

LOGGING SAFETY IN FOREST MANAGEMENT EDUCATION

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Abstract: Forest management degree programs prepare students for careers in forestry by teaching a combination of biological sciences (e.g., silvics and genetics) and business management (e.g., forest policy and timber valuation). During a 4-year degree program, students learn the impact of interest rates, equipment costs, and environmental policies on forest management and silvicultural decisions. However, little consideration is given to worker safety and health and its impact on forest management. This paper illustrates the ethical and economic importance of logging safety to forest managers and advocates incorporating safety issues into existing forestry courses. An appendix provides examples of safety and health information that can be integrated into forest policy and forest economics courses.

INTRODUCTION

Four-year forest management programs are designed to prepare students for professional careers in management of natural resources, including the business aspects of finance and personnel management. Students are exposed to a diverse curricula, ranging from the biological sciences to accounting principles. This broad program emphasis is encouraged through the *Society of American Foresters (SAF) Accreditation Standard for Forestry Program Mission, Goals and Objectives* (Society of American Foresters 1994a), in which the interdisciplinary nature and service orientation of the forestry profession are emphasized. The SAF places importance on management training -- two of the four areas of study that must be adequately represented in the forestry curriculum are Management of Forest Resources (including forest engineering, harvesting and utilization) and Forest Resource Policy and Administration (including policy development, administration, and personnel management). Forestry curricula must "provide students with an understanding of the social, cultural, political, legal, economic, institutional, and historical influences on forestry" (Society of American Foresters 1994a).

Forestry programs traditionally meet this goal of providing students with an understanding of socioeconomic influences on forestry through policy and management courses. External influences on forestry typically addressed in these courses include organizations, cultural resources, environmental concerns, pollution control, military policy, taxation, and international trade policy (see tables 1 and 2). One important topic, occupational safety and health, is not typically addressed in these courses.

WHY TEACH SAFETY AND HEALTH IN FORESTRY PROGRAMS?

Worker safety concepts should be integrated into forestry education for several reasons. First, logging is the primary tool for accomplishing forest management objectives on the ground. Logging has long been considered a dangerous industry, and death certificate data indicate that the rate of work-related fatalities in the logging industry is extremely high (Myers and Fosbroke 1994), with regional rates ranging from a low of 87.0 deaths per 100,000 workers in the southeast to 394.3 deaths per 100,000 in the central hardwood region. For comparison, the fatality rate across all industries is 7.0 per 100,000 workers, and the rate in the manufacturing sector (of which logging is a part) is 4.4 per 100,000 (Jenkins et al. 1993). The logging industry has also been identified as having a high rate of nonfatal injuries with a lost workday case rate of 10.7 per 100 full-time workers in 1990 compared to a private industry average of

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Table 1. Examples of Forest Management Influencing Legislation Taught in Forest Policy Courses¹.

<u>Legislation</u>	<u>Date</u>	<u>Notes</u>
Magna Carta	1215	King's ownership of wildlife in trust for all people
King's Broad Arrow	1691	Reserved mast trees for the British navy
Lacey Act	1900	Prohibited interstate trade of wildlife illegally taken
Antiquities Act	1906	Preservation of cultural artifacts
Week's Law	1911	Watershed protection; Fire protection
Forest Cons. and Taxation 1949		Tax incentives for certain forest management practices
Land and Water Cons. Fund	1964	Public purchase of private land for recreational use
Wilderness Act	1964	Established the Wilderness Area system
Nat'l Historic Preservation Act	1966	Assessment of activity impact on historic sites
Clean Air Act and Amendment	1970, 1973	Designation of air quality classes, scenic visibility
Fed. Water Pollution Control Act	1972	Stop discharges, attain fishable/swimmable waters
Endangered Species Act	1973	Protection of endangered plants/animals, critical habitat
Eastern Wilderness Act	1974	Extended 1964 act to eastern U.S.; added 16 new areas

¹ Sources: Cubbage, O'Laughlin, and Bullock (1993); Dana and Fairfax (1980)

Table 2. Examples of Organizations and Events that Have Influenced Forest Policy¹.

