

WORKER SAFETY IN LOGGING OPERATIONS

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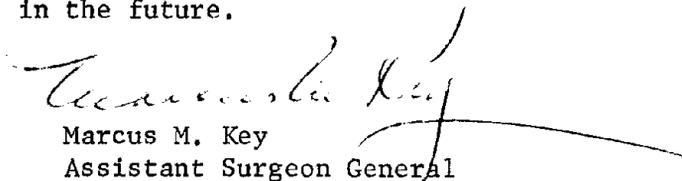
PREFACE

This report presents the findings and recommendations of Synsis, Inc., who made a study of the logging industry on behalf of the National Institute for Occupational Safety and Health, for the purpose of identifying those operations which were most hazardous as evidenced by the number and severity of employee injuries.

Logging is a part of the lumber and wood products industry which the Department of Labor has designated as a target industry. The report discusses that portion of the industry involving the felling, bucking and transportation of the logs to the sawmill.

While the recommendations contained in the report do not reflect the Institute's program plan for the industry, it was felt the information should be disseminated to employers and employees. For this reason, the first volume of the report has been reprinted and is available as long as the supply lasts. Volume II contains the analysis of the various codes, as listed.

Copies of both volumes will be available from the National Technical Information Service in the future.



Marcus M. Key
Assistant Surgeon General
Director, National Institute for
Occupational Safety and Health

FOREWORD

This is the final report for a study of worker safety within logging operations. The study was performed under Contract HSM-99-72-56 for the National Institute for Occupational Safety and Health, Department of Health, Education and Welfare.

Work on this program was initiated during June 1972 and was completed during June 1973. Effort during this period was emphasized in the area of problem definition and resulted in determination of a number of relationships which apparently contribute to the high injury frequency rate for this industry. On the basis of this determination, it is now possible to establish priorities for subsequent effort which will result in the effective reduction of disabling work injuries.

ACKNOWLEDGEMENTS

Many people and organizations contributed both information and assistance for the performance of this study. We are deeply indebted to all of them and at this time wish to extend, to each, our gratitude. Special thanks are due to each of the loggers who were willing to talk about their jobs and to the many companies who allowed us to observe their operations and provided us with very knowledgeable guides.

Without the assistance of three people whose efforts are devoted to logging safety we would have been unable to perform a comprehensive number of site observations. Mr. Kenneth L. Patrick, Director of Safety, Western Wood Products Association, escorted us through California, Oregon and Alaska. Mrs. Ethel Roesch, Timber Industries, made arrangements for tours in Washington and was especially helpful in assisting in the acquisition of data from Washington and Oregon. Mr. Kenneth S. Rolston, American Pulpwood Association, led us through Maine, Pennsylvania and Georgia. Both Mr. Patrick and Mr. Rolston contributed much of their valuable time and went out of their way to provide as much information as they could. Mr. Patrick further assisted in reviewing this document and made many valuable suggestions for ensuring accuracy.

The conclusions and recommendations of this report are those of Synsis. We hope that we have not misinterpreted the information provided to us. The massive amount of information acquired during this study was processed by Mrs. Shiela Clark and Miss Anne Fleming of the Synsis technical staff. Mrs. Clark spent many weeks in preparing the figures. However, without the devotion of Miss Alice Strom, who spent uncountable hours typing, this report could not be presented.

CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY	1
PROGRAM OBJECTIVE	1
PROGRAM APPROACH	1
PROGRAM RESULTS	2
PROGRAM CONCLUSIONS	6
RECOMMENDATIONS	8
 I	
LOGGING INDUSTRY CHARACTERISTICS	17
LOGGING PERSONNEL POPULATION	17
ESTIMATED POPULATION SIZE	18
Logging Operation Size	18
LOGGING OCCUPATIONAL SPECIALTY DISTRIBUTION	20
EXPERIENCE AND TRAINING OF LOGGING PERSONNEL	23
SOURCE OF LOGGING PERSONNEL	24
LOGGING WORK SCHEDULES	25
PERSONNEL PROTECTION PRACTICES	26
LOGGING COMPANY CHARACTERISTICS	27
SAFETY STANDARD AVAILABILITY	28
National Concensus Standard	28
State Standards	28
International Standards	31
Modification of Existing Codes	32
INDUSTRY USE OF PROTECTIVE CLOTHING AND EQUIPMENT	32
Impact of Standards	32
Protection Helmets	32
Helmet Problems	33
Foot Protection	33
Eye Protection	34
Ear Protection	34
Ballistic Nylon Pads	35
Hand Protection	35
Clothing	35
Company Policies	36
MISCELLANEOUS CONSIDERATIONS	36
USE OF SUBCONTRACTOR PERSONNEL	36
WAGE POLICIES	36
WORKMEN'S COMPENSATION	36
 II	
WORKER FATALITIES ANALYSIS ⁴¹	
FATALITY CAUSE AND EFFECT RELATIONSHIPS	41
FATALITY DISTRIBUTION	48
GEOGRAPHIC DISTRIBUTION	48
WEEKLY DISTRIBUTION FOR FATALITIES	49
AGE DISTRIBUTION FOR FATALITIES	50
ANNUAL DISTRIBUTION FOR FATALITIES	50
HOURLY DISTRIBUTION FOR FATALITIES	51
ADDITIONAL FATALITY INFORMATION	54

CONTENTS (concluded)

<u>Section</u>		<u>Page</u>
III	DISABLING WORK INJURIES ANALYSIS	57
	SOURCES OF INJURY DATA	
	RESULTS OF INJURY DATA SURVEY	59
	Data Availability	59
	INJURY DATA ANALYSIS	60
	INDUSTRY COMPARISONS	62
	GEOGRAPHIC AND TEMPORAL TRENDS	65
	CAUSES OF WORK INJURIES	66
	Types of Accidents	66
	Agencies	68
	INJURIES AS A FUNCTION OF OCCUPATION	73
	LOGGER EXPERIENCE	
	TEMPORAL DISTRIBUTION OF INJURIES	78
	Monthly Injury Rates	80
	Weekly Injury Rates	80
	Daily Injury Rates	85
	BODY PART INJURED	
	NATURE OF INJURIES	
IV	COSTS OF DISABLING WORK INJURIES	93
	GENERAL COMPARISONS	93
	OCCUPATIONAL TRENDS	93
	COSTS OF INJURIES	93
V	REFERENCES	105
Appendix A	LOGGING OPERATIONS/TASK DESCRIPTIONS	A-1
Appendix B	LOGGING SAFETY STANDARDS SUMMARY	B-1
Appendix C	FATALITY REPORTS REVIEW	C-1
Appendix D	SELECTED INFORMATION FROM PREVIOUS LOGGING STUDIES	D-1
Appendix E	GLOSSARY OF TERMS	E-1
Appendix F	GRAPHIC PRESENTATION OF LOGGING OPERATIONS	F-1

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1-1	Employment in the Logging Industry	17
1-2	Logging Occupational Structure in the West Coast Region in October 1969 (14,940 workers)	22
2-1	Comparison of Logging Occupational Specialties for Prob- ability of Fatality Occurrence	48
2-2	Weekly Distribution of Logging Fatalities	49
2-3	Age Distribution of Logging Fatalities	51
2-4	Annual Distribution of Logging Fatalities	52
2-5	Annual Distribution of Fatalities to Fellers and Buckers	52
2-6	Annual Distribution of Fatalities to Choker Setters	53
2-7	Occurrence of Fatalities by Time of Day (Washington 1968, 1970 - 1972)	53
2-8	Cumulative Rate of Fatality Occurrence by Time of Day (Washington 1968, 1970 - 1972)	54
3-1	Logging Industry Disabling Work Injury Rate	61
3-2	Logging Injury Severity Rate	61
3-3	Average Logging Injury Severity Rate	62
3-4	Lumber and Wood Products Injury Frequency Rate	63
3-5	Lumber and Wood Products Injury Severity Rate	63
3-6	Average Injury Severity Rate for the Lumber and Wood Products Industry	63
3-7	Frequency Rates in Logging by Geographic Region	64
3-8	Severity Rates in Logging by Geographic Region	64
3-9	Comparison of Average Injury Severity Rate by Geographic Regions	65
3-10	Types of Accidents Resulting in Disabling Work Injuries	67
3-11	Types of Accidents Resulting in Injuries for Montana	68
3-12	Agencies Related to Disabling Work Injuries	69

LIST OF ILLUSTRATIONS (continued)

<u>Figure</u>		<u>Page</u>
3-13	Distribution of Injury Causes for Washington (1965-66; 1970-71)	70
3-14	Cause of Logging Injuries in Washington (1967-1970 Average)	71
3-15	Logging Injuries by Causative Agent (Typical Large Southern Co. 1964 - 1972)	71
3-16	Disabling Work Injuries as a Function of Occupations in Western Operations	74
3-17	Disabling Work Injuries as a Function of Occupations in Southern Operations	75
3-18	Occupational Comparison on Basis of Probability of Injury (Western Operations)	76
3-19	Comparison of Occupations on Basis of Probability that a DWI will Result in a Fatality (Western Operations)	76
3-20	Logging Injuries by Activity (Typical Large Southern Co. 1964 - 1972)	77
3-21	Logging Injuries in Western Operations by Time on the Job	78
3-22	Logging Injuries in Southern Operations by Time on the Job	79
3-23	Annual Distribution of Injuries in Southern Operations	81
3-24	Annual Distribution of Injuries in Oregon (1970 - 1971)	81
3-25	Annual Distribution of Injuries in Montana (1968 - 1972)	82
3-26	Annual Distribution of Injuries for Representative Maine Company (1971 - 1972)	82
3-27	Annual Distribution of Injuries within Cutting Operations	83
3-28	Weekly Distribution of Injuries in Montana	83
3-29	Weekly Distribution of Injuries in Texas (1972)	84
3-30	Weekly Distribution of Injuries in Oregon (1970-1971)	84
3-31	Daily Distribution of Injuries for Southern States	85
3-32	Comparison of the Distribution of Body Part Injuries for Three Industrial Classifications	86

LIST OF ILLUSTRATIONS (concluded)

<u>Figure</u>		<u>Page</u>
3-33	Montana (1968 - 1972) Injuries by Body Part	88
3-34	Texas (1972) Injuries by Body Part	89
3-35	North Carolina (FY 69-70) Injuries by Body Part	89
3-36	Virginia (1970) Injuries by Body Part	90
3-37	Kentucky (1971) Injuries by Body Part	90
3-38	Nature of Injuries	91
3-39	Logging Injuries by Type of Injury (Typical Large Southern Co. 1964 - 1972)	91
4-1	Comparison of Injury Severity for Logging Occupational Specialties (Washington 1966-1971)	96
4-2	Comparison of Injury Frequencies for Logging Occupational Specialties (Washington 1966-1971)	97
4-3	Comparison of Average Cost/Injury for Logging Occupational Specialties (Washington 1966-1971)	98
4-4	Comparison of Injury Severity for Logging Occupational Specialties (Washington 1966-1971)	99
4-5	Comparison of Injury Costs for Logging Occupational Specialties (Washington 1966-1971)	100
4-6	Comparison of Average Costs per Injury by Types of Accidents	101
4-7	Comparison of Average Costs per Injury by Nature of Injury	102
4-8	Comparison of Average Costs of Injuries to Each Body Part	103

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1-1	Characteristics of the Eastern Pulpwood Production Industry for 1968	19
1-2	List of Logging Occupational Titles Use by Department of Labor	21
1-3	Summary of State Responses to Requests for Logging Standards and Injury Data	29
1-4	Workmen's Compensation Insurance Rates for Logging	37
2-1	Logging Fatality Frequency Rates	42
2-2	Logging Injuries and Fatalities (Western Operations of representative large company)	42
2-3	Summary of Fatality Causal Relationships for Washington (1968, 1970-1972) and California (1968, 1971)	44
2-4	Summary of Fatality Causal Relationships for Oregon (1966-1971)	55
3-1	Compilation of Results Reported by the Department of Labor for the 1955 Logging Study	58
3-2	Injuries Involving Chain Saws (APA Northeastern Division)	72
3-3	Number of Injuries (1958-1972; APA Northeastern Division)	72
4-1	Injury Costs for Selected Geographic Areas	94
4-2	Work Injury Costs - North Carolina	94
4-3	Injury Cost Comparisons	95
4-4	Washington Non-Fatal Injury Costs	95

EXECUTIVE SUMMARY

In comparison with other industries, the Lumber and Wood Products Industry (LWPI) ranks as one of the most hazardous. Although this dubious distinction has been recognized by both the LWPI and the U.S. Department of Labor (DOL) for many years, little in the way of effective effort has been accomplished to eliminate this problem. This industry is now classified as one of the target industries in which effort is to be emphasized for ensuring worker safety.

The Logging Industry, as a major component of the LWPI, evidences a greater frequency rate and severity rate for injuries than do the other industrial components of the LWPI. Consequently, there is a clearly established need for determining priorities of efforts intended to make this occupation less hazardous.

PROGRAM OBJECTIVE

The current program was planned as the first phase of a multiphase effort to recommend methods for reducing work-injury rates. As a primary objective, this phase was intended to identify the problems associated with logging operations which result in work injuries, to establish the scope and magnitude of these problems, and to make recommendations for reducing work-injury rates. These recommendations were to consider the procedures, the personal protective equipment and the tools and equipment used in logging operations and to identify requirements for implementation.

PROGRAM APPROACH

Three basic approaches were followed in this Problem Definition Phase. The first was to acquire historic data on logging work injuries which would provide visibility on cause and effect relationships. Inquiries were made to states, operating companies, insurance companies, hospitals, associations, etc. Previous studies by the Bureau of Labor Statistics and by several state organizations were reviewed and contrasted with more recent information.

The second approach was the review of existing Standards dealing with logging occupational safety. These were acquired from a number of states and included the current Occupational Safety and Health Administration regulations, as well as the current and planned standards of the American National Standards Institute. An International Labor Office Standard and a number of safe working practices documents produced by associations and operating companies were also included.

In the third approach, observations of representative logging operations were performed. These observations included a range of operational sizes and companies in Maine, Pennsylvania, Georgia, California, Oregon, Washington and Alaska. Both pulpwood and sawlog operations were included in each geographic area. During these observations, discussions were held with logging company personnel (both management and workers). Discussions were also held with personnel from state Labor Statistics and Workmen's Compensation operations.

Concurrent with these tasks were a number of additional information gathering efforts which contributed to an understanding of the problems con-

fronting the industry. Contacts were made with several logging equipment manufacturers and several sources of reference information on logging were reviewed.

PROGRAM RESULTS

Results of this program indicate that the needs for improving worker safety within the logging occupation may be considerably greater than has been generally recognized. Although the logging industry is very cognizant of its rising costs (see Section I) as a consequence of worker injuries and is taking positive action to implement what it recognizes as good work practices, this current effort may well not produce the significant impact which is required. The latter observation is made on the basis of information contained in this report and summarized by the following paragraphs.

SCOPE OF PROBLEM

Historic data in the form of injury statistics providing definition of injury cause and effect relationships was not readily available to this study. Although logging industry representatives were able to provide a large quantity of anecdotal information, quantitative data was extremely limited. However, on the basis of the information collected and presented in this report it was possible to derive the following estimates of annual costs of logging industry safety problems:

- . 19,000 disabling Work Injuries
- . 475 Loggers Killed on the Job
- . \$16,000,000 Cost for Non-fatal Disabling Work Injuries
- . 300,000 Days Lost for Survivable Disabling Work Injuries
- . 2,850,000 Days Lost Accounted for by Fatalities
- . Workmen's Compensation Insurance Costs Equivalent to 15% of Gross Salary.

Comparison of this industry with other industries is possible when considering the following derivatives for the logging industry:

- . DWI Frequency Rate = 42
- . DWI Severity Rate = 7,000
- . Loggers injured on the job have a likelihood of fatality twenty-five times greater than the "all industry" average.

The following paragraphs summarize the results of this study which led to the above estimates and other relationships developed.

Size of the Working Population

The magnitude of the industry's injury prospectus is based upon an estimate that there are at least 300,000 loggers in the United States. This estimate

(discussed in Section I) is contrasted with a population of 75,000 identified by recent Department of Labor estimates.

In considering the work characteristics of both loggers and logging companies two implications were drawn. In the first, it has been concluded that lack of population visibility results from the extensive number of logging operations involving fewer than five workers. In the second, there is much anecdotal information, corroborated by studies, to indicate that a large number of workers are seasonal or part-time employees. Thus, it has been further concluded that even the 300,000 employee estimate is conservative when considering the number of workers exposed to logging hazards each year.

Injury Occurrence

For the most part, the injury data acquired provided little definition of frequency and severity rates. Consequently, it was possible to process most of the information only as ratios to total injuries. Furthermore, most of the data did not distinguish between fatal and non fatal disabling work injuries, among the various work specialties, or identify the causes of discrete types of injuries.

This deficiency resulted because of the methods used by state agencies to summarize this injury data. Although contacts with some agencies did indicate the existence of more definitive data these sources were either reluctant or unable to retrieve and submit the information for inclusion in the study. None of the state agencies indicated an awareness of the number of workers in their respective logging work forces.

Similar inquiries to insurance companies indicated that they maintain no records (or could not retrieve) to indicate injuries, their frequency or severity rates, or even the number of loggers covered by their Workmen's Compensation Insurance plans.

The data which were ultimately compiled included state summary information, information from some companies and logging associations and a small sampling of injury report forms from Oregon. Montana provided a special computer search; however, none of the other states asked indicated a willingness to sell this service. This problem may be obviated in the future since many of the states indicated that they are in the process of developing computer data banks.

Wherever possible, the injury data were used to develop relationships such as "% of injuries to fellers resulting from being struck by falling trees". This type of information is presented in Section II (fatality information) and Section III (injury information). However, most of the data obtained did not permit development of even this simple cause and effect relationship for most of the occupational specialties.

Dangerous Occupations

Not all of the occupational specialties comprising the logging industry are to be considered as having equal probabilities for injury occurrence. On the basis of information acquired for Western operations it was possible to project expectancies of occurrence such as:

1. Fallers and buckers suffer the highest fatality frequency rates

of all logging occupational specialties. As shown in Section II, these workers will have almost twice as many fatalities as would be expected on the basis of exposure hours.

2. Vehicle operators, such as logging truck drivers, have a fatality rate less than expected on the basis of exposure hours.
3. Second loaders have a higher likelihood of being killed in an accident than being able to survive their injuries. As shown in Section III, approximately 75% of injuries to these workers are expected to end as fatalities. However, also indicated in Section III is that this occupation is among those having the lowest expectancies of injuries.
4. Choker setters have the highest disabling work injury rates of all occupational specialties but the number of injuries resulting in fatalities is lower than expected on the basis of exposure hours.
5. Fellers and buckers, and truck drivers demonstrate a nearly equal chance of surviving their injuries.

Similar expectancies could not be developed for Eastern logging operations since the data necessary for compiling these probabilities were unavailable. However, data from Maine were used in developing the estimate that loggers have a likelihood of fatality twenty-five times greater than the U.S. "all industry" average (see Section II).

Causes of Injuries

The causes of injuries are detailed in Sections II and III for fatal and non-fatal accidents, respectively. Discussions of the hazards associated with the various logging operations are presented in Appendix A.

The most frequent causes of fatal injuries to loggers are:

1. Felling into standing trees (17%).
2. Being struck by a vehicle (14%).
3. Loss of vehicle control (11%).
4. Being struck by a moving log (27%).

Survivable injuries are most frequently the result of chain saws in Eastern operations (37%) and falls in Western operations.

Types of Injuries

Injuries to the lower extremities are most frequent (primarily to the legs and ankles) with cuts and lacerations; strains, sprains and dislocations; and fractures accounting for over 85% of the disabling work injuries. The distribution of all injuries is presented in Section III; however, it was not possible to distribute the injury data (by body part) according to occupational specialty.

