Analysis of chainsaw cutting patterns

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Summary

While timber thefts occur on both public and private lands, it is difficult to prevent illegal cutting of timber in large forested areas. However, when investigators encounter suspected stolen logs, it may be possible to match the cut ends of the logs to stumps in the forest. While cutting a tree, a chainsaw operator may change saw positions so different directional striation patterns on the cut end of a tree may be produced. In this study, 25 samples were cut from a recently harvested tree. Each sample was ~ 3–6 cm in thickness and approximately 11–15 cm in diameter. A Stihl Model 290 gasoline powered chainsaw with a chipper chain equipped with a 50 cm bar was used to cut the samples. Fifty cut ends were examined for directional striation changes on the cut end. A classification system was devised to characterize the different patterns.

Key words: chainsaw cutting patterns, chainsaw tool marks, striations

Introduction

When logs are cut with a chainsaw, the cutting teeth remove chips of wood from the log leaving striated tool mark patterns on each face of the cut log. These striated patterns may have some degree of uniqueness because as the saw is manipulated by the operator during the cutting process, the direction of the striated pattern changes. In a 1970 timber theft case, a log was matched to a stump using striation patterns (Molnar, 1970, p. 29–30; Walsh et al., 2006, p. 14–40). Evidence of illegal logging activities in Brazil, Bolivia, Cambodia, Ecuador, Georgia, Indonesia, Kenya, Laos, Thailand, Vietnam, Poland and the United States have negatively impacted natural forests on public and private lands (Dudley et al., 1998, p. 248–250). Approximately 28% of Poland's timberland is protected in State National Forests. In the United States 36% of the protected timberland is located in National Forests (Nichols, Trembicka-Nichols, 2005, p. 53, 55; Fronczak, 2003, p. 4; *Statesman Journal*, 1993, p. 4C; Hill, 2012, p. 26–27). While illegal logging occurs in many countries, the examination of striated patterns produced by chainsaw cuts may be useful in investigations of timber thefts from public and private lands.

In some cases, timber thefts occur when individuals knowingly harvest timber without permission or while legitimately harvesting timber on one property, individuals illegally encroach and harvest timber on an adjacent property (Tacconi, 2012; *Field Guide*…, 2000; Paciello, 2006, p. 345–372). In either case, chainsaw striations produced from cutting patterns on the stumps and logs may provide characteristics to match or eliminate the cut ends of logs. Matching the cut end of a log to a stump may be circumstantial or conclusive evidence that the log matches the stump depending on the uniqueness of the striations on the cut. In each case, the tool mark examiner has to determine uniqueness of the striated pattern.

Materials and methods

In this study, 25 samples were cut from a recently harvested tulip popular log. Each sample was ~ 3–6 cm in thickness and approximately 11–15 cm in diameter. A Stihl Model 290 gasoline powered chainsaw with a 56.5 cc engine and a chipper chain equipped with a 50 cm bar was used to cut the samples. Some variables affecting the cutting patterns include: the type of chainsaw chain, bar length, chainsaw power and cutting speed, tension on the chain and sharpness of the cutting teeth. A constant chainsaw speed was attempted; however, the speed gradually increased as the thickness of the cut decreased.

Each side of the log sample cut was labeled. Therefore, the striation patterns on one side of a cut produced a mirror image of the striations on the other side. Figure 1 is a diagram of a chainsaw blade with cutting teeth, figure 2 illustrates striations by changing the position of the saw and figure 3 depicts mirror images of striations in a cut. Sometimes the striations have a curvature which results from a cut from the tip of the saw. Figure 4 illustrates these types of striations. The twenty-five samples yielded 50 images for comparison of striations. Digital images of the cut logs were photographed using oblique lighting to illustrate the variations in striation patterns. A graphics program was used to overlay black lines on the digital image to illustrate directional changes in striations on the surface of the cut log. To characterize the striated patterns, a pattern classification system was devised. The patterns were classified as type 1 directional striations, type 2 directional striations, and type 3 directional striations. An evaluation of type 1 was assigned to

