Analysis of Log Hauling Vehicle Accidents in the State of Georgia, USA, 1988–2004

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ABSTRACT

Mechanical failure rates associated with logging vehicle accidents in Georgia are dramatically lower today than they were in 1988–1991 before these trucks became subject to random roadside inspections. Mechanical failure dropped by half for logging tractor-trailers (from 10.9% to 4.8%) and by two-thirds for logging trucks (from 12.9% to 4.2%). Mechanical failure is now the seventh most cited contributing factor in logging tractor-trailer accidents instead of first as it was prior to 1991. Specific types of mechanical failures have also declined sharply. Three potential failure items that are visually checked during roadside inspections – brakes, slick tires, and lights – have seen the most dramatic declines. Brake failure has dropped by two-thirds and improper lights as a factor have almost disappeared. Driver impairment due to use of alcohol or drugs today occurs in less than 0.5 percent of accidents. Factors associated with logging vehicle accidents today in Georgia closely resemble those associated with all trucking accidents generally. Accidents per million tons of wood consumed, however, has increased steadily from 11 in 1991 to 19 per million tons in 2003.

Keywords: *logging trucks, accidents, transportation*

Introduction

The trucking industry is vital for the transportation of wood products for the forest industry throughout the United States. Transportation of logs via articulated 18-wheel tractor-trailers and smaller straight-frame logging trucks is a critical component of the wood supply system. Moreover, the trucking industry operates in an intrinsically dangerous environment. Roadway crashes are the leading cause of unintentional death in the United States as well as the leading cause of occupational fatalities. Tractor-trailer occupants accounted for 28 percent of all occupational fatalities from motor vehicle accidents between 1992 and 2000 (Pratt 2003). A wealth of research has attempted to isolate risk factors for large truck accidents (Jones and Stein 1989, Moses and Savage 1994, NTSB 1995, Braver et al. 1997, Lin and Cohen 1997), and the federal government performs separate analyses of accidents within this class of vehicle (Pratt 2003).

The movement of cut logs from the woods to processing facilities often requires traversing gravel roads, local and state paved roads, and possibly federal limited access highways. During the late 1980s, the safety of logging trucks was questioned in articles appearing in a number of Georgia newspapers (Earle 1987). These often quoted Georgia Department of Transportation (DOT) officials alleging that logging trucks were less safe than other trucks on Georgia highways. This created a public image issue that led to discussions within the forestry community. As a first step, the Georgia Forestry Association (GFA) and the University of Georgia (UGA) collaborated with forest industry to sponsor numerous Skilled Driver Workshops across the state that trained hundreds of logging truck drivers in how to operate their vehicles in a safe manner. In another effort, the UGA obtained funding from the Logging Safety Foundation (now Timber Harvesting and Transportation Safety Foundation) and used it to obtain motor vehicle accident data from the state for 1988–1991. These data verified many of the accusations of the DOT (Greene and Jackson 1992). Mechanical failure was involved in 10.9 percent of logging tractor-trailer accidents and 12.9 percent of logging truck accidents compared to just 3.8 percent of other heavy truck accidents during these 4 years. A logging "tractor-trailer" is an articulated vehicle consisting of a tractor with an attached trailer that most often hauls tree-length stems or two bunks of random-length wood parallel to the frame. A "logging truck" is a straight-frame (non-articulated) truck that is equipped to handle short pulpwood loaded across the frame or longer lengths loaded parallel to the frame. Over 90 percent of wood moved in Georgia is in tree-length form on tractor-trailers (Baker and Greene 2007).

Trucks and tractor-trailers hauling raw forest products in Georgia had been exempt from random roadside safety inspections by the Public Service Commission that were enacted in 1981. Forestry and agriculture were allowed exemptions when this truck inspection legislation was adopted due to their political power in the state legislature. Faced with these accident statistics and the resulting public image issue, the forestry community began to lobby to have the exemption for

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forest products trucks removed. On July 1, 1991, logging vehicles with a gross vehicle weight rating (GVWR) of 44,000 or more became subject to inspections under the Georgia Forest Products Trucking Act (Georgia 2006).

