

Documentation of Hazards and Safety Perceptions for Mechanized Logging Operations in East Central Alabama

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Abstract

The logging industry remains one of the most hazardous in the nation. Despite more stringent safety regulations and improvements in equipment safety features, the rate of logging fatalities has decreased at a much lower rate than the decrease in the rate of illnesses and injuries in the same occupation. The objective of this research was to identify and assess the hazards associated with logging operations in the Southeast region of the U.S. and propose interventions, taking into consideration the fact that, currently, most operations in the region are fully mechanized. Five logging crews in East Central Alabama participated in the study and were observed repeatedly during their normal operations. Researchers observed loggers engaging in multiple unsafe behaviors, but none of those led to an injury. The incidence of unsafe behaviors may be due in part to a lack of awareness of the hazards. Results indicate that Occupational Safety and Health Administration (OSHA) regulations appear to have little influence on logging safety. Loggers believe that most safety training recommendations are difficult to implement and negatively impact productivity. Thus, there seem to be fundamental drawbacks in the logging industry regarding effective delivery of safety training to loggers. The present study was a joint venture by the Industrial and Systems Engineering and Psychology departments of Auburn University, with support from the United States Forest Service (USFS).

Keywords. Hazard research, Logging safety, Mechanization.

Logging, along with fishing, truck driving, and construction, is considered one of the most dangerous occupations in the U.S. Attempts to improve the safety of loggers have utilized technological improvements as a means to distance the logger from the tree. Thus, the more mechanized the logging operation, the greater

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the safety of loggers. Silversides (1964) suggested that logging could be considered completely mechanized when “a standing tree can be harvested and delivered to the mill ‘untouched by human hands’” (p. 22).

Data regarding the rate of accidents for mechanized versus non-mechanized forestry operations in Canada and Sweden have been published by the International Labor Organization (ILO, 1991). According to the definitions used in this analysis, operations where chainsaws are used for felling are considered conventional even when skidders are used to transport the felled trees. On the other hand, operations with feller-bunchers, skidders, and delimiters are considered fully mechanized. Approximately 22% of the accidents in Quebec, Canada, between 1981 and 1984 were associated with mechanized logging, while the remaining 78% were related to conventional logging, even though there were only 17% more conventional than mechanized loggers in operation at the time. The Swedish data were similar, with only 20% of the reported accidents being associated with fully mechanized operations.

Most of the loggers now operating in East Central Alabama meet the above definition of mechanized loggers. The number of crews still using chainsaw harvesting or animal power for transportation is minimal. Greene et al. (1988) surveyed loggers in the state of Georgia and found that only 17% of loggers reported manual felling with chainsaws. Because the number of loggers who use chainsaws as their main method of felling trees in the region is small, a decreased number of accidents in the area should be observed.

Additional evidence indicates that logging accidents are not related to chainsaw usage. Alabama claims data indicate that the number of accidents related to chainsaws is much lower than accidents related to being hit by logs or objects, only 2.8% compared to 33.4%, respectively (see table 1). The results of a study by Shaffer and Milburn (1999) show a consistent pattern, with only 11% of injuries being related to chainsaws. Their data were collected in the Southeast region with mechanized operations, and they found that 28% of the injuries reported were related to a falling tree, limb, or log, while 23% were related to hand tools or metal parts.

On the one hand, it is clear that there has been an increase in the level of mechanization of the logging industry, and that mechanization probably leads to increased safety. On the other hand, there is evidence to suggest that the number of fatalities remains very high in this industry. Increased mechanization associated with efforts to raise productivity has characterized the logging industry since the early 1970s, and this has also made for a safer working environment. The rate and number of accidents has decreased, as evidenced by a 52% reduction in the logging occupational injury and illness rates for the U.S. for the years 1990 through 1998 (U.S. Department of Labor, 2000). Despite the decreasing trend in the number of logging-related illnesses, the trend in the number of fatalities is decreasing at a much lower pace, with only a 15.6% reduction between 1992 and 1999 (Bureau of Labor Statistics, 1998).

Table 1. ASI logging contractor data, averaged for the years 1996 and 1997.