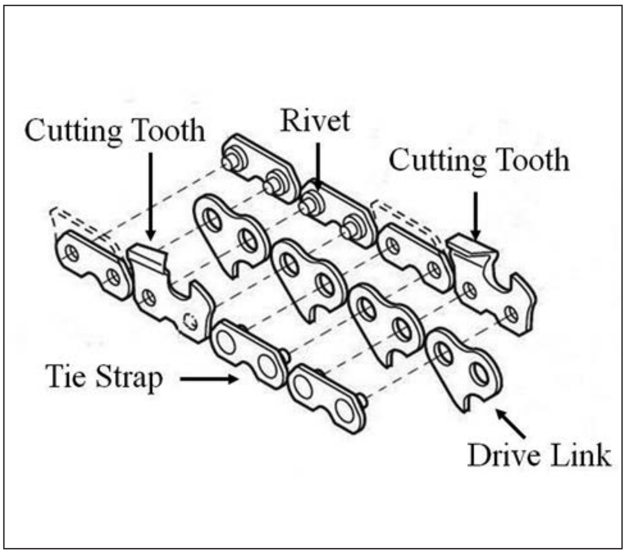

Fig. 1. Diagram of chainsaw blade.

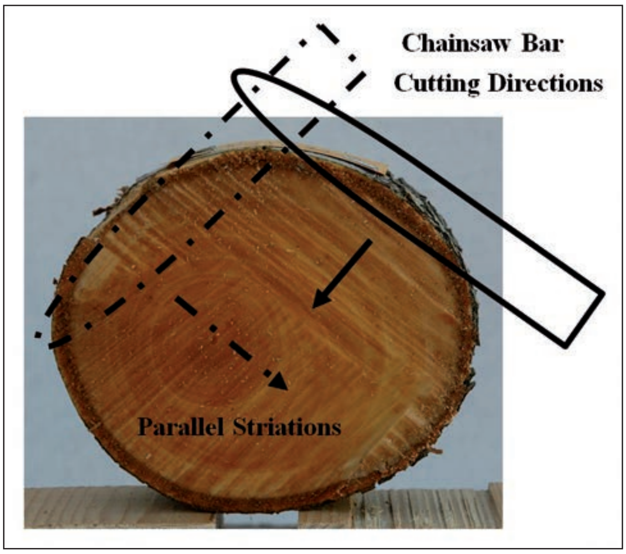

Fig. 2. Strations as effect of changing the position of the saw.

Fig. 3. Mirror images of a cut log.

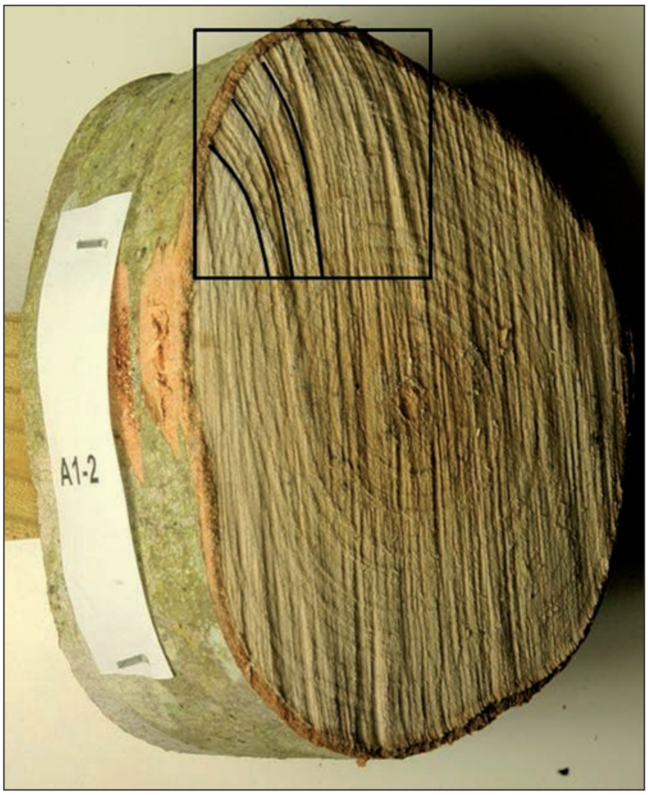

Fig. 4. Curved striations from tip of saw.