Costs of Injuries

Data are presented in Section IV to indicate the medical costs of injuries, the average days lost for each type of injury and the compensation costs. The following trends are indicated:

1. Average cost per injury
 - Montana = \$691
 - North Carolina = \$416
 - Washington = \$1,360
2. Average days lost per injury (Washington) = 95 days
 - Fellers lose 25% of all days lost
 - Chokersettlers lose 16.5% of all days lost
 - Buckers lose 12.5% of all days lost
3. Injury Cost Distribution (Washington)
 - Fellers = 28%
 - Chokersettlers = 15%
 - Buckers = 6.5%

It is to be further noted that injuries to most workers do not vary significantly in terms of average days lost. Some exceptions which occur are noted with respect to occupational specialties having an extremely low incidence of injury, such as powderman and machinist.

Industry Concern

Discussions with many representatives of the logging industry indicated that they are aware of the industry's identification as a target occupation. It was common for these representatives to suggest that OSHA provide increased assistance. A common complaint of many was that they seldom saw compliance officers at logging sites and would welcome an increase in the number of inspections.

Included in Section I is information on the activities of those companies, associations and logging personnel who are taking positive action toward decreasing the incidence of injuries. However, this concerned population representation apparently reflects only a small portion of the total number of logging operations and the total number of workers. For example, large companies employing loggers generally indicate that their loggers produce less than half and even less than one-quarter of the logs required by their mills. The remainder of their product they obtain from independents over whom companies and safety personnel admit they have little positive influence.

Discussions with independent operators and observations of their logging activities suggested that only a few were working toward improving safety. It was apparent that many were ignoring or were unaware of their own state safety codes or the OSHA pulpwood logging standard.

In this respect, it is not intended to equate large operations with safe operations and small operations with unsafe operations. Often the reverse situation was evident. Furthermore, even in large operations which consistently reported injury frequency rates much lower than the national average there was evidence of operational approaches which were highly questionable. For example, a safety representative for one company indicated that a "single jack" operation (see Appendix A) was considered unsafe. However, at one of his company shows, this was the form of operation.

Industry Standards

Appendix B compiles and contrasts standards currently available to the industry. Of particular concern are the present OSHA regulations for pulpwood logging and the newly proposed ANSI standard for all logging operations. While the latter two standards address a large number of the practices which will contribute to safer operations it is also apparent that other available standards are more comprehensive in some areas.

The effort expended in organizing the standards for Appendix B required more time than was originally anticipated. However, the results indicated that effective use of such standards by individual loggers may not be possible when considering the entire logging population and their ability to fully comprehend these requirements in the form in which they are presented.

It is obvious, by contrasting these standards, that the people responsible for their development had different criteria for selecting safe practices. Not only is it evident that the practices cited were variable but in many cases where the same practice was discussed the safety solutions were opposed to one another. Appendix A identifies a number of these inconsistencies.

PROGRAM CONCLUSIONS

Although the logging industry has undergone extensive changes during the recent twenty-year period, relating to improvements in the mechanization of its operations it continues to be one of extreme hazard to its personnel. This situation is recognized by many industry representatives who can cite many efforts during recent years which have been intended to significantly reduce the frequency of disabling work injuries.

There is evidence that the disabling work injury rate has shown a trend toward reduction. However, the injury severity rate has not changed. The conclusion drawn must, therefore, be that the average number of days lost per disabling work injury is increasing. In support of this conclusion is the indicated trend toward a higher percentage of injuries which result in fatalities. Consequently, it is further concluded that changes in operational modes and the implementation of new work practices have been effective in protecting personnel against the least serious hazards; at the same time, changes have either increased personnel exposure to extreme types of hazards or have not adequately considered these latter types of hazard.

The overall impact of OSHA during the last three years is not evident from the data available to this study. Injury information acquired for the most part did not permit the determination of new trends. However, discussions with logging personnel and logging equipment manufacturers did indicate that the act had elicited an increase in effort intended to improve the work environment.

Review of existing standards for personnel safety in logging operations indicates that collectively they address the majority of areas in which safety requirements should be available. The current OSHA regulations for pulpwood logging obviously do not cover all types of logging. The proposed changes in the ANSI standard to encompass all types of logging are an improvement.

Nevertheless, in reading the existing standards it becomes evident that the individual logger may not fully comprehend the significance of such statements as "ensure adequate separation between people and tasks". For such statements there are no criteria given for what constitutes adequate separation nor any rationale for the statement.

While standards have been available, for many years, covering the performance of logging operations, both observations and the implication of injury data indicate that there is less than universal acceptance of these standards. The individual worker is often observed, and the injury data indicates, not following such elementary requirements as "not working under or around trees which are hung up", "not working downhill of logs which can roll", and "ensure adequate separation between people and tasks". It is to be noted that these three working situations are responsible for a significant percentage of both fatal and non fatal injuries in Western type operations. The conclusion is that both lack of supervisory influence and lack of understanding or respect for good work practices among loggers are considered to be most contributory to the high work injury rate.

Among the recent changes in logging operations which have a high potential for negative impact on worker safety are those related to environmental protection. During observations and discussions with logging personnel it was determined that governmental agencies, in their concern for environmental protection, have failed to consider good work practices in their regulations. In the interest of environmental protection, methods of logging have been prescribed which are contrary to ensuring personnel safety (see Section III).

Personal protective equipment items are available and, while improvements in both protection performance and design for acceptance are suggested, there is little evidence that improvement of these items will contribute greatly to a decrease in the injury severity rate. Improvements geared to achieving greater worker acceptance should reduce the injury frequency rate. In this respect, the use of lower extremity protection against saw cuts in Eastern operations appears to promise a major reduction in injury rate.

Equipment design, which is typically considered as a major concern in ensuring worker safety, as is evidenced by the number of requirements consolidated in existing standards, is also not in evidence as a major contributor to the high injury frequency rate. However, the concern within the existing standards for equipment design is probably a major testament to the levels of safety which can be achieved by adherence to these kinds of standards.

There is a lack of extensive information on injury cause and effect relationships. Injury data retrieved during this study was quite limited and suggested that current data reporting procedures and data retrieval methods do not permit sufficient visibility as to "why injuries occur". Even more of a problem is a lack of confidence that the data which are available reveal a valid picture of the actual injury frequency rate. It is believed that the incidence of injuries is much greater than reported.

RECOMMENDATIONS

A number of approaches which will lead to the reduction of injuries among loggers are recommended in the following paragraphs. These recommendations are based primarily upon an improvement in current practices.

STANDARDS FOR OCCUPATIONAL SAFETY

Current OSHA regulations are limited in application to pulpwood logging. State codes are also available which are intended to apply to other forms of logging, as well. However, there are, as of the present, no adequate standards covering all areas of logging. It is recommended that a national standard be developed to fill this void. This new standard is intended to provide indices whereby failure to comply will be measureable. Thus, the standard must provide both the requirements and the criteria for determining compliance with each requirement.

Review of Appendix B (pages B-2 through B-5) suggests an organization or outline for the recommended standard. It is based on the scope of available consensus standards and an effort to present these standards in a common format. Thus, the organization presented compiles those topics which are discussed collectively by current OSHA regulations, state codes, etc. However, the suggested outline will obviously require some modification to incorporate requirements not presently contained or adequately discussed in those standards reviewed.

Criteria for each of the requirements established for the revised standard will be essential to ensuring effective compliance. Many of the standards as they are now presented are open to great interpretation. For example, statements such as "Trees ready to be bucked shall be piled in an orderly manner to minimize hazard to the employee" calls for an interpretation. What is needed is an additional set of statements to establish what is an "orderly manner" and to define what are the potential hazards and what actions are necessary to protect the worker against injury. Other standard statements which could be made, having the same intent, are written as "Logs being bucked are to be blocked or propped to prevent rolling" and "buckers are to stand uphill of the log".

In the first step toward preparing a new standard it is recommended that the standard compilation of Appendix B be completely edited to eliminate redundancies and inconsistencies. Also to be eliminated or rewritten are those statements for which good rationale are not available. The resultant of this editing effort will be a document considerably condensed and more explicit than Appendix B is in its present form.

The resultant draft of the recommended standard is envisioned as one which emphasizes personnel operational performance requirements and the requirements

for controlling hazards. This is in contrast with many of the current standard statements which are not adequately directed toward the performance of workers tasks; the current standards are presented more from the point of view of management requirements and the procurement and use of standardized equipment.

Once the standard draft has been formulated it will be necessary to review it with industry representatives. This review will have two purposes; the first is to determine a consensus evaluation of its adequacy in terms of enhancing safety without regard to cost effectiveness; the second is to obtain information on the cost impact versus level of injury reduction potential.

GOOD WORK PRACTICES

It is apparent that existing standards have had little direct impact on the worker's approach to job performance. The impact has been of an indirect nature where management has interpreted the standards and advises the worker on hazard avoidance.

The result has been the non standardized presentation of information to the worker and it is doubtful that safety meetings, posters, safety awards, etc., have effectively conveyed a safety awareness. The type of safety awareness needed is that which enables the worker to recognize and avoid both the real and potential hazards.

Consequently, it is recommended that a good work practices manual be prepared in conjunction with the development of the above standards document. This manual is to present information defining the types of tasks performed and their interactions within the total spectrum of logging operations. Each of the major hazards which can be confronted is to be specified along with statements on how injuries can occur within each type of situation. Typical examples of what can happen, along with industry's acceptable practices, are to be incorporated within the manual.

Essentially, it is envisioned that the good practices manual provide the rationale and background information for each of the standards established by the above recommended effort. The recommendation that the manual be prepared in conjunction with the standard will ensure effectiveness of each document; each of the two efforts provides insight into the preparation of the other and will establish needs for additional information.

IMPROVED INJURY DATA COLLECTION

The type of injury data which were available to this study provided little in the way of visibility as to who is injured, by what agency, when performing which task. It was not possible to establish the unsafe acts or even whether inadequacy of a protective helmet was the major cause of an injury. The basic reason for this was that the data acquired was in a form of summarization which precluded its recombination into multiple relationships.

The best data obtained consisted of a sampling of the basic injury reports from which states summarize their data and a collection of summary descriptions for accidents resulting in fatalities occurring within discrete periods of time. In both cases, we were limited by the preparer's selection of information. The injury and fatality reports were inconsistent in the amount of information provided for such parameters as experience, age, type of injury, time of day and even statements of the task being performed or the probable unsafe act.

Thus, it is recommended that a new method be instituted for tracking the incidence of injuries. Since the same reporting techniques are used for all industrial work injuries this recommendation should apply universally.

In terms of a new injury reporting system, it is believed that the basic reporting techniques which exist within most states can be readily adapted to increase overall visibility of the cause and effect relationships. The basic injury report forms usually used should be modified such that it incorporates the following information:

1. Date and time of injury
2. Type of injury
3. Agency
4. Task being performed by injured at the time of injury
5. Cause of injury
6. Unsafe Act Performed
7. Experience Level of Injured/Experience on Current Job or with Current Employer.
8. Statement of Injury Investigator as to What Happened
9. Location of Injury Occurrence
10. Environmental Conditions at Time of Injury
11. Other information to be determined

In cases where a fatality results from the injury it is further recommended that reports be prepared of the type used in reporting the investigation of fatalities in coal mine accidents. Included is to be an analysis of the events leading to the accident.

This data is to be processed to show multiple relationships. Typically, injury data is used only to identify the number of injuries to loggers, without regard to occupational specialty; or to identify the total number of saw injuries without regard to the job being performed with the saw, such as felling, bucking, precommercial thinning, etc. The data which are available today (ie. which can be retrieved from the sources of information) does not permit such questions to be answered as "Could the injury be the result of a failure to use protective equipment or due to failure of the protection used", "Could the injury have been prevented if current safety procedures had been followed (company standards, state standards or OSHA standards)", or "Could the injury be the result of inadequate supervision".

Paralleling the increased definition of causes and effects surrounding injuries is the need for follow-up information on the actual injury. This should include medical and Workmens Compensation information.

TRAINING

Anecdotal information on the industry's support of vocational-agricultural school programs for logging suggests a valuable approach to the reduction of injuries in the future. It is recommended that a review of the curriculum provided by each school be performed and assistance provided which will enable them to better instruct with respect to occupational safety.

The above recommended good work practices manual could be extremely beneficial to such school programs.

COORDINATION WITH GOVERNMENTAL AGENCIES

A large proportion of logging effort is performed on public lands (federal and state). As a consequence, the administrative agencies exert considerable influence on the methods used. However, from anecdotal information it appears that logging personnel safety has not been adequately considered in the contracts which have been processed.

It is recommended that NIOSH establish a set of criteria for use by these agencies in developing timber cutting plans and in establishing contractual regulations. With respect to the development of cutting plans the criteria should address those criteria which will present the least hazards to logging personnel. Section III presents a number of situations which should be addressed.

RESEARCH RECOMMENDATIONS

The following areas are recommended for increased study:

Protective Equipment

The major need for protective equipment is for prevention of saw cuts and protection during slips and falls. Ballistic nylon pads already in evidence should be studied for protection effectiveness and designs developed for increasing their acceptance and utilization. Similar protection is needed to protect the worker against slips and falls. Obviously, prevention of the accident is equally important.

Seat belt use in vehicles was observed occasionally but only when the vehicles were travelling on good roads and at high speed. Loggers are apparently reluctant to use such belts when working in the forests claiming they have a better chance of survival through escape if the vehicle overturns. There are a number of fatalities descriptions on hand which indicate that the victim was thrown from the vehicle and if a seat belt had been used then fatal injury would not have occurred. Consequently, a specific study of the feasibility of seat belt use is recommended.

With respect to the use of currently approved helmets, gloves, etc., or adding requirements for eye shield and respirator use there is no evidence from the injury data that any change in procedure is needed. However, these requirements may in reality exist.

Occupational Disease

The injury data acquired did not permit determination of occupational disease correlates. While occupational disease may not be a significant occurrence it is suspected that it has not been adequately studied and may be more evident than the industry is aware. Vibration and acoustical noise are considered to be the prime candidates for investigation.

Energy Relationships

Two forms of energy dissipation are implicated in the rate of injuries to logging personnel. These are the input energies which are the direct causes of injury and the energy expended by the logger in performing his tasks which may make him more susceptible to injury. It is recommended that both types of energy be studied from the stand point of injury control.

The first type of input energy entails such forces as blows of flying limbs, the kickback energy of the chain saw which is directed at the logger, or the impact force resulting from the logger falling from a height, etc. None of these energy levels have been determined and as a consequence the requirements for methods of protection against injury cannot be defined. It is recommended that a parametric analysis of the magnitudes of these forces be performed along with the projection of injury occurrence rate as a function of step increases in force magnitude. In accomplishing this analysis it will be necessary to investigate the details of injuries shortly after they occur since historic reports will not have sufficient information. If the magnitudes of injuries are determined along with details of the accident it will also be possible to predict thresholds of injury and to develop a threat/injury model.

The second type of energy to be investigated entails the energy output of the worker. Little data exists which indicates the level of exertion required in the performance of logging tasks. It is hypothesized that these levels of energy maintained over short and/or long durations of time may well be implicated in the incidence of injury. For example, the high frequency of injuries due to "struck by a moving log" may be reduced if the logger is in a less fatigued state and able to effect a more rapid evasive action. It has been reported anecdotally that research has been performed in the Scandinavian countries on methods of limbing with a chain saw. It was reported that a rhythmic method of saw motion is equated with greater productivity with less worker exertion. Our observations of this rhythmic technique (as demonstrated by the reporter) suggested that the motion pattern would be less prone to personnel injury; kick back of the saw would have propelled it away from the body.

It is therefore recommended that logging tasks be studied in terms of ergonomics considerations. In addition to the objective of reducing energy expenditure levels this study should include evaluation of existing tool designs and operational sequences from the stand point of more effective, and presumably safer, methods of task accomplishment.

MISCELLANEOUS RECOMMENDATIONS

This study deals with the Logging Industry. During the course of study, information was acquired and observations also made on other elements of the Lumber and Wood Products Industry. It has been concluded that similar prob-

lem definition studies should be performed within the rest of this industry. Generally, the components which require study are the sawmills, pulpmills, particle board mills, paper processing, rayon and other wood pulp processing, plywood mills, etc. Each appears to have unique problems as well as problems in common.

Other industries within the target industry list are also recommended for study.

Figure 1 shows the relationship of problem definition studies, such as the current study, to the overall effort believed necessary for ensuring worker safety within any occupational environment. The recommendations made as a result of the logging industry problem definition study fit within this flow process, as indicated by the following paragraphs.

Results of the current study have indicated the need for improved safety procedures within the logging industry. The recommendations made indicate that there are basic deficiencies which must be considered before effective procedures can be formulated and implemented.

For example, the recommendations to develop a national safety standard and a good work practices manual must include cognizance of how the logging industry currently performs its job. Each of these procedures (including safety codes and company operating procedures) must be analyzed to determine whether the currently established requirement is a safety requirement or an operational requirement without direct correlation to safety. It is believed that many of the standards presented in Appendix B are of the latter type; in many instances, where the standard suggests a strong correlation to safety, the rule has been written around a single concept of performing the job. Reference to the standards on yarding operations indicate greater concern with the types of equipment to be used and how to use it.

In figure 1, the first step is to analyze these requirements and determine what safety interface is implied. These interfaces include:

1. Evasive action by the worker.
2. Prevention of equipment failures which cause accidents involving potential injury.
3. Removal of a hazard to the worker.
4. Prevention of an unsafe action by the worker.
5. Protection of the worker in the event of an accident.

Of particular concern in the analysis will be a similar allocation of safety functions in terms of equipment and product protection. While these latter functions are important to the industry in terms of operational performance they may well detract from the worker's safety. For example, the operational requirement established, in the interest of environmental conservation, that landings be kept small has introduced an increased probability of injuries due to equipment collisions, dropped logs, etc.

This form of analysis then suggests the standards which are required for personnel safety and the language needed to effectively communicate each safety

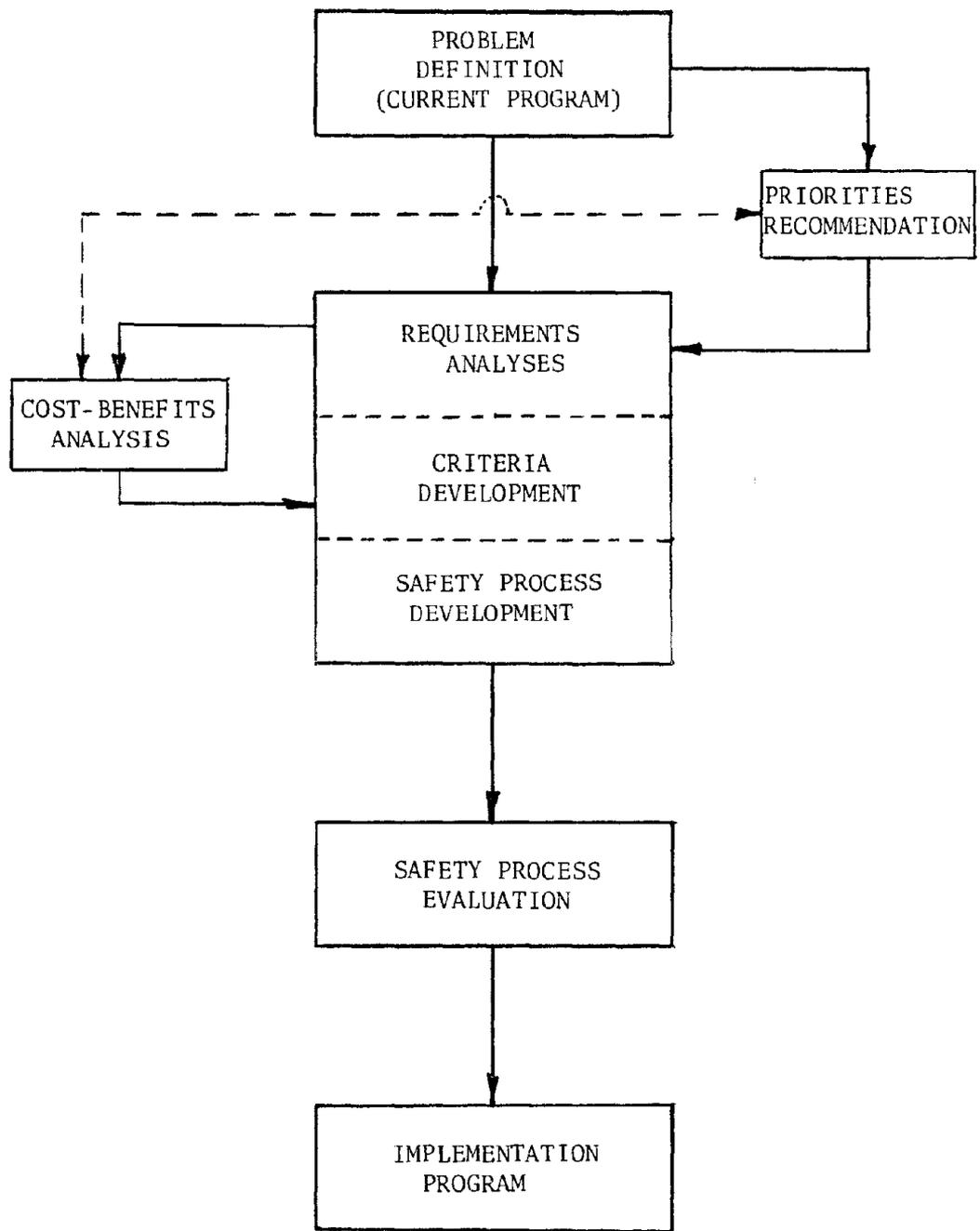


Figure 1. Recommended Program for Development of Safe Work Processes.

standard. It also provides a means for establishing the rationale for each statement. Ideally, it would include quantitative information on the injury costs associated with failure to follow the standard, the number of injuries which the standard is intended to eliminate and a criteria for how to measure compliance. The recommendation for more comprehensive reporting of injuries and for the study of the energetics of causative agents is expected to contribute to the criteria development.