American Assoc. for the Advancement of Science	Monongahela National Forest Controversy
American Forestry Association	National Academy of Sciences
Bitterroot National Forest Controversy	National Trail System
Civilian Conservation Corps	Native Alaskan Lands Settlement
Council on Environmental Quality	Office of Management and Budget
Environmental Protection Agency	Sand County Almanac publication
Farm Abandonment & Westward Expansion	Sierra Club
Hetch Hetchy	Soil Conservation Service
Friends of the Earth	Society to Protect New Hampshire Forests
Izzak Walton League	Tellico Dam

¹ Sources: Cubbage, O'Laughlin, and Bullock (1993); Dana and Fairfax (1980)

3.9 and a manufacturing industry rate of 5.3 per 100 full-time workers (U.S. Department of Labor 1992). Though there have been tremendous advances in harvesting technology over the past 30 years, the logging industry has seen little improvement in injury statistics (McCormack 1963, Myers and Fosbroke 1994).

The second reason for teaching forestry students about worker safety is that forest management decisions directly affect logging safety. There are many examples. The decision to leave den trees may raise logger's risk of being hit by a falling snag. The selection of a residual stand density influences the probability of a logger being injured in the hit-tree reaction type of incident described by Peters (1991). Decisions about the length of a cutting contract may influence the amount of time loggers have to complete the job safely. Even forestry graduates that do not make harvesting decisions may be employed by industry in supervisory positions where they are responsible for other employees. Under the provisions of the 1970 Occupational Safety and Health (OSH) Act (Public Law 91-596), employers are responsible for assuring safe and healthful working conditions for all employees (see Appendix).

Graduating forestry students need to be aware of their responsibility for understanding and following regulations that apply to their jobs.

Finally, teaching safety to forestry students is an ethical obligation of any forestry program. The "Code of Ethics" set forth by the Society of American Foresters (Society of American Foresters 1992), states in its preamble that compliance with the SAF canons "ensures just and honorable professional and human relationships, mutual confidence and respect, and competent service to society." Professional foresters are morally and ethically bound to ensure that their decisions and actions do not jeopardize the safety of others. Graduating forestry students need to be aware of how their future management decisions can affect the safety and health of other workers.

CURRENT STATUS OF SAFETY IN FORESTRY PROGRAMS

Programs that train students to become professional foresters often devote less program time to safety than do programs that train forestry technicians. This is partially exhibited by differences in SAF requirements for accreditation of professional programs and recognition of technical programs. Though current *Guidelines for Accreditation of Educational Programs in Professional Forestry* (Society of American Foresters 1994a) do require coverage of personnel management and do require that facilities provide an environment that is safe, healthful, and conducive to learning, the guidelines make no other mention of safety. In contrast, the *Standards and Procedures for Recognizing Educational Programs in Forest Technology* (Society of American Foresters 1994b) have a specific curriculum requirement for "Woods Safety," which is to include basic first aid, identification of hazards, hand and power tool safety, and pesticide safety.

In May of 1993, the authors sent a request to the 45 professional degree programs accredited by the Society of American Foresters. Each program was asked to provide a college catalog describing their program, course syllabi of management and policy related courses, and a copy of the most recent self-evaluation report. These materials were reviewed to determine how prominent a role safety topics played in the way courses and programs are described to prospective students. Thirty-one forestry programs provided materials (26 schools sent catalogs, 22 sent course syllabi, and 18 sent self-evaluation reports). Only seventeen programs referenced any safety concept within the reviewed material and these references were generally limited to the harvesting course. Based on this review, most professional forestry degree programs do not currently emphasize safety issues in their descriptions of course content.

Though the numbers above suggest that safety is not an emphasis area in forest management programs, most programs do have some safety components. Frequently, the strongest safety component of 4-year programs is in the summer forestry camps. Here, a few days are spent teaching the technical aspects of harvesting, road construction and chain saw use. Most 4-year programs also touch briefly on safety issues in a variety of courses. For example, logging hazards are discussed in harvesting classes, though the impact of these hazards in terms of lives lost and lost work time injuries is typically not. Pesticide labelling is covered in planting, silviculture, and entomology courses. Ecology and wildlife management courses also discuss pesticide safety, though usually from the environmental contamination standpoint. Each year, a few students gain practical experience in safe woods operations from forest managers while working for the school at the university woodlot or forest. Other attempts are made to instill a consciousness of safety among forestry students, including the requirement that all students wear hard hats and sturdy boots during field labs and industry tours.

