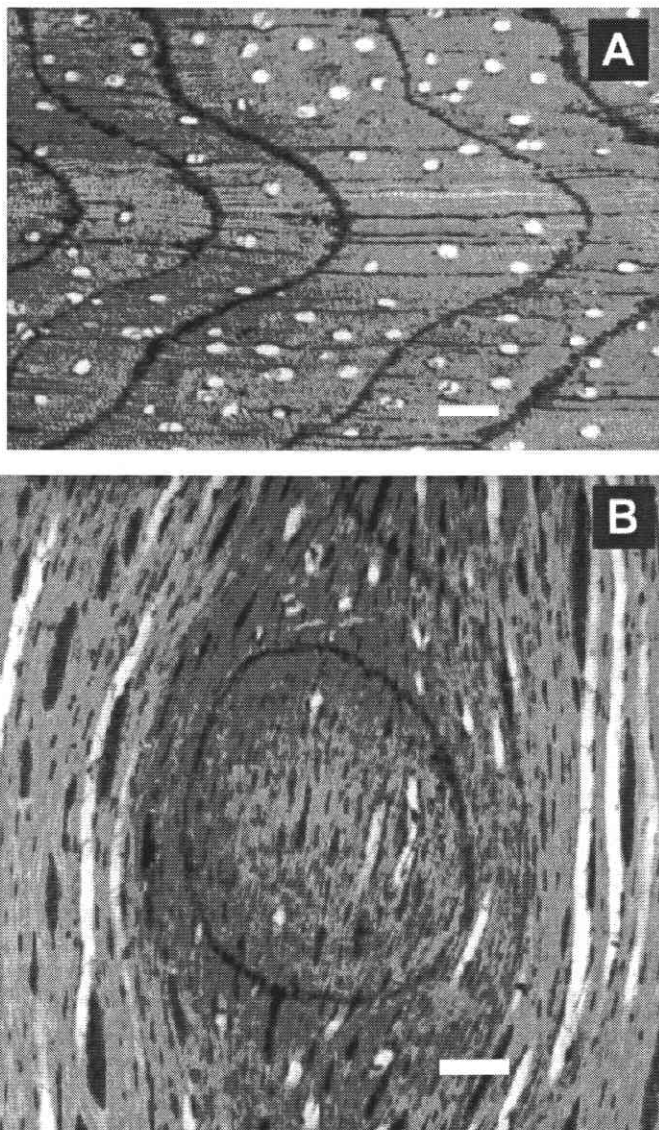
However, knowledgeable individuals often go to great lengths to secure character-marked wood (e.g., Anonymous, 1997), and are frequently willing to pay much more than standard market value for prized specimens. For example, the "birdseye" figured grain of sugar maple (*Acer saccharum* Marsh.) has a well-developed specialty market and quality birdseye maple often fetches 10-50 times the price of similar but unfigured logs (Bragg and Stokke, 1994). Given that premium pricing of timber products has been shown to promote good forestry practices (Kilgore and Blinn, 2004), figured grains and other character-marked woods have a unique potential to encourage sustainable forestry in many ecosystems. This paper will elaborate on the opportunities presented by birdseye maple, with further inferences made for other similar products.

A PRIZED ANOMALY

Birdseye is an aberration in the normal grain pattern of sugar maple where, at localized points along the stem, branches, bark, and perhaps even roots, an indentation in the wood forms (Bragg, 1999; Rioux et al., 2003). Structurally, birdseye represents a reorientation and redistribution of rays, vessels, and fibers (Figure 1), with some collapsed and hypertrophied cells and thicker-than-normal cell walls (Bragg, 1999; Rioux et al., 2003). Birdseye figure can be perpetuated for many years, resulting in an obvious dimpling along all or part of the tree (Figure 2). Though most commonly reported in sugar maple, birdseye or birdseye-like grain patterns have been noted in dozens of hardwoods and conifers (Bragg and Stokke, 1999).