Also shown in figure 1 is a cost-benefits analysis process. This step is desirable as a means for assessing the impact of each requirement and contributes to the rationale statements for each standard. The cost-benefits analysis is to determine the relative value of each standard on the basis of gains due to the number of injuries prevented versus the costs of implementation. Results of this form of analysis may well suggest the need for alternative standards, increased study, etc.

Once the safety standard and the good work practices manuals are developed there is need for evaluation by the industry. This evaluation can range from a review by industry representatives to an actual series of test situations. Once there is agreement on the documents they can be implemented.

Section I

LOGGING INDUSTRY CHARACTERISTICS

While the Logging Industry encompasses some of the oldest occupations within the United States, and has provided the basis for many folklore tales, it is still a relatively unknown occupation. The tasks comprising logging operations are described in Appendix A and shown graphically in Appendix F. However, before considering the incidence of hazards and injuries within these operations it is highly desirable to review some of the industry's characteristics; those characteristics which are believed to have an impact on worker safety are discussed in this section.

LOGGING PERSONNEL POPULATION

Review of published Department of Labor data (Ref. 3) indicates that employment within the logging industry fluctuates during the year with the greatest employment occurring during the summer months. As indicated by the Bureau of Labor Statistics (Figure 1-1), during the latest two year period (1969-1970) for which data are available this range was approximately 20,000 workers with an average employment of about 75,000. The employment of women within the logging classification is approximately 4-5% of total employment.



Figure 1-1. Employment in the Logging Industry (Ref. 12).

Employment relationships were explored, during this study, and because of anecdotal information received from a number of organizations, it was apparent that the above statistics on logging employment are somewhat conservative. Further, if a significant percentage of the logging population has escaped being counted by normal Bureau of Labor Statistics head count techniques then it is quite possible that the number of disabling work injuries might also go

undetected. Another possibility is that there is good detection of disabling work injury incidence along with poor visibility on total head count with the consequence that both frequency and severity rates have been inflated by attributing all injuries to less than the total work population.

While data have been located which appear to corroborate that the logging population is larger than reported by reference 3, quantitative data have not been located to verify the above hypotheses of injury rate inaccuracies. The following discussions are presented to describe general characteristics of the logging population and conditions which influence workers within this occupation.

ESTIMATED POPULATION SIZE

The general conclusion reached is that the logging population may be as high as 300,000 workers (ie. approximately twice the number now employed in the coal mining industry. This estimate is based primarily upon a study conducted by the American Pulpwood Association (APA) during 1961 (Ref. 15) and a relationship established by a Department of Labor (DOL) study performed during 1955 (Ref. 1). In reference 6, the APA identified 133,000 logging personnel in the Eastern pulpwood area predicated on total annual production and productivity per man day. Using the DOL statistical estimate that logging man-power is approximately equally divided between Eastern and Western logging operations then 266,000 loggers were employed during 1961.

In the recent discussions with the APA it was suggested that the DOL 1955 estimated mix for Eastern and Western loggers still exists and that the present employment is at least comparable to 1961 and very possibly higher. Validity of the APA estimate for 1961 appears highly likely; if anything it may err in being somewhat conservative. Several explanations for the discrepancy between the APA and DOL labor force estimates can be given; these will become apparent in the following sections which point out the magnitude of small independent logging operations in comparison with large company employment. While many of the medium-sized independents are readily identifiable it appears that the small independents are nearly invisible and are not likely to be counted effectively.

Logging Operation Size

Observations and discussions with loggers have established that logging operations range in size from one man to at least 90 men for a single operating area. The upper end of the range may be considerably higher; the headcount of 90 loggers was established for a single logging camp visited in Alaska. It appears, however, that logging operations are typically much smaller and although some large companies may employ a greater number of loggers they divide this staff among a number of independent operations. For example, one company indicated a logging staff of some 200 loggers divided among seven separate camps in Maine. Data contained in the DOL 1955 study (Ref. 1) identified the existence of operations having 500 employees; this report did not, however, indicate whether, or not, these represented single or combined operations for a single company.

Information obtained from Forest Industries (Ref. 7) indicates that there are over 35,000 pulpwood producers in the Eastern part of the United States. Table 1-1 was developed using this source information along with data from an

Table 1-1. CHARACTERISTICS OF THE EASTERN PULPWOOD PRODUCTION INDUSTRY FOR 1968

TYPE OF PRODUCER	TOTAL PROD. (cords)	NOTES 1 & 5			NOTES 2, 3 & 4	
		% PROD. BY REGION	NO. OF PRODUCERS	EST. NO. EMPLOYEES	AVG. EMPL. PER PRODUCER	
SOUTHERN STATES	27,148,000	100	21,612	42,301	1.96	
Small	9,230,320	34	16,691	17,307	1.04	
Medium	8,687,360	32	3,534	13,771	3.90	
Large	8,637,360	32	1,387	10,563	7.62	
Mills	542,960	2	16	660	41.25	
NORTH-NORTHEAST- CENTRAL STATES	7,244,000	100	14,048			
Small	3,404,680	47	11,024			
Medium	941,720	13	1,454			
Large	2,245,640	31	1,570			
Mills	651,960	9	13			

EXPLANATORY NOTES

1. Data obtained from Ref. 7.
2. Data derived using the following assumptions from Ref. 6.
 - a) A mean of 3.03 manhours/cord for small producers; 2.79 manhours/cord for medium producers; 2.14 manhours/cord for large producers.
 - b) A mean of 220 eight-hour days of operation/producer.
3. Reference 6 specifically states that its data is based on a survey of 281 producers and should be representative of all southern operators producing more than 500 cords annually. However, the report cautions application to broad situations. The use of productivity data from this source is, however, considered reasonable for the purposes of the current study estimates.
4. An error probably exists in the employee estimates because of the means used in Note 2. The number of days of operation by a producer may be as few as 100.
5. The production of pulpwood is the major product of the Eastern timber harvesting industry; however, sawlogs, poles, veneer logs, etc. are also produced. According to Ref. 6, 82% of the annual Southern production is pulpwood suggesting that an additional 7600 loggers are employed.
6. Productivity data were not obtained for this logging region therefore employee estimates were not made. It is also believed that this region produces a higher percentage of sawlogs etc. than does the Southern producer.

APA study conducted during 1968 (Ref. 6). On the assumption that the APA study is representative there is good reason to believe that there are over 42,000 loggers in the Southern States who harvest pulpwood. It is further estimated that about 7,600 additional loggers are employed in harvesting sawlogs, veneer logs, poles, etc.

This estimate of logging employment in Southern operations must be further increased to allow for those workers who are involved in timber yard operations. The APA study of reference 6 did not consider the man-power required to process logs delivered to these collection points. It would not be unreasonable to increase the labor force estimate by an additional 10% (or 5,000 men) to account for this function. The consequence is an estimated logging force of approximately 55,000 in the South.

Comparable information suitable for estimating size of the work population in other logging areas was not located. However, the following are presented for consideration:

1. Discussions with one logging and sawmill operator provided his estimate that there are 10,000 mills in the U.S. He further estimated that the typical mill required the productivity of 30 loggers.
2. A representative of the Alaska Logger's Association estimated that there are 1,500 loggers employed within Alaska.
3. A survey of West Coast sawmills and logging operations (Ref. 8), performed during October 1969, employing 20 workers, or more, reported a total of 21,524 logging personnel. This survey did not estimate the percentage of the total population represented by these larger operations.
4. It was reported by one company in Maine that their 200 loggers were responsible for producing only 15% of the timber they required for company mills. The company representative further estimated that about 1,800 loggers employed by small contractors were responsible for the remaining 80% of the timber required by this one operator.
5. Mill operators depend upon independent logging contractors to provide much of the timber they require. In Eastern operations it is reported that mills may have a greater dependency on contract loggers than appears true for Western mills.
6. The exportation of logs from Western ports implies that there are a large number of workers in logging activities who cannot be identified as a function of mill productivity.

LOGGING OCCUPATIONAL SPECIALTY DISTRIBUTION

Table 1-2 is the Department of Labor's list of logging occupational titles. Descriptions for most of the jobs performed are presented in the Glossary of Terms (appended to this report as Appendix E). It is to be recognized that many of these titles are either used very infrequently or have become historic in nature.

Table 1-2. LIST OF LOGGING OCCUPATIONAL TITLES USE BY
DEPARTMENT OF LABOR (abstracted from Ref. 9).

<p>94 OCCUPATIONS IN LOGGING This division includes occupations concerned with cutting trees in forest areas; installing overhead and ground-level log-moving equipment; evaluation and removal of logs from forest to storage or transportation areas; and related activities, involving operation of chain saws and log-moving machinery and equipment, and such devices as hooks, slings, and poles for manually securing or moving logs.</p>	<p>941.387 LOG GRADER (logging; sawmill) log marker</p> <p>941.487 SCALER, WOOD (paper & pulp) demurrage man measurer wood scaler</p> <p>941.488 LOG SCALER (logging; paper & pulp; sawmill) lumber scaler pulpwood scaler Deck Scaler (sawmill) Landing Scaler (logging) Pond Scaler (paper & pulp; sawmill)</p> <p>941.684 BOOM MAN (logging) catchman log sorter</p> <p>941.687 PICKER (excelsior) TIE INSPECTOR (sawmill)</p> <p>941.887 LOG BRANDER (logging) marker</p> <p>942. Log Sorting, Gathering, Storing, and Related Occupations This group includes occupations concerned with collecting, loading, moving, piling, stacking, and related activities, using donkey engines, tractors, rafts, sleds, cables, hooks, chains, and other devices.</p> <p>942.137 BOOM FOREMAN (logging; water trans.) boom man, head</p> <p>942.387 LOG MARKER (logging) scaler</p> <p>942.687 PULP PILER (logging) pulp roller</p> <p>942.782 DONKEY ENGINEER (logging) cable operator donkey puncher leverman Pullboat Engineer (logging) Skidder Leverman (logging) Yarder Engineer (logging) JAMMER OPERATOR (logging) hoister</p> <p>942.883 LOG-LOADER OPERATOR (logging) WINCH-TRUCK OPERATOR (logging)</p> <p>942.884 LOG DRIVER (logging) driver river driver riverman RAFTER (logging) raftsman BOTTOM MAKER (logging) RIGGER, SECOND (logging) groundman rigger, extra rigger helper</p> <p>RIGGING SLINGER (logging)</p> <p>942.887 BOLT LOADER (sawmill) cur loader CHASER (logging) block tender landing man Cat Chaser (logging) CHOKERMAN (logging) choke setter Tongue Hooker (logging) DECKMAN (logging)</p> <p>942.887 JAMMER (logging) Con. LOADER, HEAD (logging) loader, first LOG-HAUL OPERATOR (sawmill) LOG LOADER (logging)</p>	<p>PEELER (logging; sawmill; veneer & plywood) bark peeler log peeler rosser spudder PLUG SETTER (logging) SIDE-LINE MAN (logging) SLED TENDER (logging) chain tender frogger trailer zoogler</p> <p>949. Occupations in Logging, n.e.c. This group includes occupations, not elsewhere classified, concerned with logging.</p> <p>949.131 HOOK TENDER (logging) choker, head choker-hooker, head skidder hooker yard boss</p> <p>949.137 BUCK SWAMPER (logging) swamper foreman FOREMAN, LOGGING (logging) logging foreman River Boss (logging) Side Boss (logging)</p> <p>949.138 TIMBER BOSS (logging) walking boss</p> <p>949.228 INSTRUCTOR, LOGGING (logging) cut instructor logger instructor</p> <p>949.387 HORSE INSPECTOR (logging)</p> <p>949.781 HIGH CLIMBER (logging) climber high rigger rigger squirrel man topper</p> <p>949.868 WHISTLE PUNK (logging) flagman lookout signalman</p> <p>949.883 THIRD LOADER (logging)</p> <p>949.884 SECOND LOADER (logging) log stower sky hooker top loader</p> <p>949.886 STICKERMAN (sawmill) stickman</p> <p>949.887 BUSH MONKEY (logging) GATE TENDER (logging) HEWER (logging) timber hewer Skid Adzer (logging) Stall Hearer (logging) Tie Hearer (logging) Tie Maker (logging)</p> <p>RIGGER, THIRD (logging) rigger helper</p> <p>ROAD MAKER (logging) roadman</p> <p>SWAMPER (logging) beaver bush cutter gutterman path cutter right-of-way man road cutter run cutter trail cutter Slash Burner (logging) Slash Piler (logging)</p>
<p>940. Timber Cutting and Related Occupations This group includes occupations concerned with marking and felling timber, sawing and trimming logs, and related activities, using axes, crosscut saws, and pneumatic- or gasoline-powered saws.</p> <p>940.137 BUCKER, HEAD (logging) bull bucker saw boss timber foreman Chopper, Head (logging) WOOD BOSS (wood distil. & charc.) woods overseer</p> <p>940.384 TIMBER MARKER (forestry; logging) lay-tree marker marker tree marker</p> <p>940.687 BARK FITTER (logging) fitter preparer ringer</p> <p>940.884 BUCKER (logging) crosscutter log maker power-saw man CORDWOOD CUTTER (logging) pulpwood cutter wood chopper FALLER (logging) chopper cutter lumber faller timber cutter tree faller Faller, Second (logging) LIMBER (logging) brusher brutter knot bumper</p> <p>940.884 LOGGER, ALL-ROUND (logging) Con. all-round man stock cutter POLE AND PILING CUTTER (logging) RIVER (logging; sawmill) freeman picket maker pole sawyer timber splitter Shaker Splitter (logging; sawmill) Shingle-Bolt Cutter (logging; sawmill) Stave-Block Splitter (logging)</p> <p>940.887 CEDAR-POST CUTTER (agric.) PIECE MAKER (logging) piece cutter pulpwood cutter POST CUTTER (agric.)</p> <p>941. Log Inspecting, Grading, Scaling, and Related Occupations This group includes occupations concerned with ascertaining volume and condition of logs and assigning values, using rods, rulers, tapes, and other measuring devices.</p>	<p>949. Occupations in Logging, n.e.c. This group includes occupations, not elsewhere classified, concerned with logging.</p>	



A crew size and composition will depend upon a number of considerations with the degree of mechanization being the most important consideration; the need for specialists is related more to larger integrated operations than to smaller operations where workers are more likely to perform multiple tasks. In this respect, it is not to be inferred that all large companies work on a designated specialty basis or that all small companies work on a multiple task basis. Often the reverse is true.

The basic logging operation consists of the following task areas:

1. Felling and bucking
2. Skidding
3. Loading
4. Transportation

and many small operations perform all of these with three or less workers. One "gippo" operation observed in Washington worked with four men (one man felling and bucking; one man skidding and performing chaser-handyman activities in the landing area; one man loading; and one man driving the log truck.

The ratio of specialities will vary. In a survey of 14,940 workers in West coast logging (Ref. 8) the distribution shown in figure 1-2 for logging operations employing 20 or more workers. This distribution indicates that the fallers and buckers, truck drivers and chokermen specialties have the greatest exposure to injury since they contribute approximately 60% of the total population surveyed. Each of these three classes occurs two

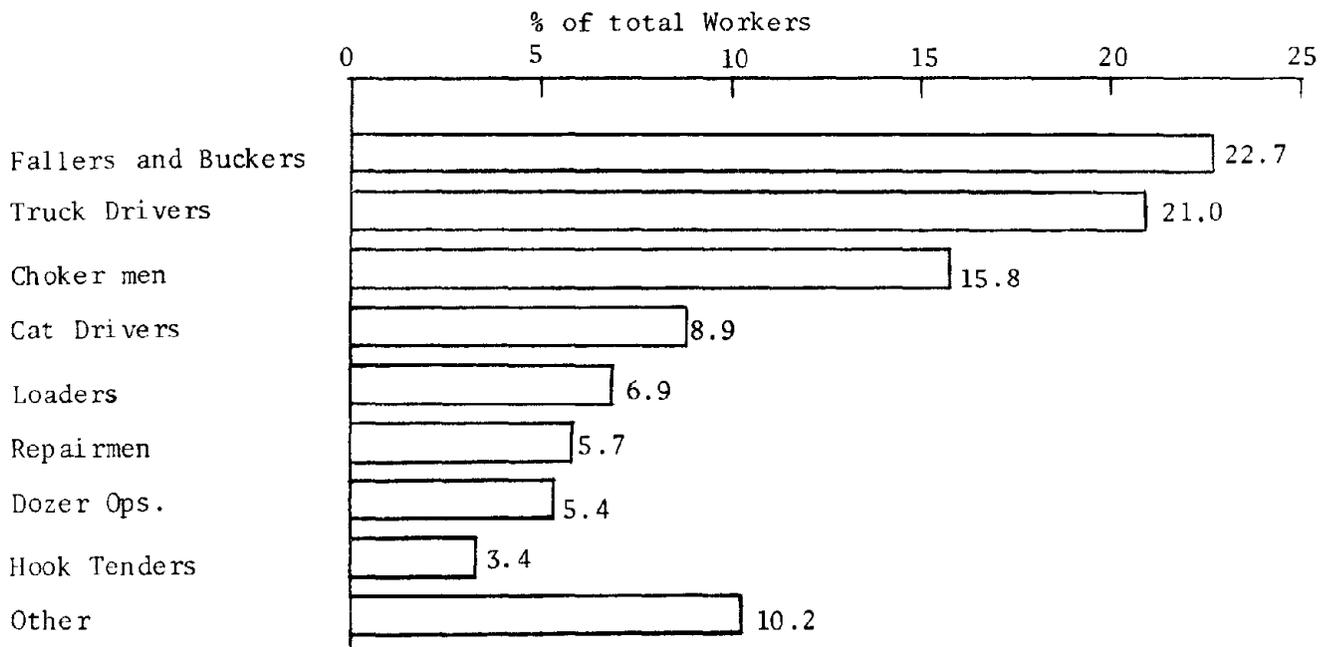


Figure 1-2. Logging Occupational Structure in the West Coast Region in October, 1969 (14,940 workers).

and three times more frequently than any of the other occupational specialties. In figure 1-2, the classification of "other" includes supervisory functions, chasers, donkey operators, riggers, etc. Reference to this figure will be made in discussions about the incidence of injuries and fatalities.