What is Missing?

Professional foresters need to make rational decisions based on an understanding of safety principles and an awareness of safety issues that affect forest (and any other management) operations. Forestry programs should prepare students for challenges they will face by at least making them aware of: the safety record of the logging, sawmilling, and paper manufacturing industries; the existence of safety regulations, standards, and policies; the identification and control of hazards; the management of safety; the methods of preventing injuries; the impact of safety programs on insurance premiums; the concepts of insurance and shared risk; the impact of injuries on operating

costs and employee morale; the responsibility and liability of decision makers and managers; and the influence of management decisions on worker safety.

When the National Research Council (NRC) surveyed academic and nonacademic forestry groups to identify needs in forestry education (National Research Council 1990), respondents suggested a need to "move from technician-type courses to more analytical, decision-making, conflict resolution types of courses." Expansion beyond technical safety topics (e.g., first aid and tool safety) toward the legal, economic, and moral aspects of safety and health fits well with this NRC recommendation. This expanded coverage of safety and health issues will provide future foresters with the analytical tools they will need to evaluate management decisions.

INTEGRATING SAFETY CONCEPTS INTO EXISTING COURSES

Integration of safety and health concepts into forestry education **will not** require a new course, "Safety in Forest Operations." Forestry curricula already contain a full complement of course requirements; any new course would require elimination of an existing course. The ultimate goal should be to teach future foresters to consider the safety implication of all decisions. To do this, safety thinking needs to be incorporated into many courses, wherever a safety issue is relevant. This need not be difficult because most safety issues relate in some way to concepts that are taught in existing courses.

For example, forest policy courses traditionally include tax laws, environmental regulations, recreational development programs, and resource funding programs because of the influence of these regulations and programs on forest management decisions. The inclusion of safety and health regulations, the regulatory process, and safety research organizations fits into the concept of teaching policies and programs which influence forestry (see tables 3 and 4 for selected examples). Additional topics that could be incorporated into forest policy courses include the regulatory process (including the OSH Act's provision for public comment during standards development), owner liability, third party tort, and specific Occupational Safety and Health Administration (OSHA) and national consensus standards related to forestry operations.

In addition to the above forest policy examples, other topics can be integrated into the existing curricula. Introductory forestry courses should cover sources of injury and illness information, injury statistics specific to forest industries and occupations, and the importance of safety. Timber harvesting courses should describe specific hazards associated with logging and recommended ways of minimizing hazards, especially machine guarding, rollover protection, and the identification and safe felling of hazardous trees. Forest Management courses should emphasize the role of managers in ensuring safe and healthful working conditions. Other safety topics for forest management include safety language in logging contracts, hazard communication, recordkeeping, accident investigation, and safety management programs. Silviculture courses should explain the effect of cutting method, leave tree selection, and cutting cycle on logging safety.

Specific information on the Occupational Safety and Health Act, the history of workers' compensation, and the incorporation of workers' compensation costs in machine cost calculations are provided in the appendix. This material provides details of the type of information that could be integrated into forest policy and forest economics courses. Other examples of incorporating safety issues into an existing curriculum are described by Taylor et al. (1994).

Table 3. Examples of Safety Legislation, Standards, and Policy Impacting Forest Management¹.