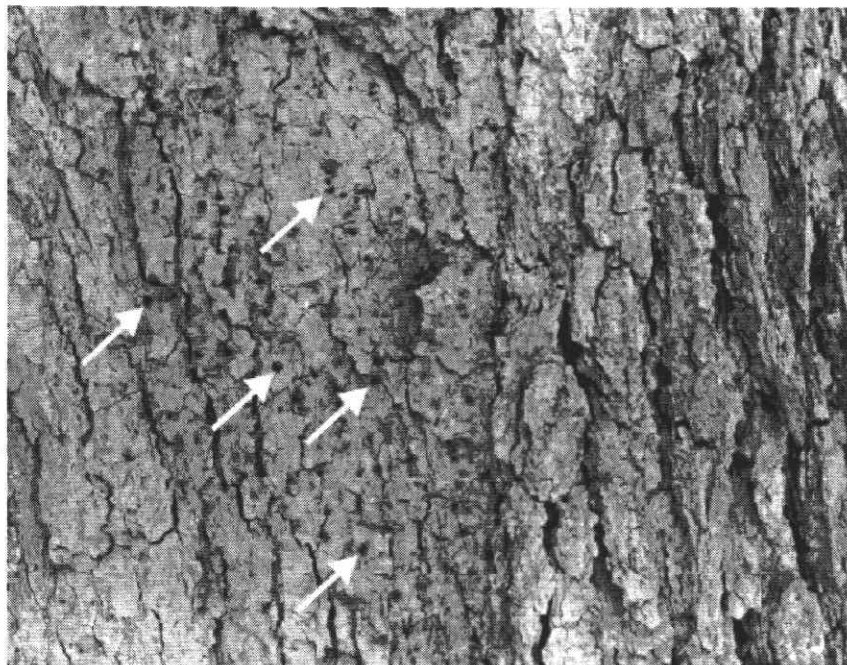
Little is known about the mechanism(s) of birdseye formation (Bragg et al., 1997; Bragg, 1999). Speculation has ranged from bird peck injury (Garratt, 1931) to suppressed or adventitious buds (Strasburger et al., 1898; Borthwick, 1905; Werthner, 1935), insect or fungal activity (Baterden, 1912; Hale, 1932), genetics (Righter, 1934), and slow growth due to competition (Holmberg, 1933; Mroz et al., 1990). Most recently, two studies (Mroz et al., 1990; Bragg et al., 1997) on the link between stand density and birdseye formation produced contradictory results. Birdseye appears more frequently in contemporary old-growth northern hardwood forests (Bragg et al., 1997) and was probably relatively abundant in virgin forests (Gagnon, 1996). For instance, Hough (1884a, p. 387) reported "large lots" of figured maple (including birdseye) in some West Virginia headwater streams, and Sherwood (1936, p. 47)

FIGURE 1. Images of the birdseye grain in sugar maple from cross-sectional (A) and tangential (B) perspectives.



Note that the vessels and fibers have been redirected around the distortion formed by the birdseye figure, and the rays are more numerous yet smaller inside the figure than in the adjacent "normal" wood. Scale bar equals 0.25 mm.
Microphotographs courtesy of D. D. Stokke.

FIGURE 2. Birdseye dimples or "gelasini" (examples are identified with arrows) exposed in the bark of a live sugar maple.



Extensive gelasini are the most obvious and dependable outward expression of a well-figured birdseye maple, and can be easily detected when timber cruising. Photograph by D. C. Bragg.

recalled a log buyer from northern Michigan who had "specialized in birdseye maple when fine logs from the virgin timber were common."

Birdseye maple has a long history of ornamental usage. Boulger (1902) reported that the ancient Romans incorporated birdseye in tables. Colonial gunsmiths and woodworkers crafted gunstocks, musical instruments, and furniture from birdseye maple (Maxwell, 1913; Werthner, 1935; Keenan, 1989). In an early text on American forestry, an individual birdseye maple tree reportedly sold for \$1,000 (Hough, 1884b). Using a conservative inflation rate, this single specimen was worth at least \$46,000 in 2002. However, not everyone valued birdseye maple similarly. Girdling or felling, and abandoning birdseye maples were practiced by industries that preferred clear, straight-grained maple. For this market, birdseye grain is a defect that lowers the product value (Society of American Foresters, 1958). As an example of this disregard, my

grandparents purchased a birdseye maple floor in the early 1960s from a hardwood mill in northeastern Wisconsin. Though it took somewhat longer to accumulate sufficient wood for this floor, the mill did not charge a premium because they preferred to sell straight-grained flooring.