EXPERIENCE AND TRAINING OF LOGGING PERSONNEL

The primary source of logging experience is on-the-job training. In many instances it is a matter of father-son influence and family tradition; this appears to be very significant in small logging contractor operations.

With on-the-job training, logging company procedures are apparently more formalistic in the West than in the East. In the West, the entry level for a new logger is as a choker setter. Several choker setters work as a team under the direct supervision of a rigging man who typically has considerable experience. The new hire may continue to work as a choker setter for an unspecified time dictated by his development of proficiency and supervisory judgments as to his adaptability to other jobs. During his work as a choker setter he may be given occasional opportunities to perform other tasks and, when he demonstrates reliability, will be promoted.

In the most often observed situation, advancement is to landing operations where knot bumping, bucking, chasing and general landing maintenance tasks are performed. Again, depending upon demonstrated talents, the worker can be promoted to felling and bucking tasks in the forest or into vehicle operation tasks. For entry into the felling and bucking classifications the worker is typically assigned to work as an assistant to a more experienced worker first.

It appears that both large and medium-sized logging operations are concerned with ensuring this gradual development. The small contractor (or gippo) operations appear to be less influenced by the presumed need for longer training periods and many people working in the more technical jobs reported comparatively short durations of experience. Nevertheless, many of the gippo personnel have long durations of experience, often derived from prior experience with larger companies.

For at least the larger Western companies, continuing efforts to indoctrinate personnel with information on good work practices has been reported. One company visited in the Washington area indicated that they and seven other large companies supported development of a series of training films on several logging activities. These films have been used routinely at safety meetings. The films have been prepared in cassettes which are used with portable viewers and presentations made aboard crew buses during transportation to working sites. Several of these films have been reviewed and found to be of excellent quality.

In Eastern logging operations there were no indications given that there is an entry training level which is generally followed by the industry. Discussions and observations indicated that new hires (even those without prior experience) could be assigned to chain saw operations within a few days of employment. Skidder and loader operations were observed where the operator may have had as little as two weeks total logging experience.

Observations and discussions at larger Eastern operations indicated that a new employee would be put to work at the job for which he claimed experience. If the new worker appeared to be reasonably productive after about three days he would be retained; if not he would be discharged.

An interesting and potentially valuable contribution to worker safety, as well as to the development of a source of new employees, is the reported support of vocational-agricultural school logging programs. By inference, this industry support of schooling appeared to be more dominant a practice in the East than in the West because of the extent to which company representatives discussed this activity. Examples of how the industry has assisted in the educational process are identified in the following:

1. Subsidization of students through scholarships.
2. Providing practical experience for students as a part of the school program.
3. Provision of training aids to the schools, including equipment, visual aids, etc.
4. Encouragement of management level employees to participate in the actual training program at the school. In one example, a transportation coordinator for one Oregon company stated that he taught defensive driving at one school, on Saturday's. He also indicated that his company made logging trucks available for this purpose.
5. Preparation of instructional material for schools. Under the sponsorship of the American Pulpwood Association, at least one textbook has been prepared (Ref. 10) along with teacher's guides. Another example of industry's involvement is reference 11 which is a training manual for operation of a knuckle-boom loader.
6. One major chain saw manufacturer has recently produced a film on "Chain Saw Safety". It is expected that other equipment manufacturers may produce similar types of promotional materials, for their equipment, having educational value.

SOURCE OF LOGGING PERSONNEL

It is obvious that industry's support of educational programs is an effort to induce young people to accept logging as a vocation as well as a means for preparing them to perform more effectively and safely after employment starts. Industry reports that finding employees to work in logging has been difficult. A large turnover rate exists, especially among young employees who become discouraged by the hard physical work.

In discussions with Eastern logging management personnel it was nearly a universal statement that they needed more employees. For many operators, both large and small, it was implied that increased mechanization (in the form of feller-bunchers, delimiting machines, etc.) was related primarily to the maintenance and increase of productivity levels rather than as a means for replacing workers. According to the APA study of reference 6, "loggers are usually forced into mechanization because of a shortage of labor or a lack of stumpage that can be produced with a low degree of mechanization. They mechanize to stay in business - not to lower production costs".

In Maine, the primary source of labor for one large company (and apparently for other large operations) is from Canada. One of it's logging camps was lo-

cated at a distance of about 100 miles from the Canadian border and developed a work schedule which permitted personnel to return to their homes for the weekend. This schedule involved a ten-hour work day starting at noon on Monday and ending at noon on Friday for a total of 40 hours per week. These loggers are highly experienced but introduced the barrier of language differences (ie. French). Visits to independent contractors working on land controlled by the large company also indicated that French-Canadians are widely employed by the small operator as well.

The indications are strong that large wood products' companies in the East do not attempt to maintain large logging crews. Instead, they rely on the independent logging contractors to harvest most of the required product and maintain the company crews for ensuring some stability in the rate of log delivery to their mills.

It was stated by at least two large company representatives in the South that they would often assign the company crew to the more difficult logging operations using the independent contractors in areas where they could operate more efficiently. The result of this is to maximize the rate of log delivery.

In Western operations, logging personnel availability was not as major a point of discussion though it was cited as a problem. One Safety Director stated that his company's problem was associated with a high labor turn-over rate, especially in the job entry level of choker setting.

College students are a significant source of labor for summer work. It is reported that these students often return in subsequent years and in the opinion of one woods foreman "they are extremely productive and cooperative". This foreman expressed unhappiness about losing these students whom he felt could be exceptional employees. He further stated that these workers had fewer injuries than other workers and he believed that they had a greater capacity for recognizing and avoiding hazards.

Similar comments were made with regard to the employment of vocational-agricultural school graduates in Eastern operations. For those graduates who retained this vocation, it was stated that they are very good employees and are able to recognize and cope with the hazards more readily. While there is only this anecdotal evidence available, it is implicit that formal education in the logging vocation can contribute to worker effectiveness and self-preservation. On the other hand, it is also implicit that the attitudes of individuals who avail themselves of specialized and advanced education would make them more effective employees even without this education.

Women are employed within the logging occupational specialties. According to reference 12, they constitute about 5% of the total work force. However, it has been suggested in some quarters that women may be classified as "loggers" if they perform office-type work for companies which are in logging and that these women do not really work as loggers. Nevertheless, discussions with two women (one a log truck driver and one a former choker setter) verify that there are some women loggers.

LOGGING WORK SCHEDULES

The work schedules for logging personnel are quite variable in terms of hours per day, days per week and months per year. The following identify the typical company schedules:

1. A forty-hour work week usually over a period of five work days. Normally this schedule is based on eight-hour days. However, unique schedules such as the above cited schedule of three 10-hour days and two five-hour days are reported.
2. A forty-eight hour work week over a period of six work days. One company reported that their fellers worked a five-day 40-hour schedule while other employees worked a six-day 48-hour schedule.
3. A fifty-week work year is possible in the milder climate areas. However, nine to ten-month schedules are reported as routine in Northern climates where climatic conditions are a more serious influence on work schedule. This will be discussed later.
4. An eight-month work schedule was reported for one Alaska company. This is the same company that reported the nominal 48-hour work week.

Weather conditions have a definite influence on actual work schedules. Rain, snow and wind often cause unplanned work stoppages. In Southern operations, rain will stop work because of the resulting ground conditions which prevent hauling of wood to the mills. In Northern operations, ground freeze is important to hauling and mild winter climates may result in serious constraints on logging.

Some of the influences on actual work schedules are discussed in the following paragraphs.

Nominally, a work-day starts when the employee arrives at the work site and ends when he departs. In many instances, the worker is transported by a company vehicle (crew bus) from a crew collection point. This collection point may be at a logging camp or other company-owned facility and may involve distances of 60 miles, or more. Although the transit time is not considered part of the work day, pay schedules are usually premiumized as a method for compensating employee's travel time. For example, the premium pay may be \$0.25 to \$0.35 per hour for actual hours worked.

In some operations, the logger may be incentivized when he uses his own equipment. As a consequence, each feller or buckner may own as many as five chain saws or even a wheeled skidder. Maintenance of this equipment is not considered on-the-job time and is usually performed in the evening, by the owner, after the evening meal. (An important observation must be made with respect to this form of operation. Company representatives have stated that worker-owned equipment is better maintained and cared for than they believe is accomplished for company-owned equipment which is maintained and repaired by maintenance personnel who are not the prime users. The logger who provides his own equipment is completely dependent upon it for his livelihood which is the reason for a feller owning as many as five saws.)

PERSONNEL PROTECTION PRACTICES

In this examination of the logging occupation, it became clear that management personnel are generally cognizant of the hazards present and the unsafe acts performed. Within some operations, personnel concerned with safety not only recognized the relationship of hazards and unsafe acts to the incidence

of injuries but maintained what are considered to be viable safety programs.

In the best examples observed, these safety programs included the following characteristics:

1. Efforts to eliminate unsafe conditions and/or operational procedures.
2. Introduction of new tools and equipment intended to reduce the incidence of injury.
3. Development of informational and training programs to make employees aware of both unsafe conditions and unsafe acts.
4. Provisions of personal protective equipment and aids to good health.
5. Provisions within company standard operating procedures making the use of protective equipment a condition of employment and holding all levels of management accountable for effective safety programs within each operation.
6. Maintenance of records of both accidents and injuries as a means for determining not only the continuing existence of personnel safety problems but for tracking the effectiveness of changes made within the operation, as well.
7. Support of research and new equipment development related to increasing the level of safety.
8. Promotion of safety programs within subcontractor organizations.

Obviously, there are variations in degree with which these approaches to system safety are followed. As would be expected, logging operations associated with the largest companies are better equipped to support effective programs. However, there are smaller operations which are equally effective and could be used as models for small operating companies.

LOGGING COMPANY CHARACTERISTICS

Logging companies range in size over an extensive range. For the purposes of this report, the company size is discussed as large versus small. Further, although a company may sustain only a small logging crew (depending upon independents for most of their timber) they may be classified as a large company because of their mill operations. It is believed that total company employment may well affect the magnitude of company activities devoted to logging personnel safety.

For the most part, large companies are able to maintain professional safety personnel. However, a number of small operators evidenced great concern for personnel safety and actively supported safety programs. Many of the smaller operators, as well as large operators, depend upon associations for much of their safety materials. Some of the largest companies have produced safety manuals and other materials.

In contrast, there are small entrepreneurs who appear to be quite oblivious to the dangers in logging operations. One man, who worked with his two sons, indicated that logging was no more dangerous than any other occupation. He made this statement while one son was in the hospital, still unconscious, due to being hit by a falling tree. The other son had massive scars from a previous chain saw injury.

SAFETY STANDARD AVAILABILITY

In addition to the set of regulations (Ref. 13) promulgated in response to the Occupational Safety and Health Act there are a number of state codes dealing with logging safety. These have been reviewed and are summarized and discussed by Appendix B. The following is intended to provide general background on these documents as interpreted from anecdotal information obtained from a number of sources.

National Concensus Standard

Only one standard has been identified as being a national consensus standard: Safety Requirements for Pulpwood Logging, ANSI 03.1-1971. This standard, sponsored by the American Pulpwood Association, is concerned with pulpwood logging in the states of North Dakota, Nebraska, Kansas, Oklahoma, Texas and all states lying east of these states.

In general, this standard has been used in developing the OSHA regulations as presented in reference 13. This regulation specifies its application to "operations associated with the preparation of pulpwood timber from the stump to the point of delivery" without designating geographic limitations. The OSHA regulation stipulates the exclusion of "logging operations relating to saw logs, veneer bolts, poles, piling and other forest products" which are not specifically excluded by the ANSI standard.

Thus, there are no OSHA regulations dealing with a large segment of the logging industry and there are logging operations which combine the harvesting of trees intended for pulpwood, as well as other products.

State Standards

Requests were made to each of the states with the result that state codes dealing with logging safety were acquired from fourteen states (see Appendix B). Forty-two states responded to this inquiry; of the remaining ten states, there is no indication of whether or not they promulgate a logging code (or that logging is considered an industry within these states).

Table 1-3 summarizes the results of this survey for the 42 states which responded. A number of interesting comments received are as follows:

1. Maine submitted their code for sanitation of logging camps; this state uses the OSHA pulpwood standard but indicates that they have deleted the restriction to pulpwood.
2. Arizona has its own logging code but reports plans to adopt the OSHA standard. Minnesota reported, both, that they plan to adopt the OSHA standard and they had no logging operations in the state.

Table 1-3. SUMMARY OF STATE RESPONSES TO REQUESTS FOR LOGGING STANDARDS AND INJURY DATA

STATE	LOGGING CODE AVAILABLE	PROMULGATES OSHA STANDARD	PLAN TO ADOPT OSHA STANDARD	REMARKS
ALABAMA			X	
ALASKA	X			
ARIZONA			X	
ARKANSAS	X			No injury data is compiled for logging.
CALIFORNIA	X			
COLORADO				No injury data compiled for logging.
CONNECTICUT				
DELAWARE				State uses ANSI code; reports only few logging operations.
FLORIDA			X	Code covers only safety rules & provisions; penalty.
GEORGIA				No response
HAWAII	X			No injury data available; no large scale logging operations.
IDAHO	X			
ILLINOIS				No response
INDIANA				No response
IOWA		X		
KANSAS				No injury data compiled for logging; state uses ANSI code.
KENTUCKY	X			
LOUISIANA				No injury data compiled for logging

Table 1-3. SUMMARY OF STATE RESPONSES TO REQUESTS FOR LOGGING STANDARDS AND INJURY DATA (continued)

STATE	LOGGING CODE AVAILABLE	PROMULGATES OSHA STANDARD	PLAN TO ADOPT OSHA STANDARD	REMARKS
MAINE		X		State has deleted OSHA restriction to pulpwood; state promulgates code for sanitation of Labor camps.
MARYLAND				No injury data compiled for logging.
MASSACHUSETTS				No response.
MICHIGAN	X			
MINNESOTA			X	State reports no logging operations.
MISSISSIPPI			X	
MISSOURI		X		No injury data completed for logging.
MONTANA	X			Injury data available.
NEBRASKA				No code dealing with logging.
NEVADA	X			State logging operations at a stand still.
NEW HAMPSHIRE				Code covers only woods labor camps.
NEW JERSEY				Logging operations considered minor.
NEW MEXICO		X		
NEW YORK				No logging code.
NORTH CAROLINA				No logging code.
NORTH DAKOTA				No logging injuries in last two years. Very few operations.
OHIO				No response.

Table 1-3. SUMMARY OF STATE RESPONSES TO REQUESTS FOR LOGGING STANDARDS AND INJURY DATA (concluded)

STATE	LOGGING CODE AVAILABLE	PROMULGATES OSHA STANDARD	PLAN TO ADOPT OSHA STANDARD	REMARKS
OKLAHOMA	X			
OREGON	X			
PENN.	X			
RHODE ISLAND				State reports no logging operations.
SOUTH CAROLINA		X		
SOUTH DAKOTA				No injury data compiled for logging.
TENNESSEE		X		State Statistical Div. inoperative since 1966; has just been reactivated.
TEXAS		X		
UTAH	X			
VERMONT				No response.
VIRGINIA				State logging code process of adoption.
WASHINGTON	X			
WEST VIRGINIA			X	
WISCONSIN				No response.
WYOMING				No response.

3. In reviewing the state codes it appears that many have adopted other state codes for their own use.

International Standards

Efforts were not concerted in attempting to locate and review standards and codes of foreign origin. However, a code prepared by the International Labor Office, Geneva, was acquired and included in the review.

Modification of Existing Codes

For several of the codes reviewed it was determined that they are considered obsolete and efforts to upgrade them are in progress. The Washington code which was reviewed was a draft copy of the new state code. Alaska plans to prepare a new code; the current code for this state was received too late for inclusion in Appendix B but, in general, it is very similar to the Oregon code.

The ANSI standard is presently undergoing a revision. In Appendix B, both the current ANSI standard and the second ballot draft of the planned revision were reviewed. It is of interest to note that the title of the revision has been changed to "Safety Requirements for Logging" and restrictions as to geographic location and to "pulpwood Logging" have been eliminated.

INDUSTRY USE OF PROTECTIVE CLOTHING AND EQUIPMENT

By observation of the large number of tasks performed by logging personnel, the tools and equipment used, and the environmental conditions which prevail, it is obvious that both protective clothing and protective equipment are required. This is generally recognized by the industry, but there is widespread reluctance to use what is available; the workers themselves report difficulties in the use of many items and, at management levels, there is considerable constraint in making the use of protective clothing and equipment a "condition of employment". Nevertheless, the utilization of protective helmets and gloves is generally widespread with protective footwear following as the third most frequently used item.

In the area of protection of personnel operating vehicles, the utilization of roll-over protection and fall-on protection is rather widespread; a few operations were observed where this type of protection was unavailable.

Impact of Standards

In reviewing the various standards for logging operations it is apparent that only helmets, gloves and safety shoes or boots are made mandatory by the language in these documents of "shall be worn". With respect to other requirements the statements are equivocal; "shall be provided" and "shall be worn when a hazard exists" statements have not induced the intended acceptance responses.

While there is considerable anecdotal evidence that logging companies rely upon the exact wording of the code, a number of logging companies, small organizations as well as large organizations, are more direct in their practices relating to the use of protective clothing and equipment. This direct approach ranges from making the use of protective equipment (eg. ear protection, protective knee patches, etc.) a condition of employment to the active promotion of the use of this equipment by employees through continuous safety personnel contacts and periodic safety meetings.

Protection Helmets

In most field observations all personnel were observed wearing helmets complying with ANSI Standard Z-89 (Ref. 18), or equivalent. Eastern operations generally exhibited the use of molded plastic helmets (or fiberglass) while Western operations combined the usage of plastic with aluminum-type helmets.

Among those personnel and companies using protective headgear there is no questioning of the real need for wearing these at all times and discipline appears excellent. However, there appears to be a large segment of the logging population which has rejected the need. Examples of this rejection are as follows:

1. In one small operation only the employer was observed to wear a protective helmet. He was asked why his employees were not similarly equipped. His response was that "they don't like them".
2. In another small operation, the entrepreneur was given helmets by a concerned logging company owner. The helmets were not used.

Helmet Problems

The basic problem cited by loggers was the tendency for loss of the helmet due to body movement and due to winds. Many loggers use helmets having nape strap suspensions for this reason. They reject the use of chin straps because "a blast of wind could take your head off".

Although none of the loggers questioned cited thermal problems with helmets it is suspected that sweat formation at the head band interface may be one of the reasons for rejection.

One Safety Director, in commenting on his company's use of aluminum shells, pointed out that other shells had little or no crush resistance in the lateral axis. He cited several instances of having retrieved helmets from employees which had sustained lateral crushing loads. The ANSI Z-89 standard does not call for this type of protection; it is recommended that a study of the need for crush resistance be performed.

Impacts to the head are to be expected with high frequency in this environment. Although the helmets used provide good protection against coronally directed blows the coverage afforded by the typical helmet provides little impact protection to the rest of the head.

While there are neither data available to indicate the extent to which helmets are not worn nor injury data to indicate the relative frequency of head injuries to personnel who do not wear helmets there is ample evidence, of an implied nature, to suggest that this form of protection should be mandatory.

Foot Protection

Boots are usually worn by most loggers. In Western operations, a widespread practice is to use caulked boots. In Eastern operations this is not followed. However, the incidence of injuries due to slips and falls suggests the need for improved foot wear in both areas.

One anecdotal story indicated a problem with caulks; problems apparently arise due to the separation of bark from logs when loggers walk over them with the probability that a fall will occur.

In Eastern operations the use of ballistic nylon pads and protective-toed boots are being emphasized. The ballistic nylon has been demonstrated as providing protection against saw injuries. In Western operations both concepts are rejected because of the need for greater boot flexibility in the typical Western terrain.