In an unrelated effort, the federal government also stiffened driver-training requirements with the adoption of the Federal Commercial Drivers License that took effect on April 1, 1992. Earlier that year, mandatory drug testing of all heavy truck drivers had taken effect. The forestry community was hopeful that the combined effect of these two efforts would result in a significant improvement of the logging truck accident record.

UGA continued to obtain these accident records with funding from GFA and annually updated this database through 1996. A comparison of accident factors during the pre-regulation period of 1988–1991 with a 3-year post-regulation period (1992–1994) found that mechanical failure as a contributing factor fell significantly (Greene et al. 1996, Greene 1996). This was attributed to both the stiffer regulatory requirements as well as the training effort undertaken to prepare for compliance with these new guidelines.

Motor vehicle accident data for the 10-year period 1995–2004 were obtained to see if the reduction in mechanical failures associated with log truck accidents immediately after the passage of this legislation persisted through today.

Methods

Law enforcement officers who investigate highway accidents record these data. Selecting from a list of 26 factors on the form, the officer can indicate which factors contributed to the accident. The officer's judgment is based upon their personal observations and eyewitness accounts. There is neither a minimum or mazimum number of factors that can nor must be selected. The Georgia Department of Motor Vehicle Safety maintains a computerized database of this information. This form (DPS-523) was changed in 1994, retaining the types of information recorded before 1994 and adding more detail in some areas. Prior to analysis for this study, the accident data since 1994 were obtained to update the existing accident record tables. This provided a complete record of truck accident statistics in Georgia for the time period of 1988–2004 that could be used to identify trends in accident factors and to compare factors associated with accidents before regulation (1988–1991) to those immediately following regulation implementation and ten years after the regulations were enacted.

The frequency of mechanical failure cited as a factor in truck accidents from 1991 to 2004 was analyzed using regression analysis. Data from 1988–1991 were reported in aggregate making it impossible to plot changes between individual years in that time period. The frequency of each individual mechanical failure type was compared for each truck type between three 4-year periods: 1988–1991 (pre-regulation), 1992–1996 (immediately post-regulation), and 2001–2004 10-yr. post regulation) using analysis of variance (ANOVA), with means comparison performed using Tukey's least significant difference.

Detailed information on vehicle miles traveled specifically for logging trucks is not available, making calculation of an accident rate per vehicle mile impossible. In its place, the accident rate per million tons of wood delivered in Georgia was evaluated. The U.S. Forest Service produces a biennial state-level report on roundwood products received at all mills across the southeastern United States (Johnson and Wells 2005). These data were available through 2003 and included roundwood imported into, exported out of, and retained in each state. Combining these three volumes, it was possible to track the volume of roundwood moved within Georgia each year and follow the trend of these data over time. This was used to provide insight into the changes in accident rates from 1988 through 2003.

Results and Discussion

Logging vehicles comprise a smaller share of the total accident pool today than 15 years ago. The percentage of truck accidents that involved logging vehicles has declined slightly since the late 1980s (**Table 1**). Logging tractor-trailers and logging trucks accounted for 3.7 percent and 1.8 percent of all truck accidents in the state during the years 1988–1991. For the most recent 4-year period, they accounted for 3.1 percent and 1.0 percent of truck accidents, respectively. The total number of accidents more than doubled between these two time periods for both logging tractor-trailers and other heavy trucks, but has not increased as substantially for logging trucks. The number of logging trucks dropped sharply with the decline of shortwood markets in the southern United States. For example, unpublished data from a 2007 survey of Georgia's logging population showed that 27 logging trucks were owned among the respondent logging firms compared to 560 logging tractor-trailers, or 1 for every 20.7 tractor-trailers (UGA 2007). Ten years earlier the same survey found 474 tractor-trailers and 85 logging trucks among the respondent logging firms, or 1 truck for every 5.6 tractor-trailers (UGA 1997). Increases in other heavy truck traffic at rates faster than logging vehicles would also serve to help lower these percentages.