Injury Source	No. of Claims	% of Claims ^[a]	% of Cost ^[a]
Chainsaw cuts	49	2.8	1.8
Falling tree/object	164	9.2	28.3
Hit by log/object	430	24.2	18.3

^[a] Does not add up to 100% as not all the types of injury possible are included.

A report by the U.S. Department of Labor published in 1988 reviewed 141 logging fatalities that occurred between 1978 and 1984. The information presented was collected by the Occupational Safety and Health Administration (OSHA), and the accidents were selectively included in the report. The accidents were classified in a variety of ways in order to consider the multiple factors that led to the fatalities. According to this report, a large percentage of accidents (approximately 40%) were related to falling trees or parts of trees. About 10% of the accidents were related to equipment or parts of equipment, while less than 2% of the fatalities were associated with chainsaw injuries (U.S. Department of Labor, 1988). In the analysis of logging fatality data by Myers and Fosbroke (1994), they concluded that the risk of fatal injury in logging from 1980 to 1988 remained virtually unchanged in those 9 years. Further, they argue that the risk of fatal and non-fatal injury has decreased little, if any, in the past 30 years.

The recommendations made by the 1988 Department of Labor report include establishing and enforcing strict safety standards, as well as increasing the level of training and supervision of the logging crews. The findings suggested that lodged trees that fall unexpectedly are one of the largest dangers, followed by falling or moving logs. Sloping terrain also led to a greater number of accidents. Most accidents related to unsafe operation of heavy equipment involved skidders (U.S. Department of Labor, 1988).

The technological improvements of the equipment employed by the logging industry should have led to a greater decrease in the number of fatalities than has actually been observed in the past 10 to 15 years. A 1994 National Institute for Occupational Safety and Health (NIOSH) alert suggests that many of the loggers who are seriously injured are unaware of the risks associated with their occupation. The alert reports that, during the 1980s, the fatality rate among loggers was 23 times higher than the average for all other U.S. workers (NIOSH, 1994).

During 1996, 155 loggers (SIC 241) were fatally injured at work in the U.S. Of these, 10 occurred within the state of Alabama. Alabama's fatality data also indicate 6 deaths in the years 1991, 1995, and 1998 (OSHA, 2000). Seventy percent of the 1996 Alabama logging fatalities (7) were caused by the logger being struck by a falling tree or limb. Though this percentage is high, it is congruent with the OSHA logging fatality data for Alabama for the 10-year period ending in 1997. Over this 10-year period, reasons for the 50 logging fatalities recorded in Alabama include: being struck by a falling tree/limb (60%), run over by equipment/crushed by a log (32%), electrocution (4%), and other fatalities (4%). By contrast, there have been only 2 fatalities directly resulting from contact with a running chainsaw (cuts) over the past 15 years (Bureau of Labor Statistics, 1998).

In response to the deaths and hazards present in logging operations, OSHA proposed a 1994 revision to the safety standards for the logging industry. This new standard, 29 CFR 1910.266 (<http://www.access.gpo.gov>), requires all workers to comply with more stringent regulations concerning personal protective equipment, training, and other safety related factors (U.S. Department of Labor, 1995). The changes in these regulations covered a broader scope of logging operations and included provisions in areas such as training, machinery, and power tools (Myers and Fosbroke, 1995). Egan (1998) evaluated the success of the implementation of the new OSHA standard. He found that the standards were being enforced differently across the country, with some states having multiple inspections while others had none. His findings also suggest that loggers are reluctant to adopt the new regulations, even though most are not familiar with what the regulations actually entail.

In Alabama, efforts to encourage safety in logging operations include the creation of a cooperative group of logging contractors who manage the risk involved in this industry with the objective of lowering their workmen's compensation insurance premiums. This group, the Alabama Self-Insurers (ASI), is primarily composed of loggers who place a high priority on safety and typically have above-average safety records. ASI considers a crew to be mechanized if they use a mechanized feller to harvest trees. The number of claims received and the sources of injuries involved in those claims from logging contractors by the ASI for the year 1996 and 1997 show similar trends to the OSHA fatality data and are presented in table 1.