Eye Protection

None of the field observations indicated the overt use of eye protection. While a number of loggers were observed to wear eyeglasses it is not known whether these glasses were safety glasses, or not. The only obvious use of eye protection was observed during welding tasks where the typical welder's face shield was used.

In terms of relative frequency of body part injuries the eye is reported infrequently. Average costs per eye injury are also reported to be comparatively low.

In questioning loggers about the use of goggles or visors the major rejection cited was fogging. This will occur in hot, humid regions as well as cold regions. Because loggers work in rain and snow, water droplets would be a frequent annoyance, as well as a potential hazard.

Incorporation of eye protection as a general standard for logging operations would not be recommended unless improvements could be effected in contemporary protective devices. It is expected that any visual impedance, and particularly in the peripheral field of vision (side vision), would introduce greater logger vulnerability to accidents and injuries due to other causes.

Only where discrete eye hazards can be identified with selected logging tasks where the potential for eye injury is high would use of eye protection be recommended with the current protection state-of-the-art. Unfortunately, the injury data acquired during this program were insufficiently definitive of causal relationships to permit this type of identification.

Ear Protection

Noise generated by equipment operation was subjectively adjudged to be a hazard. In many instances attempts to communicate verbally were quite difficult. In view of such hazards as breaking branches and falling bark slabs, etc., it is suspected that the logger may not hear the first sounds to permit him to take timely evasive action. This relationship to injuries is not evident in the injury data; however, a strong recommendation is made to investigate this relationship.

In terms of ear protection against damage it is evident that many equipment items exceed the limits of current standards. While actual noise levels were not measured during the field observations, reference information, such as references 16 and 17 from the USDA Forest Service, indicate the need for additional muffling or silencing devices on logging equipment.

Two types of ear protection were observed in use. The most frequent device was an ear plug; least frequently used was an ear muff. The extent to which this kind of ear protection is used is not known. In one company's operation it was suggested, frequently, that loggers use ear plugs and the company provided these free of charge to any employee making a request. In actual observation, while accompanying one safety man on his rounds, he carried a large supply of ear plugs and was frequently asked for a set. It is of note that this same safety man carried eyewash, as well, and was asked for it quite often.

Ballistic Nylon Pads

The use of ballistic nylon pads for protection against saw cuts to the legs and thighs was notable in Northeastern operations; particularly among employees of APA member organizations. These pads are used in the form of chaps which can be donned when required, or installed within the pant legs. Several loggers were "pleased" to show cuts in clothing and boots which they claimed would have resulted in injuries if the pads located under the clothing had not been present.

In view of the very high frequency of saw injuries reported in Eastern operations, this type of protection appears highly desirable and should be further investigated. The major problems with this concept were cited as interference of leg mobility and the tendency for icing in cold weather due to sweat accumulation. It is suspected that with the proper use of these types of pads that a reduction of leg injuries due to slips and falls, etc., can also be realized.

No observations of ballistic nylon pad use were made in Western operations. It is reported that mobility problems when wearing these pads, preclude their use. However, one Safety Director indicated his company did use them during precommercial thinning operations where a higher incidence of saw injuries was noted. It is to be further noted that injury data for Western operations did not implicate the saw as frequently as in Eastern operations.

Hand Protection

Widespread use of gloves by logging personnel was in evidence. The types of gloves used varied considerably and according to one logging camp foreman, he made a large number of types available to the loggers, on demand.

A practice cited by one company was the use of cotton-type gloves by personnel handling cables. It was stated that jagers could penetrate leather gloves before the logger was aware of their presence. With cotton gloves the logger would be aware of their presence and could take evasive action to avoid injury.

Clothing

With the exception of one company it was reported that the clothing worn by logging personnel was according to their own preference. The one exception, a Western company, requested that their employees wear loose clothing and suspenders rather than a belt. Their concern was with the binding of tight clothing possibly slowing escape movements; a belt would be more likely to permit shirt tails to loosen and flop, thus creating a hazard. If caught on a snag, suspenders would stretch and the logger could free himself more readily than with a belt snag.

The most often cited clothing problem was thermal. In most instances, as work progresses, a thermal overload occurs and the tendency is for loggers to continually remove clothing. This is true for the winter months, as well as for the summer months. During December, loggers were observed working bare-chested in mild, humid conditions in Georgia. Sweat accumulation is a major problem and results in icing during cold weather.

An observation made at one mountain logging site was of several choker setters who appeared inadequately clothed. At the time, it was raining with a relatively high wind velocity. Although the head rigger was clothed in typical

rain gear none of his crew were so equipped. When questioned about this the crew members shrugged this off as not being a problem.

Company Policies

While some protective equipment is provided by many companies it was generally determined that loggers pay for their own. It is a somewhat widespread practice for companies to order and sell many items, such as boots and helmets, at their cost.

Although some companies make the use of protective equipment and particular types of clothing a condition of employment many companies avoided this. One company representative claimed that if he stipulated clothing requirements then the workers would expect the company to provide clothing free of charge. Other companies indicated that they provide items they require at cost.

MISCELLANEOUS CONSIDERATIONS

A number of conditions within the logging industry which may influence employee safety are discussed in the following. No attempts were made to study these aspects in any great detail since data are not available for determining, explicitly, the impact of these considerations.

USE OF SUBCONTRACTOR PERSONNEL

As previously stated, many of the larger logging companies and mills rely upon subcontractors to perform logging tasks. Injuries to subcontractor personnel are not accountable to the prime contractor. Thus, it is possible for some companies to employ subcontractors to perform the most hazardous jobs. It was the opinion of one person interviewed that this practice may well prevail in tree felling operations; however, this interviewee did not present any evidence.

The ramification of this practice is that injury data obtained from discrete companies must be considered from the standpoint of this form of trade-off. Thus, any injury relationships which are presented to distinguish among company operations must consider this trade-off as a possibility.

WAGE POLICIES

Both hourly pay rates and incentive wage policies are practiced within the industry. It has been suggested that piece work practices may result in employees using unsafe practices in order to increase income. However, no evidence of this relationship was obtained.

WORKMENS COMPENSATION

While state laws generally provide for employees to be covered under workmen's compensation, anecdotal information indicates that many employees of the small independents are not insured. Extremely high premium rates approximating \$15.00 per \$100.00 of salary (1972 rates) in the States of Maine and Pennsylvania, appear to be a deterrent to this form of coverage especially where state laws do not enforce coverage. Table 1-4 has been reproduced from APA Technical Release 72-R-9 (Ref. 22) to demonstrate the premium rate trend in many other states. It is to be noted that in Kentucky the logging rate exceeds 26%.

Table 1-4. COMPARISON OF WORKMEN'S COMPENSATION PREMIUM RATE TRENDS
(Ref. 22).

STATE	YEAR						
	1965	1966	1967	1968	1969	1970	1971
ALABAMA	6.32	6.33	7.86	7.98	7.65	7.38	7.38
ALABAMA (2705)	4.05	3.69	4.08	4.82	6.20	7.70	7.70
	6.70	6.68	7.07	8.41	8.41	10.84	13.44
ALASKA	16.79	16.16	18.67	12.75	20.92	21.71	21.71
ARKANSAS	11.12	12.30	12.38	16.28	16.28	18.96	14.03
ARIZONA				10.31	10.31	10.31	13.58
CALIFORNIA	12.85	13.78	13.26	13.57	14.14	13.95	13.95
COLORADO	25.07	21.59	23.53	23.58	25.16	23.81	18.80
CONNECTICUT	8.53	8.26	9.56	10.16	9.88	10.48	10.96
DELAWARE (009)	11.15	10.85	10.00	9.15	8.70	11.70	14.20
DIST. OF COLUMBIA	12.09	11.11	10.96	11.78	11.70	11.70	11.91
FLORIDA	18.05	18.05	15.08	15.98	17.18	12.71	13.66
FLORIDA (2705)	10.58	10.58	12.37	13.06	12.32	12.49	13.49
GEORGIA	9.78	8.21	8.50	9.70	10.53	8.76	6.83
GEORGIA (2705)	7.52	6.75	6.75	7.54	7.62	6.98	7.68
HAWAII	13.76	14.23	14.83	12.38	13.75	14.90	13.24
IDAHO	10.43	10.31	10.64	10.87	11.87	10.82	10.82
ILLINOIS	22.39	22.39	17.03	16.62	18.39	19.26	21.82
INDIANA	8.42	9.15	9.78	8.27	9.27	9.74	9.29
IOWA	7.34	8.33	8.74	9.40	9.40	9.96	12.25
KANSAS	11.74	11.24	11.72	11.85	11.36	11.49	11.20
KENTUCKY	21.64	23.39	19.25	25.81	25.81	32.34	31.69
KENTUCKY (2705)						23.35	26.17
LOUISIANA	14.91	14.91	15.05	15.66	17.61	20.75	21.17
LOUISIANA (2705)	18.19	18.19	13.46	13.87	14.54	18.73	21.56
MAINE	8.33	9.86	8.86	9.37	9.37	10.83	10.70
MARYLAND	10.62	10.67	11.31	12.04	12.90	15.04	17.67
MASSACHUSETTS	15.94	16.88	16.74	15.74	15.45	15.19	15.19
MICHIGAN	19.17	23.43	27.24	20.16	16.53	17.35	17.35
MINNESOTA	12.89	16.01	21.89	18.46	14.77	16.81	17.08
MISSISSIPPI	11.74	11.20	12.36	10.99	12.88	13.45	13.45
MISSISSIPPI (2705)	21.46	19.34	19.67	17.80	19.04	23.79	23.79

Table 1-4. COMPARISON OF WORKMEN'S COMPENSATION PREMIUM RATE TRENDS
(Ref. 22). (concluded)

STATE	YEAR						
	1965	1966	1967	1968	1969	1970	1971
MISSOURI	14.59	15.64	19.25	23.46	23.46	25.21	26.51
MONTANA	12.57	13.90	14.74	16.73	17.20	17.37	23.97
NEBRASKA	5.95	6.37	7.23	6.98	7.08	7.83	9.21
NEW HAMPSHIRE	10.38	10.23	13.96	13.64	10.50	10.50	12.12
NEW JERSEY	10.50	10.95	14.19	15.11	12.33	10.50	10.76
NEW MEXICO	18.16	15.87	16.59	15.12	16.60	10.61	17.60
NEW YORK	20.70	21.90	19.50	22.70	20.30	16.73	19.50
NORTH CAROLINA (2706)	10.63	10.92	11.48	11.45	12.31	21.10	10.50
NORTH CAROLINA (2705)	8.16	8.16	9.78	10.79	11.53	10.72	10.72
OKLAHOMA	20.91	20.26	18.78	18.62	16.31	14.85	17.07
OKLAHOMA					16.31	14.85	17.07
OREGON (EASTERN) (2698)	9.45	10.44	12.14	14.53	15.27	13.90	18.56
OREGON (WESTERN) (2699)	15.00	14.98	15.57	15.80	15.27	13.90	17.87
PENNSYLVANIA (009)	6.55	6.75	8.00	10.25	9.35	7.70	7.85
RHODE ISLAND	20.73	19.15	17.62	17.62	24.70	24.70	22.43
SOUTH CAROLINA	12.01	12.01	13.70	17.19	16.73	17.19	17.27
SOUTH CAROLINA (2705)	11.19	11.18	12.17	13.26	13.42	12.65	9.23
SOUTH DAKOTA	5.95	6.56	6.68	6.40	6.57	7.63	7.97
TENNESSEE	15.49	15.02	17.49	16.43	15.84	13.61	14.37
TENNESSEE (2705)	13.17	13.25	14.49	13.82	14.62	14.10	14.89
TEXAS	18.63	14.81	15.72	17.47	20.90	13.05	13.05
TEXAS (2705)	16.07	18.01	14.21	14.21	17.06	18.59	18.59
UTAH	13.22	13.78	13.78	13.49	10.25	10.05	8.19
VERMONT	7.42	7.47	7.15	7.80	7.80	7.55	8.34
VIRGINIA	7.72	7.04	6.53	7.30	8.34	9.63	10.28
VIRGINIA	4.88	4.89	4.43	4.25	4.80	5.16	5.29
WISCONSIN	11.54	11.37	11.39	9.80	7.79	6.43	7.86
AVERAGE	12.69	12.76	13.12	13.30	13.66	14.05	14.59

Apparently there are three forms in which companies can provide for workmen's compensation:

1. Insurance through independent insurance companies.
2. Insurance through state organizations.
3. Self insurance.

Many states permit all three methods and the method used is at the employer's discretion. For the larger companies, the obvious method selected would be the least expensive. On the other hand, it appears that employer avoidance of this expense is wide-spread; especially for the very small employers.

One company, operating in Pennsylvania, used an approach, not employed by any other company observed, to "force" independents to obtain employee coverage. This company operated a sawmill and employed only one five-man logging crew. Independents supporting this company had to demonstrate that their employees were covered by workmen's compensation before they would be permitted to log company wood. These subcontractors were also forced to supply and/or ensure that employees used head protection and if independents were observed performing unsafe acts they could be stopped (ie. a condition of independent employment).

Two larger companies in Georgia were questioned about their ability to influence the operation of independents in terms of insurance, worker safety, etc. Both companies were extremely negative on this approach because of the legal impact involving employer-employee relationships. It was stated that if they attempted to influence the independents, in law they could be considered as an employer and, therefore, ignored independent subcontractor omission of good safety practices. In this respect, the two companies felt that workmen's compensation and even unemployment insurance and FICA were not withheld by many independents.

The larger companies did indicate, however, that they helped the independents with some of their book-keeping if the independent asked for help (for example, some independents requested that payment for wood delivered be made with separate checks payable to each member of the logging crew).

Section II

WORKER FATALITIES

Disabling work injury (DWI) data includes those injuries which result in fatalities. However, frequency rates which have been reported seldom provide any visibility as to how many of these injuries are fatalities; severity rates, on the other hand, may be somewhat indicative of the number of fatalities if the percentage of fatalities to non fatalities is relatively high.

Based on very limited information it can be concluded that the fatality frequency rate for logging is higher than the fatality frequency rate for all industries combined. As shown in table 2-1, the frequency with which fatalities occur within logging is five times greater than the all industry average. In the two selected states of Maine and Washington, this ratio is nine and fifteen times, respectively. Also indicated by table 2-1 are the following relationships:

1. Approximately 2.5% of all logging DWI are classified as fatalities as compared with 0.1% for all industries on a national basis (ie. the likelihood of a DWI being a fatality is 25 times greater with the logging industry).
2. In comparing Washington and Maine statistics (assuming these states are representative of Western and Eastern logging, respectively) it could be concluded that in Western logging it is more likely that a DWI will be a fatality than in Eastern logging (ie. about six times more likely). It is to be noted that the DWI frequency rate for Maine is higher than for Washington.

Records obtained from one large company having extensive logging operations in the Western part of the country are shown in table 2-2. While this company shows a consistently lower fatality rate than the national index for logging (Table 2-1) it is still higher than the "all industries" fatality rate. Over the 11-year period of record keeping, this company demonstrates that 4.5% of its disabling work injuries result in fatalities. For the most recent 4-year period (1968-1971) this rate is 6.5%. As a ratio of fatality frequency to DWI frequency this company demonstrates an average of 0.055 over the years reported (ie. 5.5% of the DWI frequency rate is the fatality frequency rate). The conclusion is that although this company has consistently demonstrated a much lower DWI frequency rate and a much lower fatality frequency rate than is shown for the national index on logging, its expectancy that an injury will result in a fatality is about double the national rate. The inference is that, although this company has an excellent record in reducing both fatal and non fatal injuries, it has had far greater success in reducing the non fatal rate. In other words, reduction of non fatal injuries is apparently more readily accomplished than the reduction of fatal injuries.

FATALITY CAUSE AND EFFECT RELATIONSHIPS

Information detailing logging fatalities was not readily available to this study. Three sources of injury description summaries were located including:

1. California fatalities for the years 1968 and 1971.
2. Washington fatalities for the years 1968, 1970, 1971, 1972.

Table 2-2. TYPICAL LARGE COMPANY - LOGGING INJURIES & FATALITIES(Western)

YEAR	TOTALS INJURIES	DWI FREQUENCY	DWI SEVERITY	TOTAL FATALS	FATALITY FREQUENCY	FATALITIES/DWI
1961		28.38	4335	3		
1962	227	30.01	2751	2	(.264)	.009
1963	180	25.73	3891	4	(.57)	.022
1964	176	21.01	7483	8	(.955)	.045
1965	108	12.35	4085	5	(.57)	.046
1966	87	9.54	5227	7	(.768)	.081
1967	95	9.93	6317	9	(.94)	.095
1968	105	9.02	4407	8	(.687)	.076
1969	82	6.68	1845	3	(.244)	.037
1970	73	5.68	4000	6	(.467)	.082
1971	96	6.27	2842	6	(.392)	.063
1972	64	6.27	1974	3	(.294)	.047

Table 2-1. LOGGING FATALITY FREQUENCY RATES

	1969			1970		
	DEPT OF LABOR	WASHINGTON	MAINE	DEPT OF LABOR	WASHINGTON	MAINE
LOGGING FATALITY FREQUENCY	NA	1.69	0.50	1.0	1.53	0.36
ALL INDUSTRY FATALITY FREQUENCY	NA	0.12	0.07	0.2	0.1	0.04
LOGGING DWI FREQUENCY	34.6	73.3	72.9	42.4	65.5	81.5
ALL INDUSTRY DWI FREQUENCY	14.8	17.5	21.6	15.2	20.9	21.7
RATIO OF LOGGING: ALL INDUSTRY FATALITY FREQUENCY	NA	14.08	7.14	5.0	15.3	9.0
RATIO OF LOGGING FATALITIES: DWI	NA	.023	.007	.024	.023	.004
RATIO OF LOGGING: ALL INDUSTRY DWI	2.34	4.19	3.38	2.79	3.13	3.76
RATIO OF ALL INDUSTRIES FATALITIES DWI	NA	.007	.003	.001	.005	.002

3. A selection of fatalities descriptions reported by the American Pulpwood Association (Ref. 14). This latter source was not a complete compilation and except for revealing a number of cause and effect relationships could not be used for any statistical analysis. These descriptions are given in Appendix D along with non fatal injury descriptions for the Eastern logging area.

Although the California and Washington fatality descriptions cover somewhat different time periods they were combined and analysed as a single population. The results of this analysis are considered to be a good index of fatality trends in Western logging.

Appendix C is a summary of all of the fatality reports obtained from California and Washington. It is to be recognized that this table is a summary of summary reports and it is possible that some inaccuracies have resulted at each step of summarization. The notations of "probable deficiency" are inferences not necessarily made in the State summaries.

Table 2-3 further summarizes the total of 184 fatality reports from the two states. It is to be noted that many of the fatalities have been used more than once in showing relationships. Only the total fatalities, as a function of occupation, for each cause are correct; the totaling of vertical columns is not intended.

In referring to table 2-3 the following conclusions are possible:

1. Fallers, choker setters and truck drivers are the occupations which demonstrate the greatest number of fatalities, in that order, respectively.
2. The location of the fatality is most likely to occur at the site of the victim's primary job. There is no clear evidence of a trend to indicate that workers are likely to be killed when entering less familiar areas. However, this could be a positive relationship.
3. The most frequent cause of fatalities to fellers is related to the felling of a tree into standing trees. The fatality summaries (Table 2-3 and Appendix C) indicate a number of secondary influences (such as, the breakage of tree parts which can fly large distances; temporarily lodging in another tree and then falling at a later time; tree kickback due to striking another tree; being struck by a tree knocked down by a felled tree; etc.).
4. Kickback of trees and snags and being struck by flying timbers share the second spot as the most frequent causes of fatalities to fellers. There is an apparent relationship among these causes and with the felling of trees into standing trees. For example, snags will often shatter spontaneously, resulting in flying timber; be knocked down by a falling tree; cause a tree to kickback when it strikes the snag; widowmakers falling from trees as they are being cut and especially slabs and broken tops dropping from snags.