The value of birdseye maple comes from its relative scarcity. The most prized specimens (those with good log quality and abundant, well-distributed, and moderately sized "eyes," sometimes mixed with curly grain) occur in less than 1% of the sugar maples where birdseye is most common (the Upper Peninsula of Michigan), and is usually much less frequent. Nevertheless, even a few good birdseye maples can appreciably increase the value of timber sale (Mroz et al., 1990; Gagnon, 1996; Bragg et al., 1997). In fact, some areas have experienced so much birdseye poaching as to make it a newsworthy event (e.g., Fullerton, 1996; MacLean, 1997).

AVENUES OF POTENTIAL VALUE RECOVERY

Even in areas where birdseye maple is relatively common and awareness of the value of this figured grain is greater, many quality birdseye logs are not detected or recovered during the merchandizing process, and hence are relegated to low-value uses. Some of these failures may arise from a common misconception that birdseye is not identifiable in standing timber. However, signs of birdseye presence in trees have been recognized for years (Pillow, 1955; Mroz et al., 1990; Bragg and Stokke, 1994). Bragg and Stokke (1994) determined that birdseye maples could be distinguished from unfigured trees by examining the bole form, bark, and (if necessary) wood. Since the bark of well-figured individuals also shows the characteristic dimpling expressed in the wood (Figure 2), a simple surficial check could be incorporated in pre-harvest timber cruises without undo burden. With the potential value of birdseye, missing a single figured tree could result in thousands of dollars of lost value for either the seller or the purchaser. Recognition of the value of figured wood may also allow timber buyers to improve their offer and give them an advantage in lump-sum bidding.

Another opportunity to improve value recovery using figured wood lies in the protection of the quality of veneer in standing timber. Stand thinning, though favored for increasing individual tree growth, often triggers inconsistent ring thickness, which degrades the quality of the veneer (Alderman et al., 2004; Cassens, 2004). Given the pronounced price difference between veneer (especially, when figured) and sawtimber,

boosting tree growth at the expense of prime veneer production could lead to a decrease in overall stand value. This may prove especially critical if the anecdotal evidence of an abrupt cessation of birdseye grain formation following overstory release reported by Pillow (1930) and Constantine (1959) is true.

USING BIRDSEYE TO SUPPORT SUSTAINABLE FORESTRY

Birdseye Value

A key to understanding the potential of birdseye in sustainable forestry is recognizing that management options diversify as product value increases. In turn, this could affect stand-level prescriptions and how the harvested materials are logged and transported to market. For instance, some landowners want to encourage "old-growth-like" stand characteristics (e.g., bigger trees, more large woody debris, greater overstory diversity; Marquis, 1981). Those interested in this treatment often view it as an option that balances unharvested reserve areas and intensive timber management (Guldin, 1991; Morton et al., 1991), and supports broader ecosystem management objectives, including long-term productivity (Mladenoff and Pastor, 1993). However, managing for old-growth-like characteristics often proves relatively expensive to implement and maintain, and thus is harder to sustain unless additional returns are realized. If a direct link between old-growth-like conditions and birdseye occurrence is shown (as has been found for unmanaged old-growth northern hardwoods), this silvicultural strategy may prove more economically feasible. The presence of quality birdseye maple in these stands would allow for a limited degree of harvesting to be profitable, even if longer-than-usual, low-intensity cutting cycles are used.

Harvest Implementation Issues

The potential value of birdseye, especially in the relatively slow growing sugar maple, places a greater premium on protecting tree quality. Most mechanized, tree-length logging operations inflict considerable damage on residual timber, often with 20-50% of the remaining trees experiencing some type of bole wounding (Kelly, 1983; Nichols et al., 1994; Heitzman and Grell, 2002). Stem wounds allow for the introduction of decay and stain fungi, especially in hardwoods (Mielke

and Charette, 1989; Erickson et al., 1992) or may trigger other physiological responses that reduce veneer quality (Cassens, 2004). In areas of elevated birdseye maple occurrence, the risk of damage favors efforts that protect residual tree quality, even if they are operationally more expensive (see Leak and Gottsacker, 1985, for some recommendations). Special tactics for birdseye maple logging may need to be developed. For instance, Gagnon (1996) reported that some loggers would only fell birdseyes during certain months of the year to minimize mineral stain formation. Another strategy would be to protect known birdseye maples by not cutting or skidding in their immediate vicinity unless absolutely necessary.