The total volume of wood moved annually within the state of Georgia gives an indication of the number of trucks moving roundwood without giving an indication of hauling dis-

Table 1. ~ *Percentage of truck accidents in Georgia by truck type, 1988-1991 and 2001–2004.*

	1988–1991		2001–2004	
Type of truck	% of accidents	No. of accidents	% of accidents	No. of accidents
Logging tractor-trailer	3.7%	1,199	3.1%	2,629
Logging truck	1.8%	567	1.0%	863
Other heavy trucks	94.5%	30,550	95.9%	85,595

tance. All wood moves by truck for at least one part of the journey from stump to mill; however, changes in the wood supply system since 1981 have increased the percentage of the overall distance moved by truck. Hauling distance has probably increased in the last 20 years with the decline in wood shipments by rail and barge. As data on total miles hauled for logging vehicles in the state are not available, total volume hauled was used to develop an estimate of how the accident rate has likely changed during this period (**Fig. 1**). Total tons moved in Georgia peaked in 1995 and has been declining since. The number of logging vehicle accidents (logging tractor-trailers and logging trucks) per million tons hauled, however, has been slowly but steadily increasing, from roughly 10 accidents per million tons hauled in 1989 to almost 19 in 2004. Causes for this increase are not readily apparent.

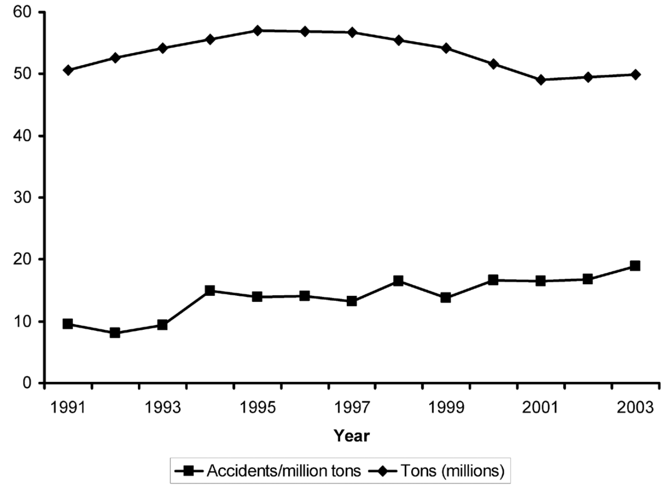

Figure 1. ~ *Total tons of roundwood and annual accidents per million tons of roundwood hauled within the state of Georgia, 1991–2003.*

During the years 1988–1991 before truck inspections, mechanical failure was cited in 10.9 percent of logging tractor-trailer accidents and 12.9 percent of logging truck accidents (**Table 2**). These rates have since fallen to 4.8 percent and 4.2 percent, respectively. The rate of decline in mechanical failures has not been uniform for logging tractor-trailers (**Fig. 2**). The first 3 years after the truck inspection law was changed showed a precipitous decline, but since 1994 there has been essentially no change. Logging trucks exhibited a slower initial decrease than logging tractor-trailers, as they were not subject to the regulations passed in 1992, but the mechanical failure rate has continued to decline slightly since 1994 and they are now similar. By comparison, the mechanical failure rates for other heavy trucks fell from 3.8 percent to 2.5 percent during this time period. Given the much harsher operating environment for logging vehicles, the difference between these classes of vehicles are relatively small and somewhat expected. The industry should be encouraged by the significant improvements already obtained while continuing to focus on obtaining further improvements in this record.