Legislation	Date	Notes
Federal Workers' Compensation	1908	Federal law providing compensation for federal workers injured on the job
State Workers' Compensation	1911	Wisconsin and Maryland pass laws similar to federal workers' compensation law
Walsh-Healy Act	1938	Specified working conditions for employees working for private companies under contract to the U.S. government
Fair Labor Standards Act	1938	Prohibited children under 18 years old from working in hazardous occupations (including logging)
Occupational Safety and Health Act	1970	Created regulatory and research agencies and a process for development and enforcement of OSH standards
Safety Requirements for Pulpwood Log.	1971	ANSI national consensus standard
OSHA Pulpwood Log. Standard 1910.266	1971	OSHA adopted ANSI consensus standard
NIOSH criteria document on logging	1976	Recommendation for an occupational standard on logging from felling to first haul
Safety Requirements in Logging	1978	ANSI consensus standard extending prior pulpwood requirements to all logging
ANSI withdraws Safety Req. in Logging	1984	ANSI committee fails to renew standard
OSHA Logging Standard	1994	Proposed in 1989, OSHA promulgated a single standard for the logging industry on October 12, 1994.

¹Sources: DeReamer 1980; Hammer 1989; Kavarianian and Wentz (1990); Public Law 91-596 (1970); Readers' Digest (1975); U.S. Department of Labor (1989, 1994)

Table 4. Organizations Influential in the Establishment of Safety Policy Affecting Forest Management¹.

Organization	Notes
American National Standards Institute	Develops national consensus standards
American Pulpwood Association	Produces logging safety materials; facilitates safety
American Society of Agricultural Engineers	Forest Operations Safety Committee provides a forum for harvesting safety research
American Society of Safety Engineers	Established an independent board to certify safety professionals
International Labor Organization	Established as part of League of Nations to improve working conditions around the world; major contributor to woods worker training and international recommendations
National Fire Protection Association	Develops national consensus fire protection standards
Nat'l Institute for Occupational Safety and Health	Conducts occupational safety and health research, trains safety and health professionals
National Safety Council	Private, non-profit organization working in traffic, home, recreational, and occupational safety
Occupational Safety and Health Administration	Administers the OSH Act, promulgates regulations, and provides state training grants

¹Sources: DeReamer 1980; Hammer 1989; Kavarianian and Wentz (1990); Readers' Digest (1975)

SUMMARY

Logging is well known as a hazardous industry, both in terms of fatal and nonfatal outcomes. Recent statistics, when compared to statistics from 30 years ago, indicate that the industry's injury record is not improving (Myers and Fosbroke 1994). These facts led OSHA to promulgate a new standard for logging operations (U.S. Department of Labor 1994). The new mandatory standard has direct implications on the way logging is conducted. Since logging is the primary tool for accomplishing natural resource management objectives, this standard also impacts forest management decisions. Therefore, graduate foresters increasingly will need to be aware of occupational safety and health concepts. Professional forestry degree programs have traditionally provided students with a wide range of background; however, worker safety and health typically is not a major focus of class instruction. Integrating important occupational safety and health issues into existing curricula can be done, but will take a concerted effort on the part of faculty to expand existing courses into new subject areas. This paper demonstrates a few examples of how safety topics can be covered in forestry courses. The appendix contains additional examples. It is hoped that faculty will consider these examples, look at their existing courses, and ask, "Are there important safety issues that I should incorporate into my courses?"

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APPENDIX

SELECTED SAFETY TOPICS FOR FOREST POLICY AND FOREST ECONOMICS COURSES

The Occupational Safety and Health Act

The most sweeping U.S. law regarding worker safety and health was passed by Congress on December 17, 1970. The preamble to the Occupational Safety and Health (OSH) Act (Public Law 91-596) includes a promise to "assure safe and healthful working conditions for working men and women." Section 5 of the Act defines (in broad terms) the duties of employers and employees with respect to occupational safety and health. An employer has the duty under Section 5(a)(1) "to furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing, or are likely to cause death or serious physical harm to his employees." An employer also has the duty to "comply with occupational safety and health standards promulgated under this Act." This section of the OSH Act **clearly** places on forest managers the responsibility of knowing what standards are applicable to forestry operations. An employee also has a duty under Section 5(b) to "comply with occupational and safety and health standards and all rules, regulations, and orders pursuant to this Act which are applicable to his own actions and conduct."