Fig. 5. Type 1 Striation pattern.

Fig. 6. Type 2 Striation pattern.

Fig. 7. Type 3 Striation pattern.

samples with slight directional variation or absence of a cutting pattern. For example, if the chainsaw remained in the same position during a cut, there would only be a series of linear striations which would not be useful for matching the two cut ends. A type 2 classification indicated some movement of the saw producing a cutting pattern but not enough variation for a visual match and a type 3 classification indicated sufficient movement of the chainsaw to produce a cutting pattern sufficient for matching cut ends of logs. Figures 5, 6 and 7 are examples of the classification types.

Results and discussion

Some chainsaw striation patterns on cut logs may be used to match log sections. When cutting a log, the chainsaw operator usually manipulates the saw by rocking it back and forth during the cut. The purpose for rocking the chainsaw is to reduce the amount of the cutting surface on the chain. The initial cut into the circumference of a log begins with less surface; however, as the cut progresses through the log, the cutting surface increases. Changing the position of the chainsaw by rocking it also creates a unique striation pattern on each side of the cut. As the bottom teeth on the chainsaw remove wood chips from the floor of the cut, the teeth on each side of the chain removes chips from each side. Consequently, the two patterns created by removing chips are similar when juxtaposed because they are mirror images. Also, the cutting teeth are alternated on the chain. Thus, one tooth cuts the right side of the log followed by another tooth that cuts the left side of the log. Therefore, the chain cuts uniformly on both sides and the angle of striations changes as the position of the saw is changed.

Thus, these characteristics can be used to match one section of a log to another or a log to a stump. The more movement of the saw by the operator during the cutting process increases variations in directionality of striations making the cut pattern more individual or unique. If the operator holds the saw in one position to make the complete cut, the striation pattern will be uniform and linear. Consequently, no match can be accomplished.

Typically, the first step in felling a tree is referred to as a face cut followed by a cut on the opposite side perpendicular to the trunk. The first cut is a wedge-shaped notch cut from the trunk of the tree. A log cut from the stump using this technique may have a beveled cut on the log resulting from the face cut. This type of cut end is considered a class characteristic. Another class characteristic is the presence of semi-circular striations on the cut end. This can occur when the tip of the chainsaw contacts the surface of the log. The radius on the end of the chainsaw bar produces this type of pattern. In some cases, morphological anomalies in the log or trunk can be used to match the ends such as the shape of the trunk or cavities in the trunk.

Conclusion

In conclusion, analyzing chainsaw cut patterns can be an effective and efficient procedure for making matches between the ends of cut logs or a cut log and a stump. Of the 50 surfaces examined for chainsaw striation patterns, 6 (12%) were type 1 and yielded no useful matching patterns, 10 (20%) were type 2 and had some matching patterns and 34 (68%) were type 3 with sufficient striation variations in the cutting pattern to be useful for matching the cut ends of logs. Only 6 (12%) of the cuts offered no pattern for matching the cut ends. Wood is a hygroscopic material comprised of cells that absorb water and expand, or lose water and shrink depending on the relative humidity of the surrounding environment (Maxwell, Williams, 2013, p. 75–81). Chainsaw striation patterns are more prominent in fresh chainsaw cuts. As the logs dry the striations become somewhat diminished and eventually obscured. Moreover, it is important for toolmark examiners to photograph and examine chainsaw cuts early in the investigation.

Source of Figures: Author

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