Accidents that involved logging tractor-trailers were of greatest interest since they haul the majority of wood in Georgia. Not only did the mechanical failure rate for these trucks fall by more than half (**Table 2**), it also dropped from being the most cited contributing factor to the seventh most cited factor since 1991 (**Table 3**). Now the factors associated with logging tractor-trailer accidents closely mirror those involved with other heavy truck accidents (**Table 3**). Three of the four most-cited contributing factors ("following too close", "misjudged clearance", "failed to yield") have similar rankings between these two types of trucks. The differences in the ranking of contributing factors between truck types tended to illustrate differences in the types of roads they travel and their different delivery methods. Other heavy truck traffic tends to be concentrated on federal highways and interstates. Logging vehicles spend a much larger share of their time on county and state highways where misjudging clearance and control accidents are more likely to occur. For example, improper lane change was the second most cited factor with other heavy trucks (suggesting more interstate or urban driving where multi-lane highways are more common) while it was only the fifth most cited factor for logging tractor-trailers. Likewise, improper backing was the fifth most cited factor for other heavy trucks (these often back up to make deliveries) while it was not found among the top

Table 2. ~ *Frequency of mechanical failure cited as a contributing factor in truck accidents in Georgia by truck type during 1988–1991 compared to 2001–2004.*[a]

Type of truck	1988–1991	1992–1995	2001–2004
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Logging tractor-trailer	10.9 a	5.1 b	4.8 b
Logging truck	12.9 a	9.3 a	4.2 b
Other heavy trucks	3.8 a	2.7 a	2.5 a

[a] Means with different letters within each row are significantly different $p < 0.05$.

Table 3. ~ *Most cited contributing factors in accidents involving logging tractor-trailers and other heavy trucks in Georgia during 1988–1991 compared to 2001–2004 (# = rank, 1 = most cited).*

	1988–1991		2001–2004	
Contributing factor	Logging tractor-trailers	Other heavy trucks	Logging tractor-trailers	Other heavy trucks
Mechanical failure	1		7	
Misjudged clearance	2	2	3	3
Too fast for conditions	3		6	
Failed to yield	4	4	5	4
Following too close	5	3	1	1
Driver lost control	6	7	2	7
Improper turn	7	6		6
Improper lane change		1	4	2
Improper backing		5		5

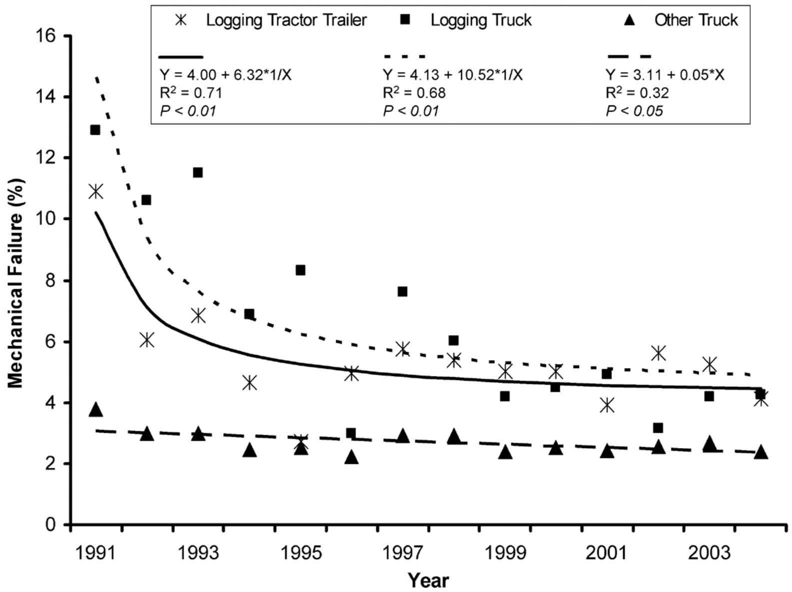

Figure 2. ~ *Decline in frequency of mechanical failure as a factor in truck accidents for three classes of trucks, 1991–2004.*

seven factors for logging tractor-trailers. The similarity in accident factors suggests that training materials for general trucking may now be even better suited than in the past for training drivers of logging vehicles.