The ASI, BLS, and OSHA data suggest that, despite mechanization, the number of fatalities associated with logging operations in East Central Alabama, and probably the Southeastern region of the U.S., remains high. These trends pose the obvious question: Why hasn't the number of fatalities decreased at a similar rate as that of injuries? Could factors not related to mechanization account for the prevailing fatality rate? Thus, this study was designed to assess hazards that accompany prevailing logging practices in an attempt to identify likely explanations for the relatively high number of fatalities.

Objectives

This study was conducted to explore the following issues in relation to forest harvesting operations:

- Identify and document the hazards that are present in coastal plain logging operations in the Southeastern region of the U.S.
- Document perceptions of loggers regarding the hazards of their occupation, safety requirements, and the agencies that enforce those requirements.
- Develop suggestions that may serve to reduce the identified hazards.
- Generate ideas for future research that further investigate the identified hazards.

Methods and Procedures

General Method

Behavioral observations of the loggers at work were conducted to assess the hazards that exist in mechanized logging operations. Interviews, both formal and informal, were also used to gather data from crew owners and individual loggers. The crews in this study were chosen to represent different types of logging operations in the area (i.e., using various types of logging equipment), not to be representative of the crews in East Central Alabama as a whole in a statistical sense. An individual from each of the logging crews, the crew leader or owner, was interviewed at least once using a structured questionnaire.

Participants and Setting

Five independent logging crews working in East Central Alabama took part in this study during the summer of 1998. At least one person in each crew had participated in a professional logging management course. Participation in the study was voluntary, and no compensation was provided. All of the crews contracted for the same forest products company, which may have helped minimize differences in logging practices that were a result of company policies.

The size of the logging crews ranged from two to fifteen loggers, not including the truck drivers. Loggers had a mean experience level of 12.8 years with a standard deviation of 9.03 years, and there was great variability in terms of experience, both within and between crews. Some loggers had as little as one year of logging experience, and others had over thirty years.

All the operations observed were considered fully mechanized. There were no loggers on the ground in the landing areas unless something unusual occurred, such as the need to trim branches by hand. One crew consisted of a harvester–forwarder combination, while the others worked with feller–bunchers, skidders, and loaders. Four of the crews produced whole stem logs rather than cutting (bucking) the stems into the shorter (saw) logs. One crew used a log chipper and sent chips, instead of logs, to the mill. The average piece of equipment was a 1995 model (SD 2.58 yrs), with the oldest being 10 years old. Two bulldozers that were inspected were not included in the computation of equipment age since they were considerably older than the rest of the equipment, dating from 1976 and 1968, respectively. All field observations took place at various harvesting locations in East Central Alabama.

Additionally, officials from OSHA agreed to cooperate with this study. Several investigators, knowledgeable about logging, provided researchers with data and information concerning safety issues of the logging industry. The Alabama Self Insurers (ASI) furnished accident and cost data on logging claims for the years 1996 and 1997.

Procedures and Data Collection at Logging Sites

Crew behavior was observed during normal work operations with as little interruption as possible by the researchers. Continuous, on–site observations were carried out at different times throughout the workday in order to collect a diverse sample of working hours. Although most of the observations took place at busy times during the workday, the researchers visited sites early in the morning and late in the afternoon to observe startup and shutdown procedures. When on break, crew members were occasionally approached by the researchers and asked general questions about the company for which they contracted, the machines they operated or for which they were responsible, maintenance practices, training, and safety issues. The observations were meant to be as unobtrusive as possible to avoid interrupting the work of the loggers or influencing their behavior.

Researchers would usually contact crew owners and leaders the night prior to the intended visit to obtain the location of the current cutting site and provide notification of the expected visit. Each visit lasted 1.5 to 2 hours, for a total of over 60 hours of observations.

When arriving at the site, the observers would ensure that everyone was aware of their presence and then proceed to observe the operation. The landing was the most observed work area, although skidding, felling, and trimming were observed repeatedly. Most of the activity at the logging operation occurs at the landing (i.e., bucking, delimiting, maintenance, etc.). Thus, the landing was deemed the area that required closest inspection. In addition, crew leaders requested that observers stay as close to the landing as possible, for their own safety.

Daily observations were recorded on forms generated for the study. An exit interview questionnaire was also constructed and administered to all the crew owners, either in person or over the telephone. The exit interview afforded researchers an opportunity to ask remaining questions regarding the general safety of the operation, and the hazards of the profession, as well as to gather information regarding insurance costs and worker's compensation.