Table 2-3. SUMMARY OF FATALITY CAUSAL RELATIONSHIPS FOR WASHINGTON (1968, 1970-1972) CALIFORNIA (1968, 1971).

FATALITY CAUSE	OCCUPATION OF VICTIM																		
	TOTAL	FALLER	BUCKER	RIGGER (MISC.)	CHOKER SETTER	LOG LOADER	SKIDDER	CHASER	TRUCK DRIVER	SCALER	LABORER	POWDERMAN	TAG & TALLY MAN	GRADER	EQUIP. OPERATOR	HAULING ENGR.	OBSERVER	OTHER	
<u>FELLING/BUCKING OPERATIONS</u>																			
STRUCK BY FELLED TREE (self)	2	2																	
STRUCK BY FELLED TREE (other)	10	3	3	1	1	1	1		1	1						1			
STRUCK BY TREE KNOCKED	6	6																	
STRUCK BY SNAG	9	7		1	1	1													
STRUCK BY FLYING TIMBER (& widowmaker)	14	11	1	1	1														
STRUCK BY UPROOTED TREE	3	1	1	1	1														
STRUCK BY LODGED TREE	5	4	1																
STRUCK BY KICK BACK	13	13																	
STRUCK BY TREE LEFT STANDING PARTIALLY CUT	4	4																	
STRUCK BY SLAB	2	2																	
TREES FALLING UPHILL/BCKWRD	12	11	1																
<u>SKIDDING/YARDING OPERATIONS</u>																			
STRUCK BY ROLLING LOG/TREE	17	3	6	3	3	3								1					1
HIT/LOG HIT BY OTHER THING	3	1			1												1		
HIT/LOG DROPED DURING LOADING	14	1	1	1		3			2	7									
STRUCK BY LOG BEING YARDED	10			2	7														1
STRUCK BY TRACTOR SKIDDED LOG	1	1																	1
STRUCK BY RIGGING INCL. CHOKER	4				3														1

Table 2-3. SUMMARY OF FATALITY CAUSAL RELATIONSHIPS FOR WASHINGTON (1968, 1970-1972) CALIFORNIA (1968, 1971) (cont.)

FATALITY CAUSE	TOTAL	OCCUPATION OF VICTIM																
		FALLER	BUCKER	RIGGER (MISC.)	CHOKER SETTER	LOG LOADER	SKIDDER	CHASER	TRUCK DRIVER	SCALER	LABORER	POWDERMAN	TAG & TALLY MAN	GRADER	EQUIP. OPERATOR	HAULING ENGR.	OBSERVER	OTHER
STRUCK BY LOG MOVEMENT DURING CHOKER SETTING	4			2	2													
STRUCK BY SPRINGBACK OF TREES RELEASED FROM TENSION	1			1														
STRUCK BY CHUNK OR TIMBER DROPPED FROM RIGGING	2			2														
STRUCK BY TREE FELLED BY WINCHING CABLE	1			1														
STRUCK BY SWINGING LOG	1						1											
<u>TRANSPORT OPERATIONS</u>	15								13									2
<u>AGENCIES</u>																		
SLIPS & FALLS OVER CLIFF ETC. & FROM CABLE	3	1			2													
HEART ATTACK	3	1			1													
DROWNING	1		1															
FALLS FROM LOGS	1		1															
STRUCK BY LOG HIT BY VEHIC.	1	1																
CHAIN SAW	5	3	1															
HIT BY TREE FELLED BY VEHIC.	1				1													
STRUCK BY VEHICLE	26			10	6	1	2	7										
ELECTROCUTION	1					1												
LOSS OF VEHICLE CONTROL	20			3	4	9		2	1									1

Table 2-3. SUMMARY OF FATALITY CAUSAL RELATIONSHIPS FOR WASHINGTON (1968, 1970-1972) CALIFORNIA (1968, 1971) (conc).

FATALITY CAUSE	TOTAL	OCCUPATION OF VICTIM																
		FALLER	BUCKER	RIGGER (MISC.)	CHOKER SETTER	LOG LOADER	SKIDDER	CHASER	TRUCK DRIVER	SCALER	LABORER	POWDERMAN	TAG & TALLY MAN	GRADER	EQUIP. OPERATOR	HAULING ENGR.	OBSERVER	OTHER
POWDER BLAST	1										1							
SNAG (DIRECT OR INDIRECT)	13	11			1	1												
<u>LOCATION</u>																		
FELLING/BUCKING AREA	72	55	13	1	1				1							1	1	1
YARDING SKIDDING AREA	50	1		8	35	5										1		
LANDING AREA	40	3	1	1		13	1	8	11	1			1					2
TOTAL	184	60	13	8	37	15	6	8	25	1	1	1	1	2	1	1	1	2

5. Trees which are felled uphill, or fall uphill inadvertently, are the fifth ranked cause of fatalities to fellers.
6. The chain saw, as a cause of fatalities, is infrequent.
7. In skidding and yarding operations, the most frequent cause of fatalities is due to being struck by a rolling log or tree. Most often this results from loggers working down hill from logs which are not propped or are inadequately propped. Usually it can be identified as a log starting to roll spontaneously, but may be due to a log set in motion by being struck.
8. Being struck by a log which is skidded or yarded, or by rigging, combine as the second most frequent cause of fatalities in the yarding and skidding operations.
9. In landing operations, the log loader operator and the truck driver are the most frequently killed personnel. The majority of these fatalities are the result of logs dropping from the log loader and/or from the truck. Most other fatalities at the landing could be related to inadequate distances separating personnel and operations and inadequate vehicle control procedures.
10. Fatalities resulting from vehicle operations occur with a high frequency. Personnel struck by a vehicle (eg. trucks, skidders) rank second only to the category of fatalities caused by "falling into standing trees". Many of these are due to "loss of vehicle control". It is also to be noted that choker setters are the most frequent occupation in terms of fatalities due to "struck by vehicle".

The above data can be used to identify a number of direct controls on logging operations which will have significant results in reducing fatalities. Some of the more obvious controls are as follows:

1. Preventing truck drivers from standing near their truck during loading and unloading operations could result in a 50% decrease in truck driver fatalities.
2. Instituting vehicle traffic control patterns and guarding against personnel entering the traffic control patterns could result in a 14% decrease in all fatalities.
3. Prohibition of loggers from working down hill of logs or felled trees which are not adequately propped could eliminate about 9% of all fatalities.
4. Ensuring adequate separation between loggers and operations could eliminate 14% of the fatalities during felling operations and a large percentage of the fatalities occurring at landings (roughly estimated at 50% of landing fatalities).

Other inferences are possible; however, the above appear to be the ones most readily solved by the least complex procedural changes.

FATALITY DISTRIBUTION

While the above information identifies the frequency of fatalities for Western logging it does not consider personnel exposure rate. Using the occupational specialty distribution shown in figure 1-2 and the fatality data of table 2-3, a comparison of the probabilities of fatalities among logging occupations was developed as shown by figure 2-1. In this figure, the fatality

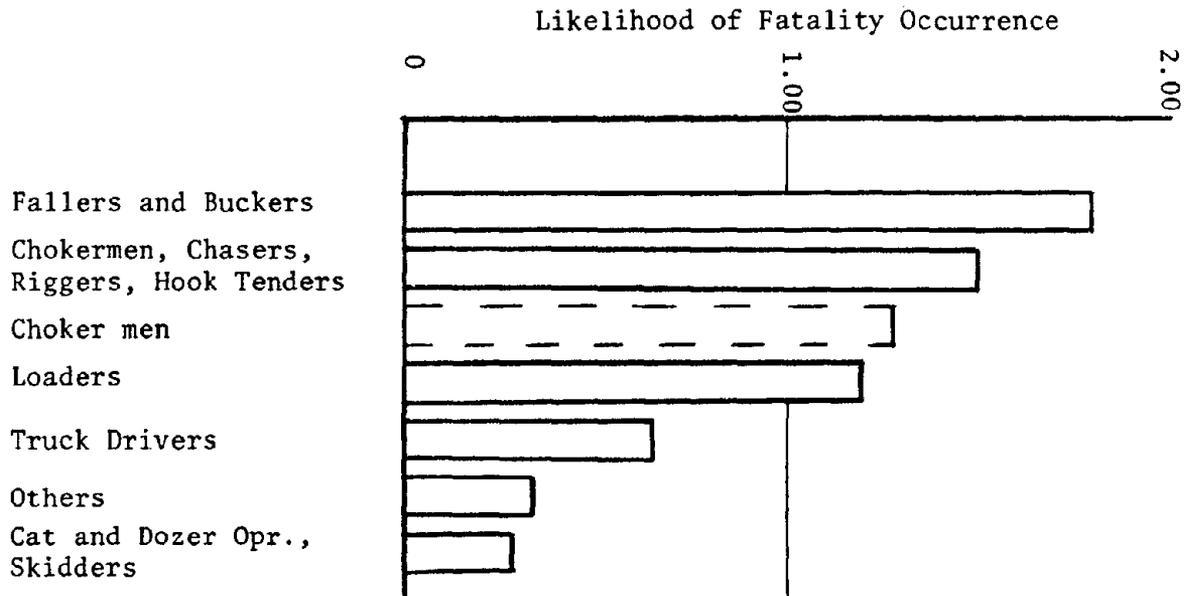


Figure 2-1. Comparison of Logging Occupation Specialties for Probability of Fatality Occurrence.

occurrences have been normalized as a function of number of workers within an occupation. Thus, the index value of 1.0 means there is an equal probability of a fatality occurring regardless of occupation. As shown, truck drivers who have the second greatest number of fatalities are within the range of occupations which have less fatalities, based on rate of exposure to hazards, than would be expected.

GEOGRAPHIC DISTRIBUTION

Except for the fatality rate data presented for Maine in table 2-1, and the injury data summaries for pulpwood logging in Appendix D, there was no information acquired on Eastern fatalities. The inference from the Maine data is that fatalities are less frequent for Eastern types of logging even though the rate is considerably higher than the national "all industries" index.

In reviewing the highly selected pulpwood injury data of Appendix D, it is apparent that many of the same fatality relationships exist in the East as in the West. It is likely that the smaller trees and relatively flat terrain in the East may modify the distribution of fatality causes as well as the total number of fatalities. Nevertheless, being struck by trees felled into standing trees (and by lodged trees which suddenly move) appear to be the same major contributor to the fatality rate that it is in the West.

Since the data of Appendix D are highly selective(not randomly gathered) it is not possible to make any quantitative analysis of cause and effect relationships. However, observations in a number of Eastern logging operations indicated that falling into standing trees and working around lodged trees was more prevalent than observed in the West.

WEEKLY DISTRIBUTION FOR FATALITIES

Over a period of four years, a trend is indicated for the highest frequency of fatalities occurring on Thursdays as shown by figure 2-2 (for Washington). There was no information obtained to help explain this; however, some speculations are possible.

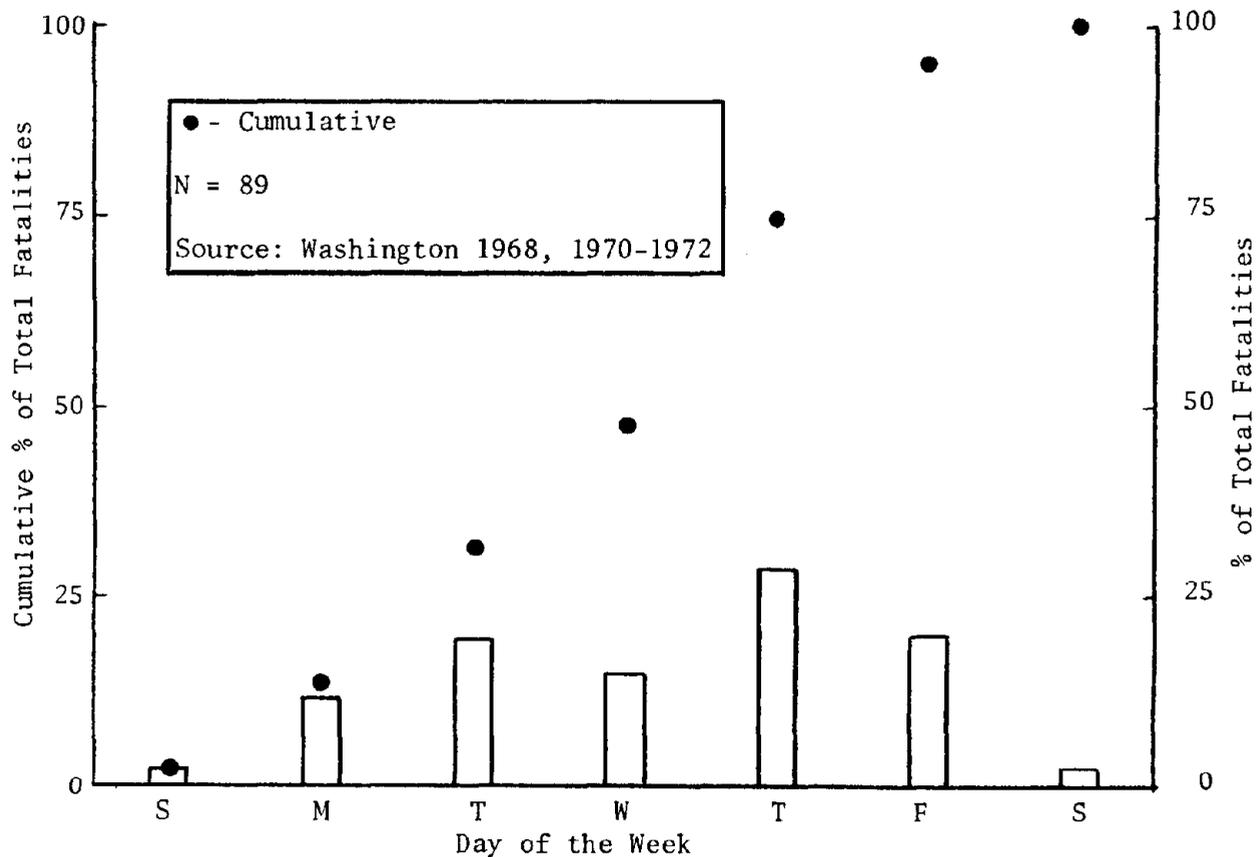


Figure 2-2. Weekly Distribution of Logging Fatalities

The days on which the smallest number of fatalities occur are Saturdays and Sundays. This is expected since most operations follow the typical five-day work week. On the other hand, the comparatively lower rates for Mondays and Fridays were not initially expected; however, it may be consistent with work trends in other industries (ie. higher rates of absenteeism on these days).

Expectancy of a higher fatality occurrence on Monday was predicated on anecdotal statements made by several logging supervisors who suggested that many loggers reported for work on Mondays in a "hung up" condition. Further

suggesting that this condition constituted an incapacitation which could lead to accidents.

While this may prove to be the case, the comparatively low frequency rate for Monday suggests on the other hand, that exposure rate for this day may be lower. As in the case of other industries, employee absenteeism is expected to be highest for Monday (and high for Friday, as well), thus, reducing the population size exposed to the hazards. Statements made by some logging supervisors tend to support this latter hypothesis of absenteeism for both Monday and Friday.

An obvious recommendation would be to normalize the fatality data in accordance with total productivity rates for each day. However, this type of information was not obtained during the program. A number of hypotheses are possible and should be considered in developing good work practices recommendations as follows:

1. By normalizing the fatality/daily crew size rates it may be possible to show that fatalities are more frequent as the week progresses; by inference the rate increase may be related to increasing worker fatigue.
2. By normalizing the fatality/average daily crew member production rate it may be possible to show that fatalities increase as a function of increased productivity.

Another hypothesis which should be checked relates to fatalities which occur on the week-end. It is suspected that most work accomplished on these days is performed by people who have already worked a normal work week. It is highly probable that the small number of fatalities is related to an equally small work population and that the frequency rate based on number of hours worked may well be higher than for other days of the week.

AGE DISTRIBUTION FOR FATALITIES

The trend indicated by figure 2-3 is that a higher fatality frequency rate occurs for younger workers. While this might be expected (ie. greater experience would tend to contribute to increased safety), it is doubtful that this interpretation is totally valid. In reality, the chart could just as well be interpreted to indicate an age distribution for the logger population (assuming that fatalities are equally distributed over age). Since data were not obtained for population age distribution, a normalized frequency-age distribution was not possible and the only valid interpretation is that more young workers are killed than older workers. An experience index is presented in the discussion of injuries in Section III.

ANNUAL DISTRIBUTION FOR FATALITIES

Figure 2-4 indicates that fatalities are more frequent (in the State of Washington) during the month of July than for other months. It will be shown later that the disabling work injury rate is higher during this period as well. It has been suggested that as logging activities are increased with improved weather conditions, there is an increase in the new hire rate

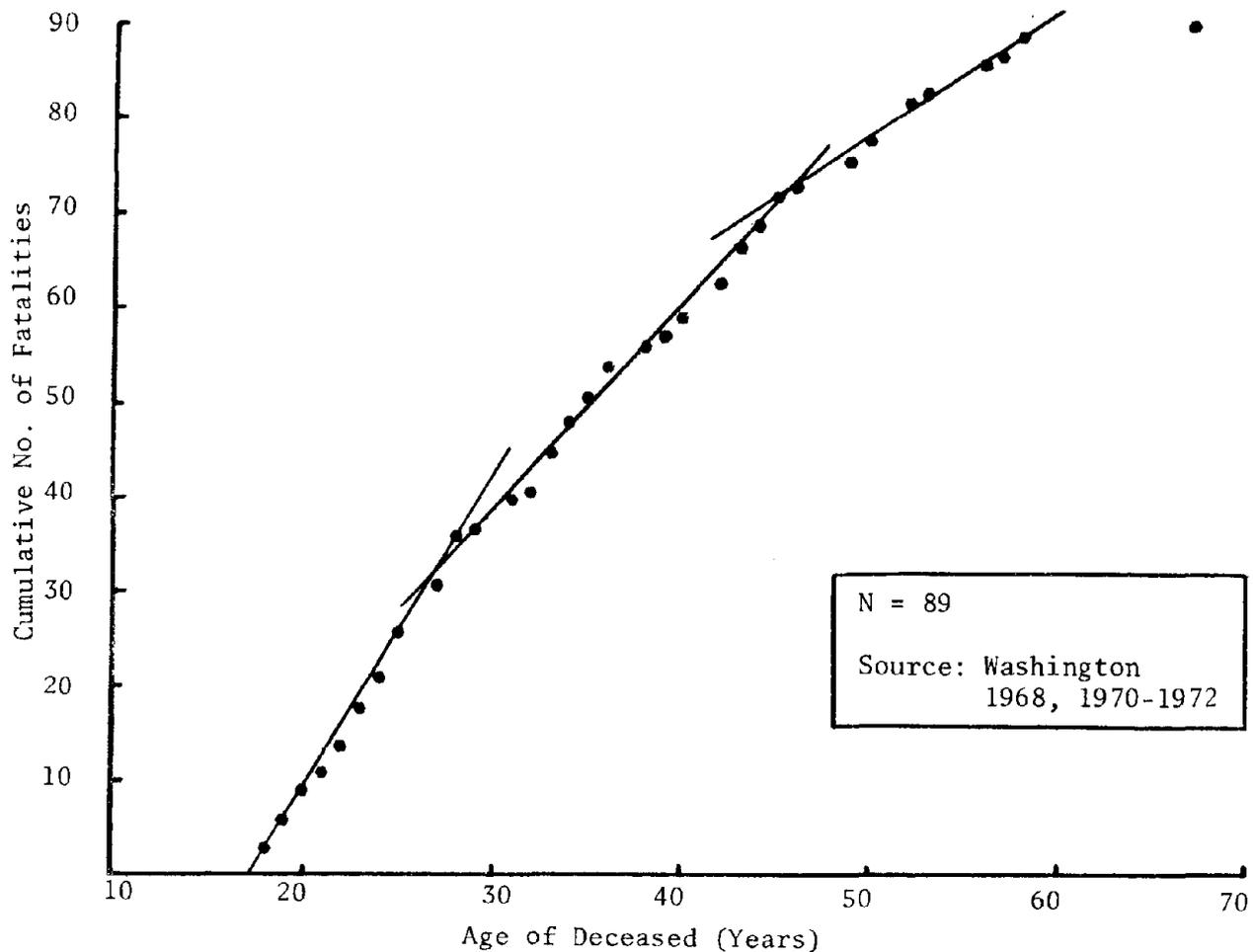


Figure 2-3. Age Distribution of Logging Fatalities.

and that people with low levels of work experience may be the largest contributors to this rate increase.