Within 2 years of the effective date of the Act, the Secretary of Labor was to "promulgate as an occupational safety and health standard any national consensus standard, and any Federal standard, unless he felt that the promulgation of such a standard would not result in improved safety and health for specifically designated employees." Several existing Occupational Safety and Health Administration (OSHA) standards resulted from adoption of national consensus standards developed by organizations such as the National Fire Protection Association and the American National Standards Institute (ANSI) (Kavianian and Wentz 1990). The original pulpwood standard (U.S. Department of Labor 1993a) is an example of a national consensus standard that was developed by ANSI and promulgated by OSHA into the new OSHA standards in 1971 (U.S. Department of Labor 1989). OSHA continues to review consensus standards during regulatory review and development.

OSHA has promulgated general industry standards and industry-specific standards. General industry standards apply to all industries. Examples include electrical, machinery and machine guarding, hazardous materials communication, fire protection (Kavianian and Wentz 1990), and lockout/tagout standards (U.S. Department of Labor 1993b), and recordkeeping regulations (U.S. Department of Labor 1986). Other standards apply to a specific industry. The logging standard that OSHA recently promulgated² (U.S. Department of Labor 1994a) is an example of an industry-specific standard.

Several aspects of the Occupational Safety and Health Act and the standards and regulations promulgated under the Act influence forestry operations³. The new logging standard, and the pulpwood standard that it replaced, obviously apply to the harvesting of trees. However, these are not the only factors of which forest managers need to be aware. The Act clearly was intended to hold employers responsible for the safety of their employees. OSHA has used the

2 For a discussion of the new OSHA logging standard and what it means for forest management, see Myers and Fosbroke (1995). For a copy of the text of the new standard, contact: U.S. Department of Labor, Occupational Safety and Health Administration, Office of Publications, Room N-3101, 200 Constitution Avenue, NW., Washington, D.C. 20210.

3 Examples of OSHA requirements are included to apprise the reader of the range of regulatory issues affecting forestry and logging employers. This is not a complete list, and a full description of the specifics of these requirements is beyond the scope of this paper. The reader should also be aware that OSHA is continually revising its standards and regulations; therefore, affected readers should remain cognizant of the status of applicable OSHA regulations by contacting their Regional OSHA Area Office.

provisions of the General Duty Clause [Section 5(a)(1)] to cite employers that allowed a recognized hazard to persist at a site of employment, even when no specific OSHA standard or regulation had been violated. Additionally, there are many general industry standards that forestry employers are also responsible for meeting, even though logging and forestry are not specifically mentioned in these standards. For example, a sawmill owner may be held responsible for failing to maintain protective guarding on machinery.

Any company employing 11 or more employees is required to maintain an annual log of employees' occupational injuries and illnesses. These logs must be posted annually for public disclosure and provided to OSHA upon request (U.S. Department of Labor 1986). OSHA must also be notified of any fatality or incident resulting in the hospitalization of 3 or more employees within 8 hours of the incident, or when the employer became aware of the incident (U.S. Department of Labor 1994b).

Workers' Compensation

The development of the Workers' Compensation System in the United States is another topic relevant to courses in forest policy. Workers' compensation costs are a significant portion of overall labor costs (DeReamer 1980). Additionally, discussion of workers' compensation provides the opportunity to introduce students to the concepts of shared risk, of occupational injury and illness costs, and of risk management.

Workers' compensation is a system of insurance, initiated in the early 1900's, that is funded by employers to compensate workers who receive an injury or illness while working. Employer premiums are based on an experience-rating mechanism, such that employers with fewer occupational injuries and illnesses pay lower rates than employers with poor safety records (U.S. Chamber of Commerce 1984). Currently, all 50 states and the District of Columbia have workers' compensation laws. Each state administers its own law and these laws vary in terms of the employers covered, the definition of a compensable injury or illness, and the type of system (U.S. Chamber of Commerce 1984).

Several premises underlie the workers' compensation system (U.S. Chamber of Commerce 1984). First, industrial employers should assume costs of occupational disabilities without regard to any fault involved. Second, economic losses resulting from occupational disability are considered costs of production. Third, employers are relieved from lawsuits under common law involving negligence. The goal is that adherence to these principles promotes honest study of injury and illness causes rather than concealment of fault. As a result, future incidents and human suffering can be prevented. The experience-rating mechanism is intended to encourage employers' interest in safety and rehabilitation as a means of reducing costs.