Mechanical failure is not only listed in the list of contributing factors on the accident form, but specific mechanical failures may be indicated by the officer working the accident to help pinpoint the type of failure. Five failures are listed: tire failure, slick tires, brake failure, improper lights, and steering failure. The observed frequency of each of these factors associated with logging vehicle accidents dropped, in many cases dramatically, between 1988–1991 and 2001–2004 (**Table 4**).

Tire failure dropped slightly for logging tractor-trailers and by two-thirds for logging trucks since 1991 (**Table 4**). The rate of tire failure increased slightly for other heavy trucks. The most dramatic improvement for logging vehicles was the reduction in slick tires as a causal agent. For both logging tractor-trailers and logging trucks, slick tires as a factor in accidents dropped by two-thirds from approximately 3.5 percent of accidents to 1.3 percent over the 17-year period. Visual inspection of tire tread is a key component of the random safety inspections that started in 1991. Little change in the frequency of slick tires associated with accidents of other heavy trucks was observed between the three time periods in question, and the failure rates for slick tires in other heavy trucks are still lower than for all classes of logging vehicles.

Brake failure as a contributing factor in accidents also declined dramatically across the three time periods (**Table 4**). Before 1991, brake failure was a factor in 6.51 percent and 7.50 percent of accidents involving logging tractor-trailers and logging trucks, respectively, compared to a brake failure rate of just 1.69 percent for other heavy trucks. Logging vehicles travel far shorter routes and spent more time on single-lane and two-lane roads than many of the trucks found in the "other heavy truck" category that are long-haul trucks spending long hours on multi-lane roads with much less frequent braking. Braking is more frequent and likely necessary with less warning

Table 4. ~ *Mechanical failure rates as a percent of all accidents by type of truck and failure type for three periods.*[a]

Variable	Truck type	1988–1991	1992–1995	2001–2004
Tire failure (%)	Logging tractor-trailer	1.18 a	1.11 a	0.81 a
	Logging truck	1.47 a	1.72 a	0.73 a
	Other heavy truck	0.62 a	0.76 a	0.75 a
Slick tires (%)	Logging tractor-trailer	3.46 a	1.93 b	1.28 b
	Logging truck	3.50 a	2.45 ab	1.36 b
	Other heavy truck	0.27 a	0.20 a	0.25 a
Brake failure (%)	Logging tractor-trailer	6.51 a	3.25 b	1.62 b
	Logging truck	7.50 a	6.10 a	2.32 b
	Other heavy truck	1.69 a	1.50 a	0.91 b
Improper lights (%)	Logging tractor-trailer	2.05 a	1.08 b	0.41 c
	Logging truck	3.10 a	1.48 a	0.0 b
	Other heavy truck	0.23 a	0.25 a	0.10 a
Steering failure (%)	Logging tractor-trailer	0.59 a	0.30 a	0.17 a
	Logging truck	0.42 a	0.21 a	0.37 a
	Other heavy truck	0.12 a	0.08 a	0.10 a
Other failure (%)	Logging tractor-trailer	4.74 a	2.70 b	3.19 ab
	Logging truck	3.50 a	4.75 a	2.33 b
	Other heavy truck	1.39 a	1.08 a	1.55 a

[a] Means for a variable within a row with different letters are significantly different ($p < 0.05$)

for logging vehicles. Brake condition is also a key visual inspection point in the roadside safety inspections performed on Georgia logging vehicles. Today, brake failure is a factor in just 1.62 percent of logging tractor-trailer accidents compared to about 0.91 percent of other heavy truck accidents. Given the differences in the working environments of these categories of vehicles, this seems to be a reasonable difference. The greatest improvement for logging trucks has been since 1995, a period during which brake failures for other heavy trucks also saw a significant decline, the only significant change in any mechanical failure class for other heavy trucks. This indicates that there has likely been some improvement in brake technology that has also helped reduce the frequency of brake failures marginally.