Figure 2-5 shows that fallers and buckers have the largest number of fatalities during July thus evidencing the same trend as the total logging population. However, also shown by figure 2-5 is a second peak in fatalities for the month of September.

Choker setters (Figure 2-6) evidence a peak fatality occurrence during the month of August which suggests that the above suggested relationship of new hires (summer workers) may be unsubstantiated. It is to be recalled that in Western logging operations that the entry level for inexperienced personnel is at the choker setter position.

HOURLY DISTRIBUTION FOR FATALITIES

Fatality data from Washington provided an indication of time of day for each fatality. There is a suggestion (Fig. 2-7 and 2-8) that fatalities are more frequent during the morning hours for the total spectrum of occupations. The apparent decrease in fatality rate as the day progresses may well be the

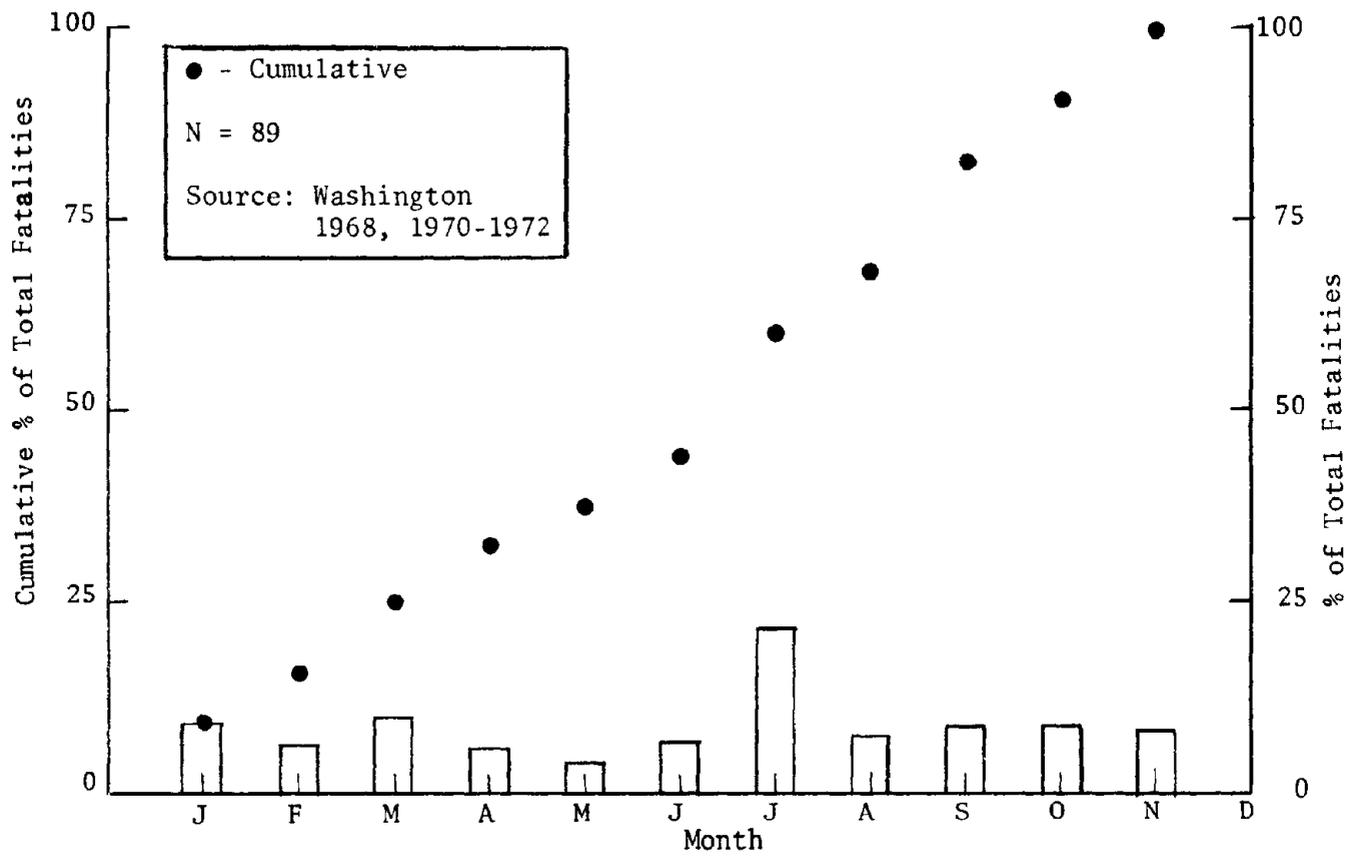


Figure 2-4. Annual Distribution of Logging Fatalities.

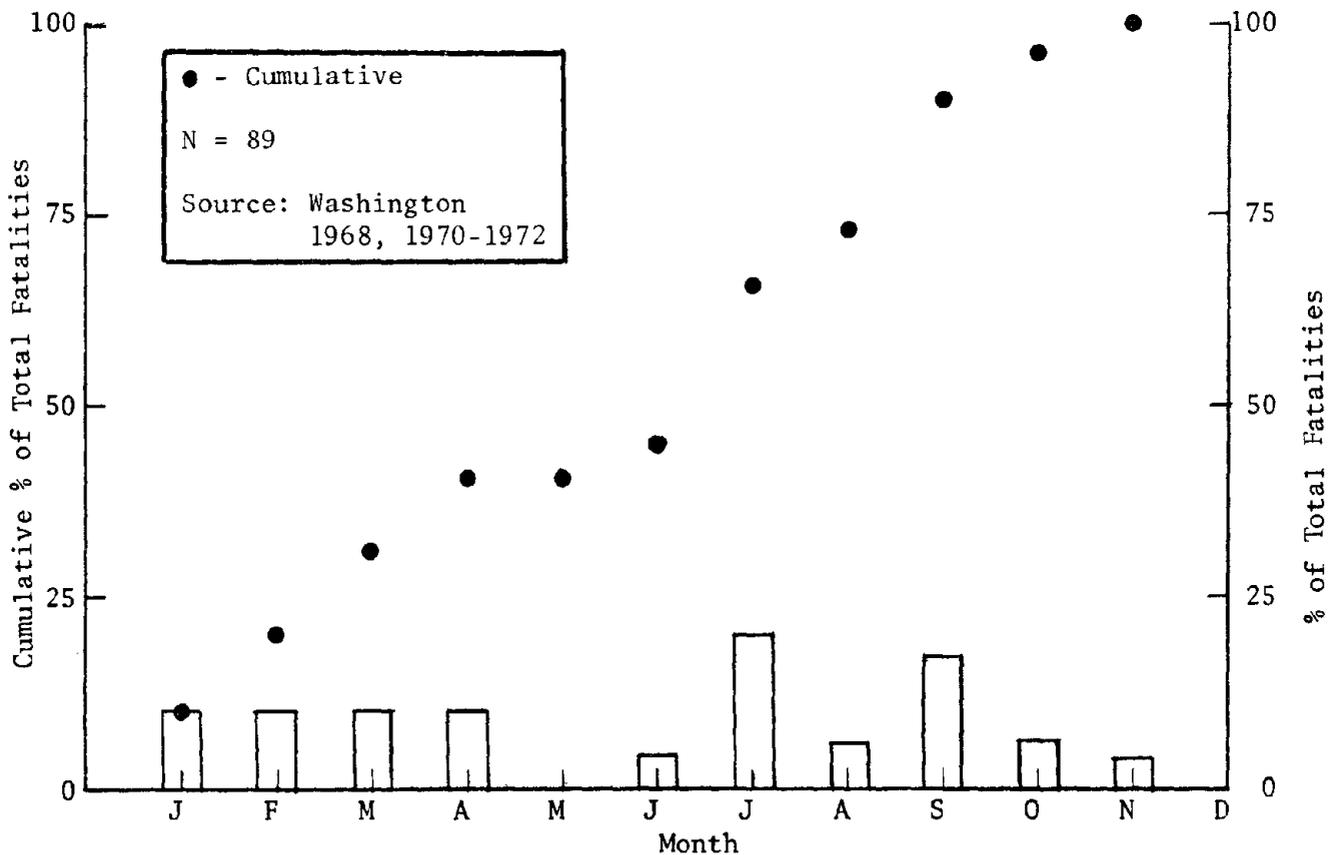


Figure 2-5. Annual Distribution of Fatalities to Fellers and Buckers.

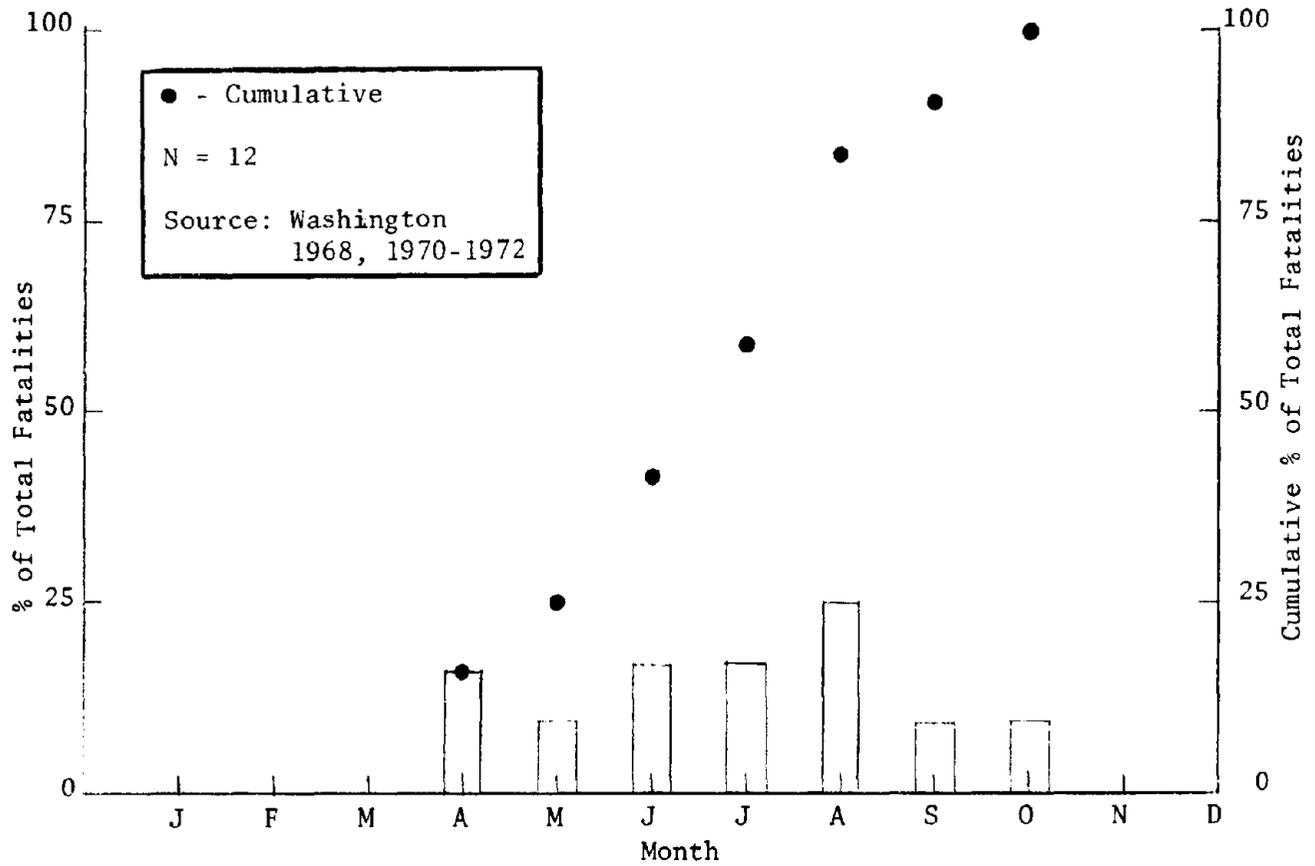


Figure 2-6. Annual Distribution of Fatalities to Choker Setters.

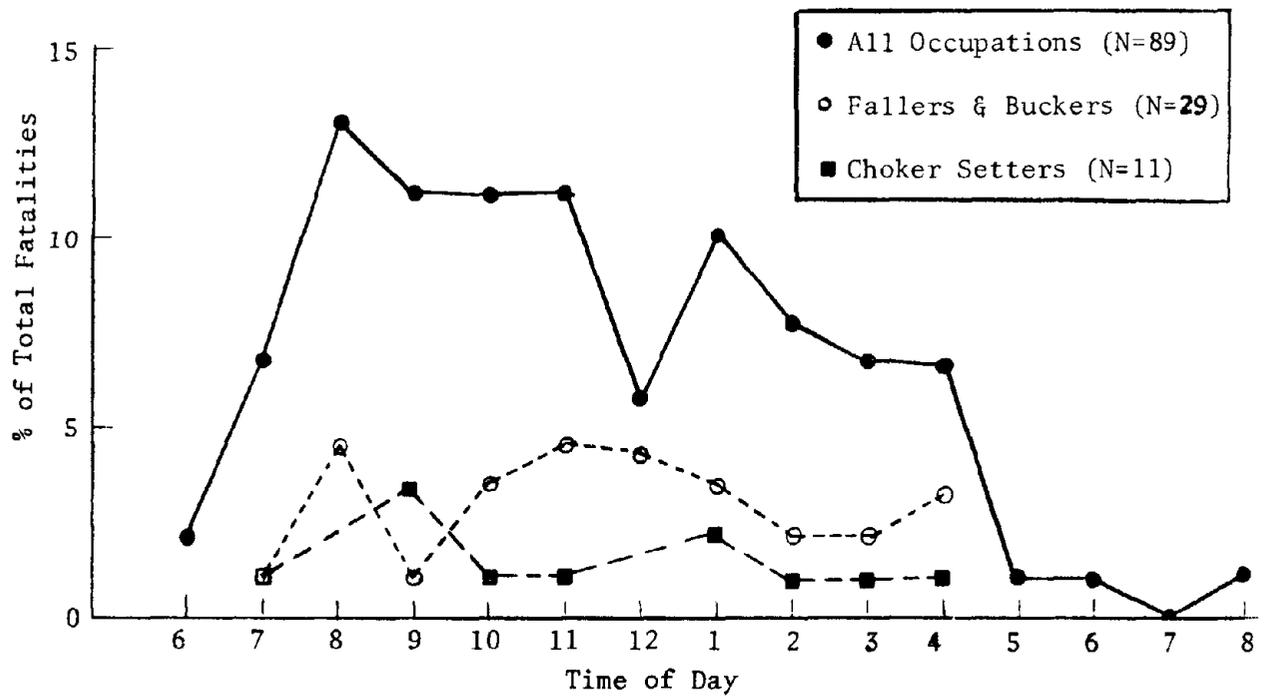


Figure 2-7. Occurrence of Fatalities by Time of Day (Washington 1968, 1970-72).

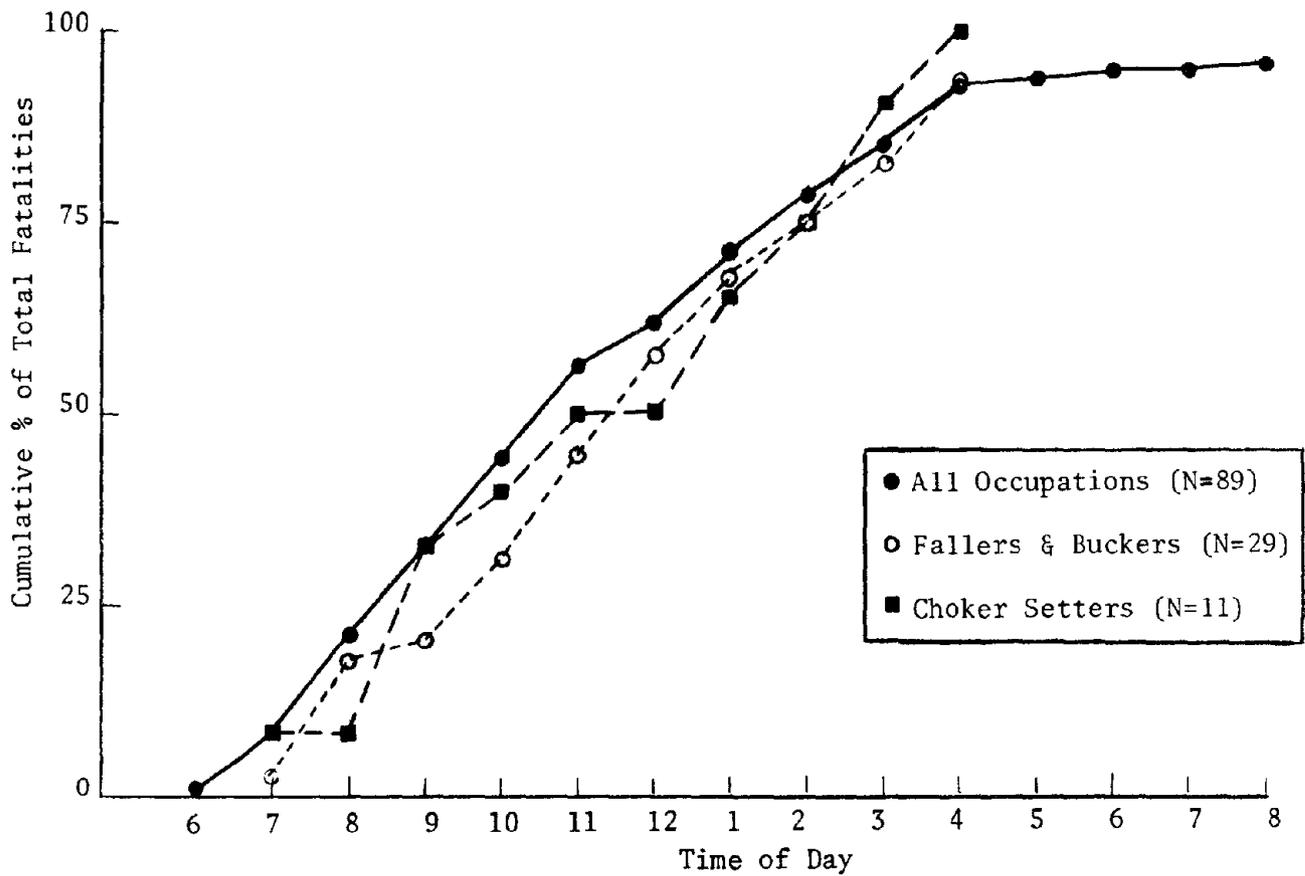


Figure 2-8. Cumulative Rate of Fatality Occurrence by Time of Day (Washington 1968, 1970-72).

result of reduced production rates; this is certainly the interpretation of the drop during the noon hour.

ADDITIONAL FATALITY DATA

A summary of logging fatality data obtained from Oregon (1966-1971) is organized in table 2-4. Since the data were acquired late they were not included in the above analysis of fatality causal relationships for Washington. Additionally, since accident descriptions were not available it was not possible to derive further relationships. However, these data appear to follow a pattern similar to the Washington data.

Section III

DISABLING WORK INJURIES

In referring to previously published information the most definitive study of disabling work injury occurrence to logging personnel is a special study conducted by the Department of Labor (DOL) during 1955 (Ref. 1 and 2). Prior to that, the DOL also published some limited information on logging injuries during 1940 (Ref. 19).