High-value timber lends itself to harvest systems that would ordinarily be considered uneconomical, even under the best market conditions. The stumpage price of birdseye maple and other veneer-grade trees, for example, has permitted the use of helicopters to transport these select logs from otherwise inaccessible forests in the Upper Peninsula of Michigan. This avoided the need to build expensive and ecologically disruptive roads into undeveloped landscapes and preserved much of the naturalness in the harvested areas. Given the extreme value of some individual birdseyes, special birdseye-only harvests may be warranted, with felling and bucking performed under the specific direction of the buyer to capture the greatest value.

Harvest equipment that damages wood while processing logs can also prove detrimental. Any machining that degrades a log from its highest value use and relegates it to something less is an avoidable loss of revenue. Thus, more effort should be placed in identifying valuable logs before they are processed. For example, slashers or other highly automated merchandizing machines can misdirect veneer or figured trees into low-value products since it is virtually impossible to identify birdseye from the cab of a log processor.

Improved Fiber Recovery

Better wood utilization can increase profitability and reduce the pressure for timber production on other portions of the landscape. Unfortunately, many operations fail to realize that the specialty market for birdseye involves more than traditional sawlogs and includes smaller diameter trees, shorter piece lengths, and even low-grade logs or residue. As an example, birdseye buyers have on occasions purchased logs as short as a meter in length. A growing market has also developed for finished products like knife handles, gunstocks, humidors, jewelry cases,

and other turnings and novelties (Figure 3) that can be produced from very small pieces of figured wood. Hence, wood previously deemed unfit for standard dimensional lumber can have considerable value if sufficiently figured and properly marketed (Hoffman, 2004).

In addition to more fully identifying salable materials, better manufacturing of sawlogs in the bucking process (cutting for grade) can improve profitability without increasing the intensity of harvest. For instance, Pickens et al. (1992) reported significant improvements in log manufacturing by buckers that have been trained to maximize log value by optimizing log length and minimizing defect. Boston and Murphy (2003) also reported that inefficient or inappropriate bucking of timber relegated many logs to pulpwood rather than more valuable sawtimber, often because the logs were cut too long or too short for acceptable tolerances. Optimized bucking following conventional log grading rules, whether human or mechanized, becomes even more important when a value-multiplying feature like birdseye is present.

FIGURE 3. Examples of hand-crafted birdseye maple products.

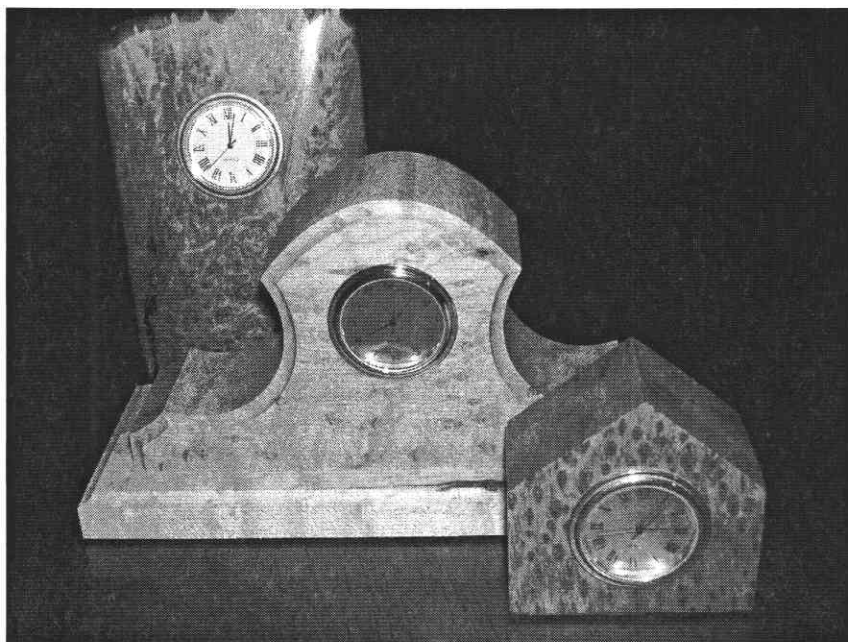


Photograph by D. C. Bragg.