Results and Discussion

Behavioral Observations

Overall, loggers were observed to take many safety precautions and use safe work practices in carrying out their duties. For instance, all of the crew owners were interested to know about any hazards that were observed at their sites. None of the crews that participated had previous fatalities or recent accidents. However, several instances of unsafe behaviors were observed (see table 2), although those behaviors did not result in injuries. Nevertheless, any one instance of some of the unsafe behaviors observed could have led to serious or fatal injuries.

Table 2. List of observed hazards.

Equipment-related
Heavy machinery with inoperable backup alarm
Worn-out tires creating traction problems (possible turnover)
Behavior-related
Failing to wear seatbelts inside cab
Inappropriate use of personal protective equipment
Drop starting chainsaws
Using chainsaw above head level
Trimming load without eye protection
Passengers inside skidder cabs beyond seating capacity
Skidder operators driving too fast
Open cab operators driving through flying debris
Operator not looking while backing up machinery
Combination of not looking prior to backing up with an inoperable backup alarm
Machinery not turned off during fueling
Throwing fuel nozzle from one vehicle to another
Working inside running machinery to clear obstacles and obstructions
Workers standing under raised loader boom
Jumping/walking on log pile
Jumping from machinery vs. using 3-point contact method
Training-related
Attachments (booms, blades and grapples) not grounded (potential energy)
Saw heads and blades left exposed/uncovered overnight
Overlapping arcs of loader booms working in close proximity
Butt saw lowered by mistake repeatedly
Operator not aware of hydraulic fluid spraying from machinery
Servicing equipment without knowledge of proper procedures
Wheels not blocked while performing maintenance on a slope
Greasing equipment without turning off engine or lowering blade/grapple
Operating equipment booms near power lines
Using equipment beyond design purposes
Dragged trees snapped around tight turns
Cutting trees with observers within two tree lengths
Other
Unsafe logging roads (e.g., muddy, steep slopes, sharp curves)
Loader boom too close to moving skidders
Improper HAZMAT storage and labeling

Training Programs

Each of the logging contractors participating in the study reported that no formal training program was being used to train their crews. Most relied heavily on a combination of “on the job training” and experience gained in the logging or other similar industry while working for previous employers. This lack of training appears to be primarily due to the nature of the logging environment and the high daily production demands necessary to keep the operation profitable. Owners were unwilling to waste valuable production hours and resources on formal training programs. Rather, most crews would place new employees, usually unskilled, into greasing, fueling, and maintenance jobs for a trial period, until they were deemed productive and retainable. Eventually, these employees would receive informal training on skidding operations, followed by felling/bunching, and finally, on operating the loader. New employees with previous experience would be immediately assigned to the equipment they were capable of operating.

Training was also lacking in both the corrective and preventive maintenance areas. Each operator observed seemed to have a different method of performing the same or similar tasks, indicating a lack of standardization in following safety procedures and recommendations. When asked if they were doing a particular procedure in accordance with the operating/maintenance manual, most reported that they had never read the manual and were unsure if it was even at the job site.

Initial training and annual re-certification in first aid for all employees was reported for two of the five crews observed. All the logging crews interviewed included at least one graduate of the Professional Logging Managers Course taught at Auburn University, Alabama, typically the owner and/or the foreman.

A frequent complaint of logging crew managers was that the safety training they do receive is often not easy to communicate to their employees, is sometimes difficult to implement, and generally would have a detrimental impact on production.

Several managers commented that they would like to have had instruction in how to organize and deliver safety training. Further, they were not generally aware of the training resources commonly available to them from sources such as professional organizations, insurers, paper products companies, and the government.

Safety Meetings and Equipment Status

Compliance with the requirement to have regularly scheduled training meetings varied widely between crews. Some had discussions during their daily drive to and from work in the crew truck, and reported the use of American Pulpwood Association (APA) alerts and similar literature provided by their insurance carriers as a source of safety meeting topics. Other crews simply discussed mistakes they had observed when they occurred, or they corrected the deficiencies on the spot. One crew reported taking a few moments at the end of each day to discuss any mistakes that day and share lessons learned. Some stated they kept safety and training records only because it was required by the insurance carrier, but never actually conducted the training.