Adding Workers' Compensation Cost to Machine Cost Calculation. Calculating the hourly machine cost of harvesting equipment entails a combination of time study and financial analysis, accounting for a projected production rate (e.g., cords/day), fixed costs (e.g., investment and tax costs), and variable costs (e.g., fuel and maintenance costs). Inclusion of workers' compensation premiums as a cost factor in machine cost calculations provides an appreciation for the effect of workers' compensation insurance on total operating expense. Because workers' compensation insurance in the logging industry is expensive and increasing rapidly (Lansky 1990, Longwell and Lynch 1990, Williams 1991, and Stevens and Giannetti 1992), premium costs should be considered in the financial analysis methods taught in forest economics classes.

An example of how to calculate the impact of workers' compensation on operating costs is provided on the next page. In this example, the hourly machine cost for a medium-sized cable-skidder is determined using a workers' compensation rate of \$35.62 per \$100.00 of payroll. Most of the calculations are based on the methodology laid out in a U.S. Department of Agriculture Forest Service pamphlet entitled, "How to Calculate Costs of Operating Logging Equipment" (Miyata date unk.). The exception is that a workers' compensation premium was added to the labor costs. All cost items have been updated to approximate realistic costs in 1994.

Example of Machine-cost Calculation for a Cable Skidder Using the Methodology of Miyata

BASIC ASSUMPTIONS

Purchase Cost	\$90,000
Less: Tire	<u>-9,500</u>
Initial Investment (P):	\$80,500
Salvage Value (S): 20% of P	\$16,100
Economic Life (N):	3yrs
Schedule operating hours (SH):	2,000 hrs/yr
Utilization	65 percent
Productive Hours (PH):	1,340 hrs/yr

FIXED COSTS

Depreciation (D): $(P-S)/N$	\$21,466/hr
Interest, Insurance Taxes (ITT):	<u>9,445/yr</u>
ITT = $16\%((P - S) (3+1)/(2)(3)) = 9445.33$	
Yearly Fixed Cost (YFC): $D+ITT$	\$30,911/yr
Hourly Fixed Cost (HFC): YFC/PH	\$23.07/hr

OPERATING COSTS

Maintenance and Repair (MR): $0.5(D)/PH$	\$8.01/hr
Fuel (F): 4 gal./hr at \$1.00/gal.	\$4.00/hr
Lubricants (L):	\$1.90/hr
$L = (((12 \text{ gal.})(\$4/\text{hgal.}) + 138)/100 \text{ hrs}) + ((50\#)(\$1.03/\#)/1340 \text{ hrs}) = 1.86 + .04 = \$1.90/\text{hr}$	

Tire (T): $T = (1+0.15)(\$9,500)/3,000 \text{ hrs} = \$3.64/\text{hr.}$	<u>\$3.64/hr</u>
Hourly Operating Cost (HOC):	\$17.55/hr

Hourly Machine Cost (HMC): $HFC+HOC$	\$40.62/hr
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LABOR COSTS

Hourly Wage	\$7.00/hr
Social Security @ 7.57%	\$.53/hr
Workers' Compensation 35.62%	<u>\$2.49/hr</u>
Total Labor Cost (TLC):	\$10.02/hr

Hourly Machine Cost (HMCL): $HMC+TLC$	\$50.64/hr
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A comparison of the proportion of the hourly machine cost for three different levels of workers' compensation premiums are shown in Table 5. The premiums are the low, mean, and high rates for the calendar year 1989 from a survey of state workers' compensation systems (American Pulpwood Association 1990). The cost a company pays for insuring a single logger against work-related injury or illness accounted for as little as 2.4 to as much as 10.1 percent of the hourly owning and operating cost of a cable skidder. Even at the mean compensation premium rate of \$35.62 per \$100.00 of payroll, workers' compensation is an important cost factor.

Table 5. The Effect of Different Workers' Compensation Premiums on the Hourly Machine Cost of a Cable-Skidder.

Premium Rate (\$/\$100 payroll)	Hourly Machine Cost (\$/hr)	Percent (%)
17.08	49.35	2.4
35.62	50.64	4.9
76.90	53.53	10.1

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