TRANSLATION TO OTHER FIGURED GRAINS

The potential of birdseye maple for sustainable forestry also applies to other types of figured grain and wood with character (Figure 4). Since figured grain develops in virtually all tree species (Beals and Davis, 1977), every commercial forest type probably has untapped specialty wood markets that could enhance their sustainability (Oliver, 2003). The novelty and relative rarity of character wood also means that both manufacturers and retailers must be willing to develop consumer markets or seek alternative distribution options, if needed (Bumgardner et al., 2000; Hoffman, 2004). Woodworkers can also help bolster interest in figured grains that are otherwise problematic to locate and work with (like birdseye) through forums on how to best purchase, surface, and finish this product (e.g., Paul, 1962; Keenan, 1989; Johnson, 2000).

FIGURE 4. Clocks produced using figured grain casements.



The taller clock in the back is manufactured from burlwood, while the center clock is birdseye maple and the front timepiece is constructed from figured oak.
Photograph by D. C. Bragg.

Identifying figured wood is the first step in maximizing the potential value of a tree. If properly trained, timber cruisers can spot many character features with a quick examination (Pillow, 1955; Bragg and Stokke, 1994; Cassens, 2004). For example, the markings of birdseye, curly, or spiral grain are often visible in the bark of trees (Pillow, 1955; Harris, 1989; Bragg and Stokke, 1994). Burlwood and branch crotches are very apparent, even at great distances. Character marks due to decay, insects, or birds are sometimes noticeable from outward signs of injury, while others (e.g., heartwood color, texture, or shape patterns) do not appear until after the tree has been felled or are not obvious until the log has been milled. The extra time invested in locating, separating, and shipping figured wood can usually be justified by substantially higher financial returns (Hoffman, 2004).

While many consider high-value wood products the realm of international commodity brokers (indeed, many of the best veneer-quality birdseye logs are purchased by Asian or European interests), the emergence of the Internet as an avenue of commerce allows for new and small-scale marketing opportunities. Individual woodcarvers in the Upper Peninsula of Michigan, for example, now offer birdseye and curly maple housewares, furniture, turnings, and curios worldwide; a much broader distribution than just local stores or craft markets. In addition to finished products, many of these vendors also sell unfinished blanks of figured or character-marked wood to other craftsmen and hobbyists. The scarcity of highly figured wood makes it unlikely that global markets will be saturated, thus sustaining their premiums.

SUSTAINABILITY OF THE FIGURED GRAIN RESOURCE

There are risks inherent to the widespread commercial exploitation of figured grains. For instance, quality birdseye maple logs take many decades to develop. Since we do not yet know how to artificially culture birdseye, the supply of this special product will continue to depend solely on natural mechanisms. Indications are that the best birdseye is becoming increasingly scarce (Bragg et al., 1997). Although even less research has been done on other figured grains, their occurrence has also probably decreased across managed landscapes, and will almost certainly to continue to decline even as demand for specialty woods remains strong.

Artificial inducement of figure may prove a partial solution. Developing a better understanding of the role of genetics in figured wood

formation is critical to ensuring the long-term sustainability of the resource. Unfortunately, few figured woods have ever been successfully propagated (Bailey, 1948) in large part because of our limited knowledge of their originating cause(s). In most cases, the "accidental" nature of the figured wood determines its abundance and, inevitably, its value. However, enough may be learned to encourage the formation of figured grain that could then help develop silvicultural prescriptions designed to favor its propagation. If nothing else, management options could be designed to improve overall stand quality, thereby helping to ensure that figured trees would have fewer defects.