Most of the equipment observed in the study was in very good physical and operating condition, with the average model being three years old. Routine preventative maintenance was observed a number of times at various points during the workday, although most of the planned maintenance occurred prior to daily start up and operation. No guards appeared to be disabled or broken, and with few exceptions, the equipment was generally used for its designed purpose.

Perceived Hazards

Most loggers who participated in the study felt that the primary hazard they were exposed to was that of not being attentive while working with a chainsaw. Researchers found this surprising, since use of chainsaws was limited. The second prominent hazard was thought to be the general working conditions that exist in the vicinity of the landing where an employee, while working on the ground and (probably) operating a chainsaw, could come into contact with loaders, skidders, and logging trucks. A related concern was the possibility of ground-based workers being struck by moving logs.

Few of the loggers interviewed had personal experience with serious or life-threatening incidents. However, prior experience with major incidents did not appear to necessarily increase awareness of hazards. One logger had been involved in a life-threatening accident eight years earlier but did not appear to be personally motivated to follow safe work practices nor to encourage other crew members to do so.

Other reported hazard concerns included visitors to the site and hunters. Most of those surveyed felt that by using a "little common sense" and remaining inside the machine, they were generally safeguarded from serious injury. The safety records of the surveyed crews endorse this belief, with few, if any, minor injuries in the past 5 years. Loggers believe that the higher the level of mechanization (operators in cabs, not on the ground) the safer the operation, as long as they are aware of and can control the presence of visitors.

A concern noted by researchers was that the importance of reporting near-misses and learning from them was not generally evident in conversations with either logging crew managers or individual loggers. Interviewees were normally hesitant to discuss the details of those near-misses that they acknowledged, even when confidentiality of the information was assured.

Logging Standard 1910.266 Violations and OSHA

Observation of violations of Logging Standard 1910.266 was not an objective of this research, and formal efforts to gather and analyze data related to this issue were not undertaken. However, based on their knowledge of the standard, researchers observed and/or were informed of over 34 individual violations during their visits to the logging sites. When loggers were asked about their perceptions of OSHA, their responses included "Have never seen them. They only come if there is a death..." and "...prefer that they stay away...but they could possibly help us with safety." Most owners and individual loggers viewed the OSHA standards and inspections by OSHA compliance officers as "...yet another additional administrative requirement."

A review of OSHA inspection activity related to logging (SIC 2411) in Alabama for the past 25 years showed that a total of 398 inspections had been performed. If unplanned inspections (accident/fatality, complaint, referral, unprogrammed related, or follow-up) are disregarded, there were only 240 inspections over a 296-month period. This translates to an inspection rate of 0.81 planned inspections per month in the State of Alabama. The Alabama logging population in 1998 was approximately 6800 employees, and Greene et al (1998) indicate that the average crew size in the target area is 8 loggers. Assuming equal probability of inspection for each of the estimated 850 logging crews within the state, the frequency of inspection would be once each 85 years of work for any single crew. This appears to validate the loggers' responses regarding their perception of the lack of OSHA presence/oversight.

Recent attempts by OSHA to increase awareness of hazards and compliance with logging standards are evidenced by its new program "Logging Technical Advisor," which can be found at OSHA's website (www.osha.gov). The program provides information derived from numerous standards regarding establishing and maintaining a safety program. Dissemination of this information, however, appears to be a problem. None of the crews indicated that they used the Internet to acquire safety information or that they were aware of the OSHA website.

Officials at the Mobile, Alabama, OSHA area office indicated they were implementing a statewide initiative to increase surveillance of logging operations and had made contact with several logging activities in their area (generally the southern half of Alabama). They acknowledged, however, that they have a limited number of staff that is familiar with logging procedures to commit to oversight of compliance in the industry. They also felt that the current level of penalties they are able to exert provides little motivation for loggers to comply with existing OSHA standards. Data obtained from the OSHA website indicate that there were only three citations in the entire U.S. associated with the use of personal protective equipment during fiscal year 1999. In addition, the average fine for those citations was only \$125.00.