Another visual inspection point involves proper working lights on vehicles (**Table 4**). Prior to 1991, improper lights were cited in 2.05 percent of logging tractor-trailer accidents and in 3.10 percent of logging truck accidents. During this same time period, improper lights were cited in only 0.23 percent of other heavy truck accidents. Today, improper lights are cited in just 0.42 percent of logging tractor-trailer accidents, have not been cited in a logging truck accident in 4 years, and are involved in just 0.10 percent of heavy truck accidents. Additionally, these improvements have been continuous with significant improvement for logging tractor-trailers occurring in both the 1992–1995 and the 2001–2004 periods. These improvements are undoubtedly due to greater inspection with logging vehicles, but more reliable lighting systems may also help account for this record. Steering failure, accounting for fewer than five accidents per year, has never been a significant factor in truck accidents, of any type, in Georgia (**Table 4**).

As with the overall mechanical failure rate, the rate of individual mechanical failures for logging trucks has improved since 1995. Slick tires, brake failures, improper lights, and other failures all showed significant drops ($p < 0.05$). Between 1992–1995 and 2001–2004, only improper lights showed a significant drop for logging tractor-trailers, and brake failures declined for other heavy trucks. Despite not falling under the jurisdiction of the new regulations, improvements in logging trucks have followed the trend of logging tractor-trailers.

The Federal Commercial Drivers License regulations enacted in the late 1980s significantly strengthened the testing of drivers to detect the presence of alcohol or drugs. Commercial drivers are now required to have blood or urine tests after each motor vehicle accident. During 1988–1991, driving under the influence (DUI) of alcohol was a factor in 0.9 percent of logging tractor-trailer accidents and 2.3 percent of logging truck accidents (**Table 5**). These rates have fallen significantly ($p < 0.05$) to just 0.3 percent and 0.7 percent, respectively, compared with just 0.2 percent of other heavy truck accidents. Interestingly, the DUI alcohol rate is higher for logging trucks, compared with other truck types, and the DUI drugs rate is lower. Putting these rates in perspective, 1 percent of logging tractor-trailer accidents during 2001–2004 represents just 6 to 7 accidents per year, thus a 0.4 percent frequency would represent 2 to 3 accidents. Comparisons between truck types should be made while recognizing the very different sample sizes.

Table 5. ~ *Driver impairment statistics associated with truck accidents in Georgia by truck type during 1988–1991 compared to 2000–2003.*

Driver condition	Truck type	1988–1991	2000–2003
DUI alcohol	Logging tractor-trailers	0.9	0.3[a]
	Logging trucks	2.3	0.7[a]
	Other heavy trucks	0.5	0.2[a]
DUI drugs	Logging tractor-trailers	0.2	0.2
	Logging trucks	0.0	0.1
	Other heavy trucks	0.1	0.1
DUI, alcohol and drugs	Logging tractor-trailers	na	0.2
	Logging trucks	na	0.0
	Other heavy trucks	na	0.0

[a] Indicates significant difference ($p < 0.05$) between means within a row.

Conclusion

Trucks that haul forest products in Georgia today have accident statistics that in most cases resemble very closely those of other heavy trucks. This is due to regulatory changes and driver education programs implemented in the early 1990s. Factors associated with logging truck accidents so closely mirror those of heavy trucks generally that future education efforts should focus primarily on general, rather than industry-specific, trucking issues.

While there is not a direct measure of the miles traveled by logging vehicles, the accident rate per million tons of wood delivered in Georgia was evaluated. Using this metric, the accident rate has climbed steadily from around 11 accidents per million tons to about 19 today. Without further research into this issue, we can only speculate that increased use of trucking by the forest industry and continued increases in population and traffic generally help explain this trend. This is an area that should receive attention by future research projects.

While accident statistics for logging vehicles have improved significantly, they are still higher than for the heavy truck population generally – perhaps due to the operating environment – therefore ongoing vigilance and education are required to maintain and further improve the safety record of the log trucking community.

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