CONCLUSIONS

Even though few figured grains have the same promise as birdseye, they have considerable potential to increase timber value and product recovery. Figured grain-based forestry will never replace traditional systems in either their contribution to the economy or their influence on landscape management. However, prescriptions that recognize the unique potential of a highly valuable (if exceedingly scarce) commodity should permit greater flexibility in the type of management opportunities available. This, in turn, expands the number of silvicultural and harvest options, including those alternatives that are most conducive for long-term, sustainable forestry.

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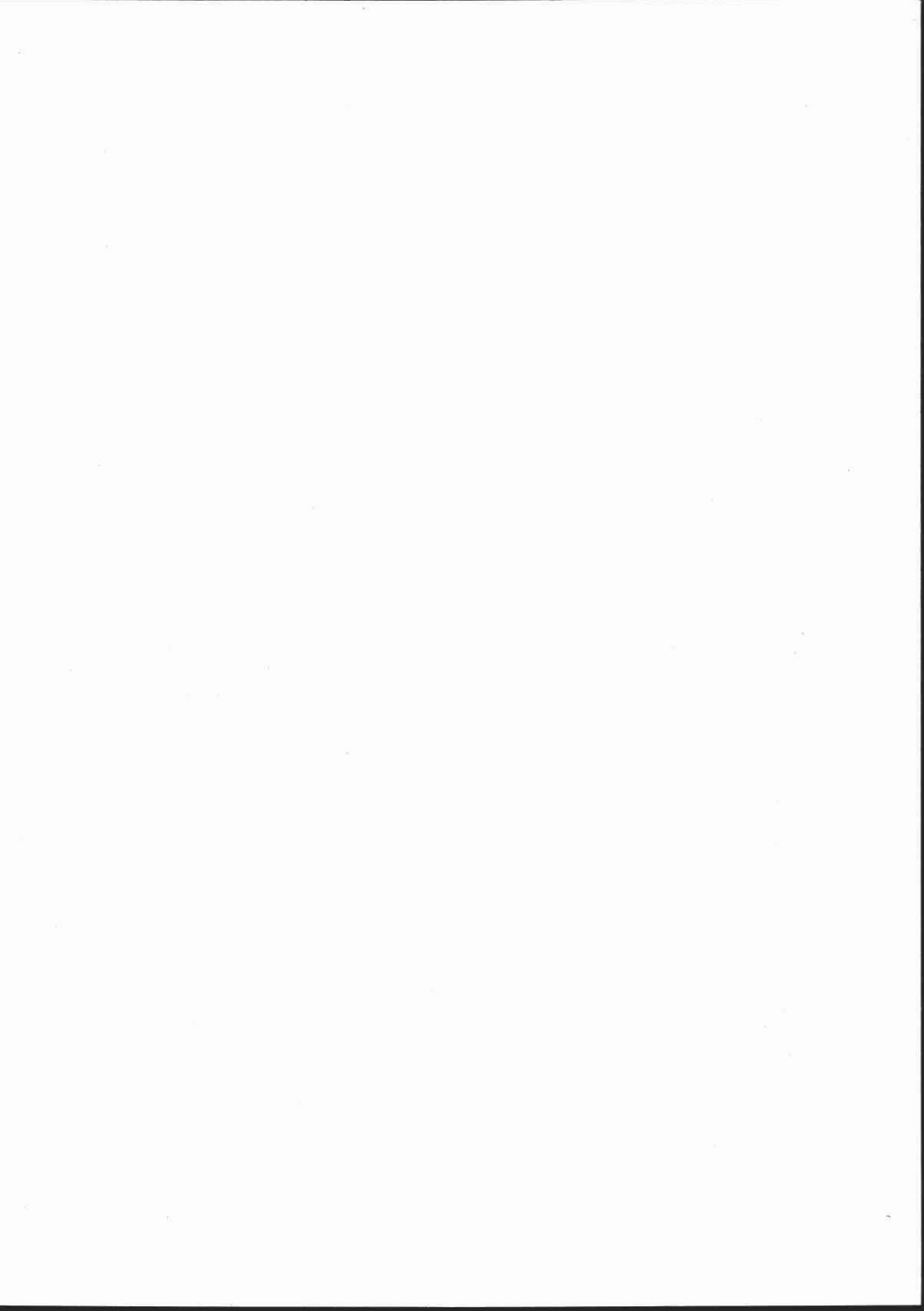
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