Conclusions and Recommendations

Although the results of this study are very valuable, they were not meant to be representative of the loggers across the country. They represent the typical composition of crews in the Southern region. We believe this study has some applicability beyond East Central Alabama because crews working in this type of terrain in the same region are comparable to the crews in our sample in terms of size, equipment, and type of logging operation. This notion is corroborated in the Greene et al. (1998) article on logger characteristics.

The sample in the Greene et al. (1998) article was limited to Georgia loggers, but for both geographical and cultural reasons, Alabama and Georgia loggers are comparable. Further, the type of logging that is done in Alabama, Georgia, Mississippi, and South Carolina involves similar terrain and trees, and this area is often referred to as the "Southern region" (Sygnatur, 1998). Approximately half of the employees interviewed by Greene et al. (1998) had experienced at least one accident, and 11% of these had been injured three times or more. Forty-six percent of the loggers who participated in the study had finished high school, while 6% had graduated from a technical school. Loggers' ages ranged between 16 and 60, with a median tenure of 15 years. The loggers expressed a preference for the profession for reasons that included monetary compensation, relationships, and work environment.

Our results indicate that hazards to forest workers engaging in logging operations in East Central Alabama follow national injury trends and are likely to be typical for the Southeastern region of the United States. Falling trees and limbs and being "hit by logs" are the type of incidents most likely to cause an injury or fatality.

Instances of unsafe behavior are common among logging crews, as are violations of federal logging standards. Most of the loggers interviewed have had little or no direct personal experience with life-threatening accidents or injuries at their logging sites, which may result in behavior that is not safety minded and in a decreased likelihood of recognizing existing hazards. However, prior direct experience with major accidents does not appear to necessarily increase a logger's awareness of hazards.

Another conclusion is that unsafe behaviors may be exacerbated by the low level of awareness of the existence of such hazards. A countermeasure to this situation is to disseminate relevant incident/injury information directly to logging crews with emphasis on the “lessons learned” aspects. Equally important, however, is the establishment of a non-punitive information collection system that would encourage timely and frank reporting of significant near-misses.

The presence and influence of OSHA at cutting sites is negligible. First, loggers’ distant relationship to OSHA makes them less aware of the safety regulations that exist and the purpose for which they are designed. Second, loggers feel it is highly unlikely that OSHA representatives will observe them working unsafely due to the low frequency of site visits. Third, OSHA does not have enough personnel who are experienced in forest harvesting operations. Finally, the relatively insignificant fine and penalty structure that OSHA is able to assess does not constitute an incentive to increase safety compliance.

Even though documenting compliance with OSHA standards was beyond the scope of this study, several measures that may increase OSHA’s visibility and influence in logging safety are:

- Increase the frequency of visits to logging sites.
- Distribute more information relative to the logging standard to individual loggers through all available means, including directly, as well as through forest product companies, insurers, and academic activities.
- Develop and use a fine/penalty structure that will generate compliance.
- Undertake efforts to promote a “user friendly” image, including participation in educational activities such as the Logging Managers Course and professional logging conferences and activities.

Loggers believe that much of the safety training they receive, including that presented in the Professional Logging Managers Course, is not easily implemented. Most of them agree that much of the safety training is useful but impractical, and would negatively impact productivity. A countermeasure may be to invite experienced loggers with good safety records to participate in developing more effective training programs. Further, those providing the training need to be more sensitive to the impact of their suggestions on productivity. If negative impacts are likely, they should clearly emphasize the positive tradeoffs involved, including financial benefits, if possible.

Finally, there appears to be an institutional problem at the logging crew manager level regarding knowledge of effective means and resources for delivery of safety training to loggers. Crew safety training is usually very informal but often has minimal content and breadth, and frequently is not conducted at all. This problem needs to be jointly addressed by all those with a direct interest in logging site safety.

Based on these findings, we would like to make some recommendations for future research. First, it would be useful to make a more detailed study, similar to this one, but with a larger sample and a count of observed hazards. This may help generalize to a larger population and give a better picture of which hazards are most prevalent in the Southeast. Further, we strongly believe that, based on studies like this one, a series of interventions aimed at decreasing unsafe behavior can be implemented. Areas such as logger training on proper safety procedures and creating a system that rewards loggers for safe behaviors have the potential for success in reducing the hazards of loggers in the area.

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