No attempts were made to completely digest the data contained in the latter reports. However, data are reported, herein, as indicated by the following:

1. The major conclusions drawn by the DOL for the 1955 study are summarized by table 3-1.
2. Appendix D contains a number of the relationships developed from the 1955 data and is presented for reference purposes.
3. Comparisons are shown, in this section, of data reported for 1940, 1955 and more recent periods obtained during the current effort.

SOURCES OF INJURY DATA

All fifty-two states were contacted and requests made for data on logging industry injuries. Some of the relationships for which data requests were made included the following:

1. The number of loggers working or the number of man-hours worked during the period covered by any injury statistics.
2. Injury frequency and injury severity as a function of:
 - a) job being performed
 - b) tools being used
 - c) hazardous condition prevailing
 - d) weather conditions
 - e) cause of injury
 - f) type of injury
3. Frequency and severity of each type of injury as a function of:
 - a) tool or other equipment being used
 - b) task being performed at time of injury
 - c) hazardous condition which prevailed

In addition to these requests made to various state agencies, similar requests were made to those companies which supported the field observations

Table 3-1. COMPILATION OF RESULTS REPORTED BY THE DEPARTMENT OF LABOR FOR THE 1955 LOGGING STUDY (Ref. 1 and 2)

COMPARISON	RESULTS REPORTED
GEOGRAPHIC	<p>Disabling work injuries are most frequent in Western area and least frequent in the South Frequency rates were 88.5/Western; 72.7/Northern; 70.2/Southern. Average number of days lost per DWI was 198/Western; 86/Northern; 154/Southern.</p>
ESTABLISHMENT SIZE	<p>Injury frequency rate is the highest in establishments having 20 to 49 employees and 100 to 249 employees, and lowest in establishments having less than 10 em- ployees, 10 to 19 employees, 250 to 499 employees, and 500 or more employees. However 49% of establishments surveyed had an injury free year. (Most of the injuries were distributed as follows: 69.0/ 10 employees; 76.1/10-19 employees; 97.6/20-49 employees; 66.1/50-99 employees; 93.0/100-249 employees; 77.7/250-499 employees; 74.4/ 500 employees.)</p>
INJURY TYPES	<p>Cut, laceration or puncture/29%; bruises, contusions/28.8%; strains & sprains/20.49% fractures/15.3%; eye irritations, amputations & enucleations, occupational diseases, hernias & others/ 2%.</p>
BODY PARTS	<p>Leg, toe & foot/40%; trunk & back/25%; head/13%; arm, hand & finger/19%; body, general/ 8.7%.</p>
OCCUPATION	<p>DWI frequencies were greater than 130 for choker setters, riggers, loaders & fallers (approximately 150% of industry average); cookhouse crews, office personnel, super- visors & foremen & timber cruisers had the lowest rate (30); riggers had the highest severity rate.</p>
OPERATIONS	<p>Operations with animals & cable hauling system had much higher injury rates than did tractor skidding operations. Operations with stationary loaders had higher injury & severity rates than with mobile units (stationary/248 days; mobile/144 days).</p>
PRODUCT	<p>Saw log frequency rate = 82.5; pulpwood frequency rate = 76.2; North & West pulpwood had higher rates; severity for sawlogs was almost 3 times pulpwood rate. Pulpwood fallers & buckers frequency was about 15% less than sawlogs; skidders were approximately equal.</p>

and to a number of industrial associations, insurance companies, hospitals and the Forestry Service.

RESULTS OF INJURY DATA SURVEY

A large quantity of data was obtained from the many sources contacted during the study. However, the quality of this information, in terms of fulfilling the program's total objective, fell considerably short of expectancy. While the data are apparently available it is equally apparent that retrieval of this data in a useful form will require even greater cooperation from the sources than the courtesies which were extended. A brief discussion of the problems faced in collecting injury data is particularly appropriate at this time.

Data Availability

The most available data were reports published by many states to summarize their annual records of injury rates for all industries. In many of the cases, logging could not be separated from the overall compilation performed for "lumber and wood products" (SIC 24). It was most frequently reported by states that they had not computerized their injury report data banks and were unable to retrieve anything beyond what is contained in the state summary reports.

Of those states which indicated they had a computerized data retrieval system, only Montana and Texas showed willingness to produce readouts for our use. Several states have indicated that they are developing computer data banks but were unable to produce logging information during the current period of time. Some states stated that they could retrieve the data but were unable to "take the time necessary" to provide computer read-outs.

California and New York indicated that they were in the process of developing special reports on logging for their own purposes. Both states have promised to send copies of these reports; but, as of now, neither have submitted the promised reports.

Hospital contacts proved to be completely negative. All of the contacted hospitals, located in heavy logging areas, stated they had no way of retrieving data on logging personnel, who had been patients, from their complete files. They also indicated that even a manual search would not isolate the logging population.

Insurance companies stated that they could not retrieve the requested information. According to one of the largest insurers within the logging industry they "do not maintain records which would indicate the number of employees working for our insureds nor do we keep records relating to frequency and severity rates".

Associations were not too much more helpful in this respect since they compile only limited data, and only that which has been previously summarized grossly by their members. In general, the data available are indicative of frequency and severity rates, only, and do not differentiate among occupational specialty, agency, body part, etc.

Logging companies indicated availability of injury data, but none of

those which promised to make special computer retrieval runs have yet responded. Some companies have, however, continued to send us digested data developed by the associations to which they subscribe and, in one case, data summaries developed for in-house use previously. Nevertheless, some data were obtained during discussions with safety personnel.

INJURY DATA ANALYSIS

Figures 3-1 and 3-2 summarize the national trend for DWI frequency and severity rates, as reported by the Department of Labor. While this annual survey indicated that the disabling work injury frequency rate for logging is decreasing at a high rate of change it also indicates that the severity rate is not in a similar pattern of decline, as shown by the cumulative average. The implication is that the severity of each work injury (ie. average number of days lost per injury) is increasing. Figure 3-3, derived from the frequency and severity rate data, shows graphically that the cumulative average severity rate per injury has increased from 82 days to 120 days over the 24-year period of analysis.

The immediate interpretation of this trend is that the logging industry is becoming less hazardous in terms of the milder types of injuries but that the types of injuries which continue to prevail are those of a more lasting and disabling nature. It is to be recalled from the fatality data (Table 2-2) that at least one operating company demonstrates that, although it's fatality and DWI frequency rates are decreasing, there is an increase in the ratio of fatalities to non fatalities.

It is possible to suggest several hypotheses for these relationships, as follows:

- HYPOTHESIS 1. Increased automation within the industry may have reduced the exposure rate to hazards which result in the less severe types of injuries.
- HYPOTHESIS 2. Safety programs instituted in the past have had a positive impact on reducing the number of unsafe acts and hazards which result in low severity rate injuries.
- HYPOTHESIS 3. Increased medical profession concern with ensuring more time for personnel recovery from disabling injuries.
- HYPOTHESIS 4. As workmen's compensation benefits have been increased over the years, there has been a reduction of employee incentive to return to work prematurely after a disabling work injury.
- HYPOTHESIS 5. Due to company diversification trends there have been alternative jobs made available, within the company, for those employees suffering the less extreme types of injuries and, thus, have less lost time recorded.
- HYPOTHESIS 6. Inadequate injury occurrence sampling techniques or changes in techniques which increase visibility on severity rates.

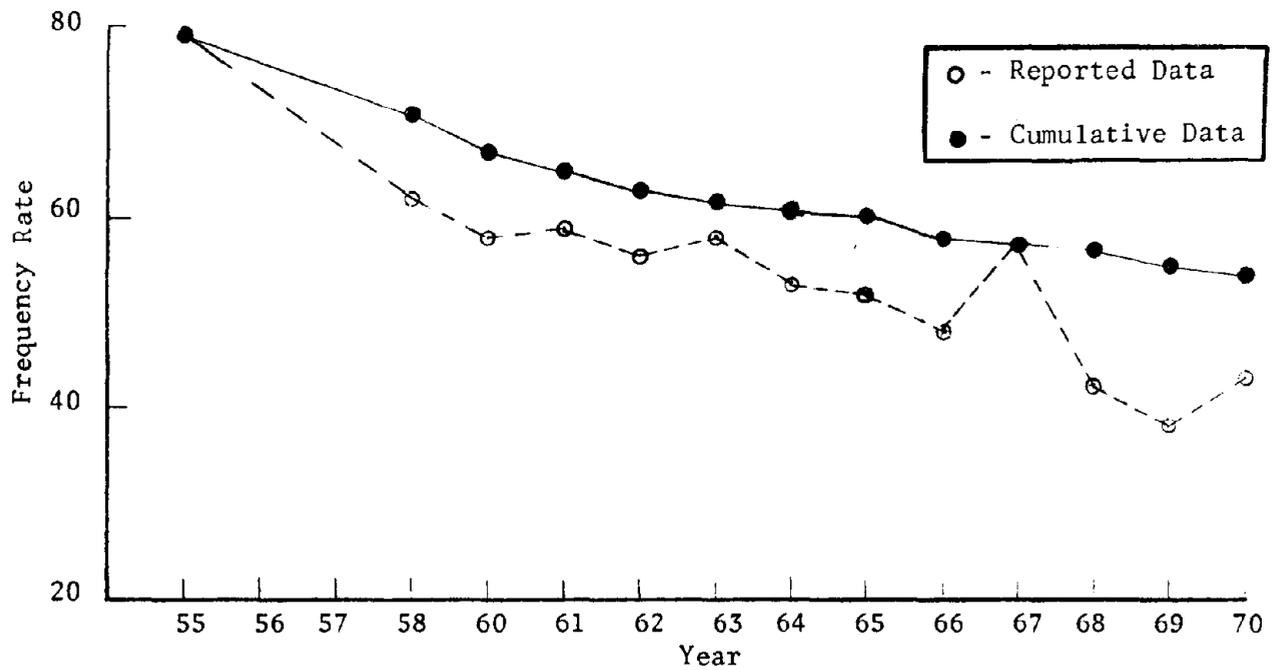


Figure 3-1. Logging Industry Disabling Work Injury Rate (Ref. 3)

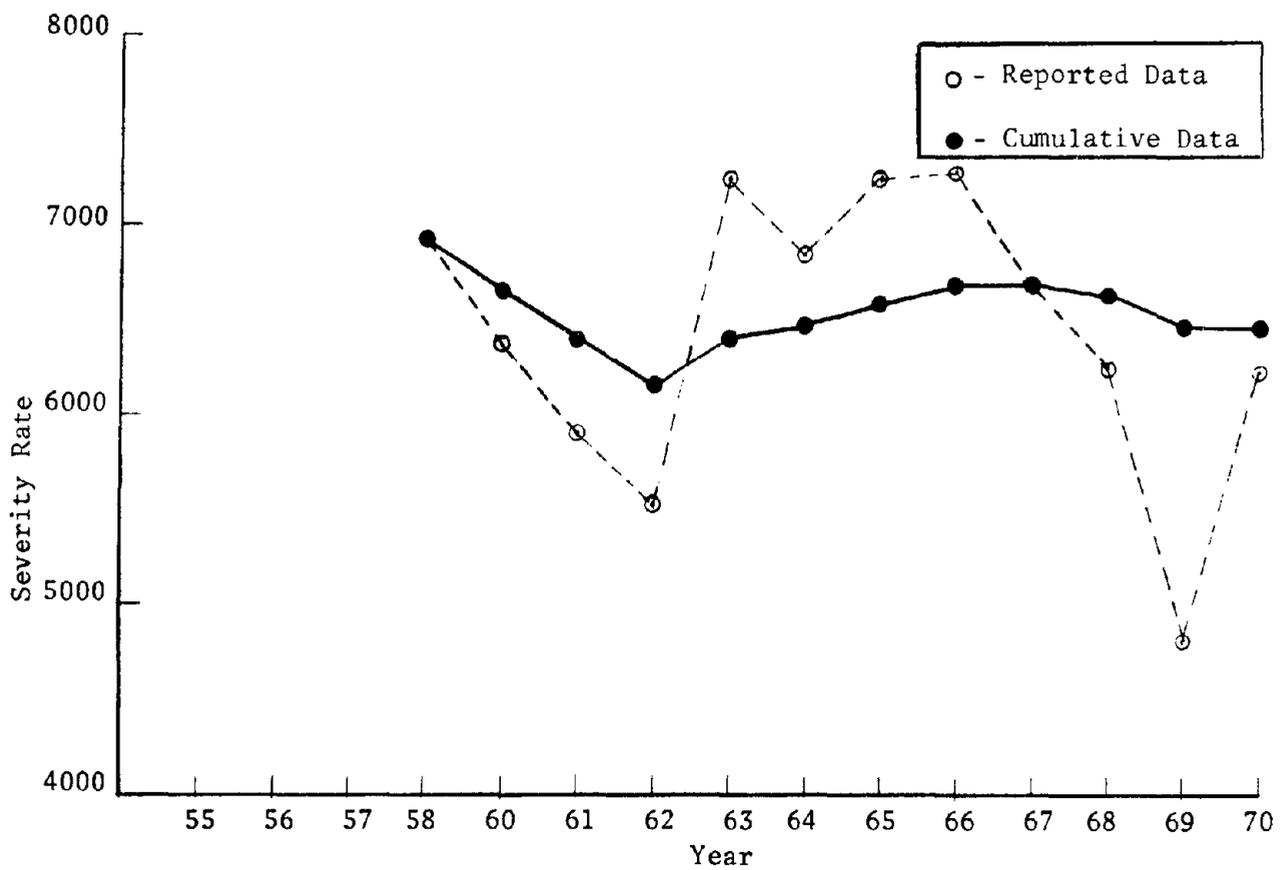


Figure 3-2. Logging Injury Severity Rate (Ref. 3)

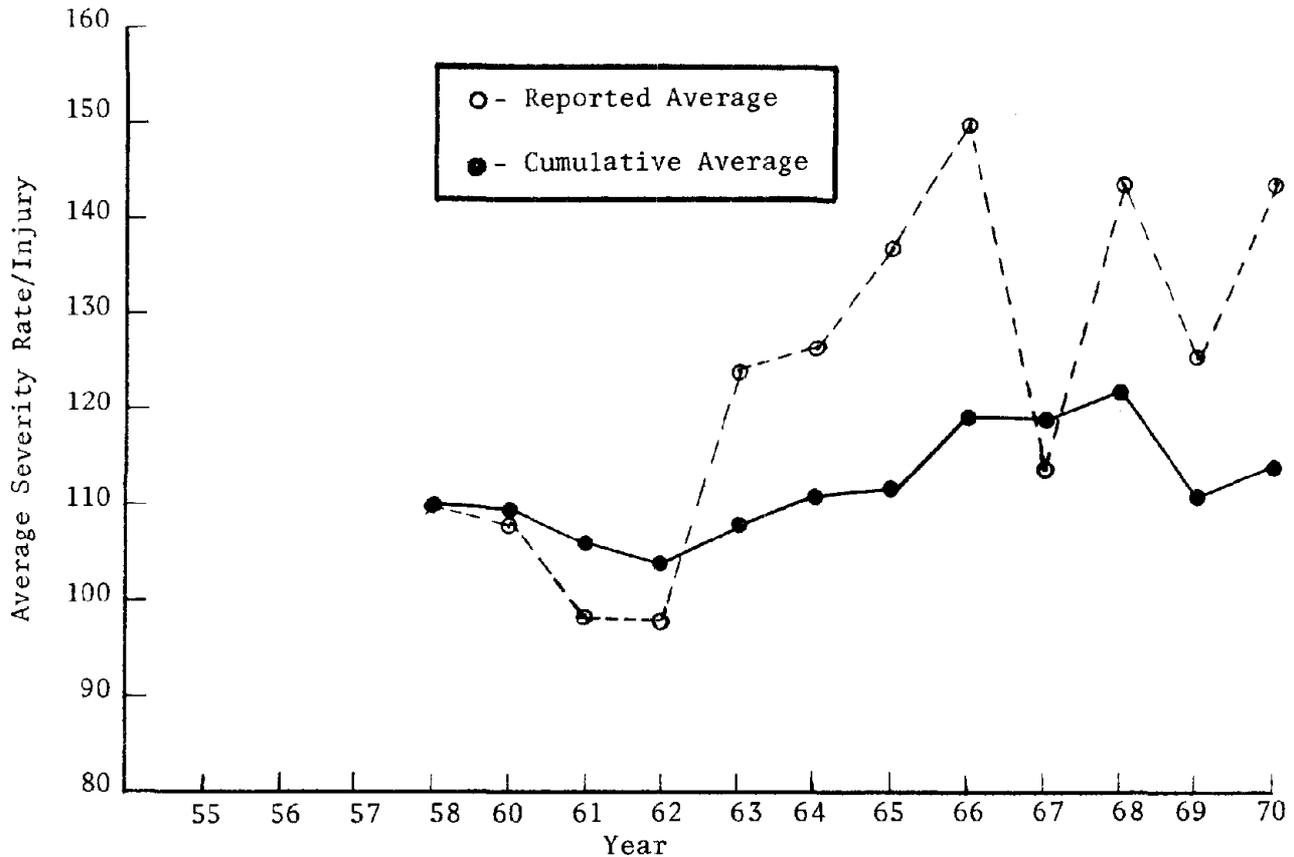


Figure 3-3. Average Logging Injury Severity Rate

Each of these will be considered in the analysis of data presented in the following sections. IT IS TO BE NOTED THAT THE ABOVE HYPOTHESES WERE FORMULATED ONLY AS A MEANS FOR ASSISTING IN THE INTERPRETATION OF THE FOLLOWING DATA AND WERE NOT INTENDED AS THE PRIMARY PROBLEMS TO BE ADDRESSED BY THIS PROGRAM.

INDUSTRY COMPARISONS

Extensive efforts were not devoted to showing injury characteristic comparisons across industrial lines; however, some comparisons with "all industry" averages are shown in several of the subsequent data presentations. A significant comparison of frequency and severity rates is, however, drawn by referring to figures 3-4, 3-5 and 3-6. Although the logging component of the lumber and wood products industry demonstrates a decline in frequency rate with severity rate remaining essentially constant this trend is not evident for the total industry. Over an eleven-year period, the lumber and wood products industry (which includes logging) has demonstrated relative constancy in both frequency and severity rates. As shown in figure 3-6, the derivative of severity/frequency rates also appears to be relatively constant.

In readdressing the above six hypotheses about the trend in logging, several, at least, would now appear highly improbable. This differential in trend is quite disconcerting since logging is so closely related to the rest of the industry in the geographic sense as well as commonality of management in many instances.

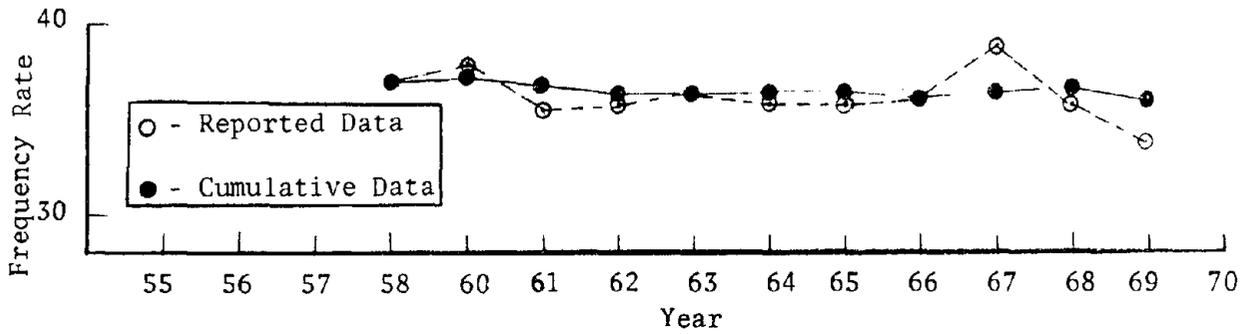


Figure 3-4. Lumber and Wood Products Injury Frequency Rate (Ref. 3)

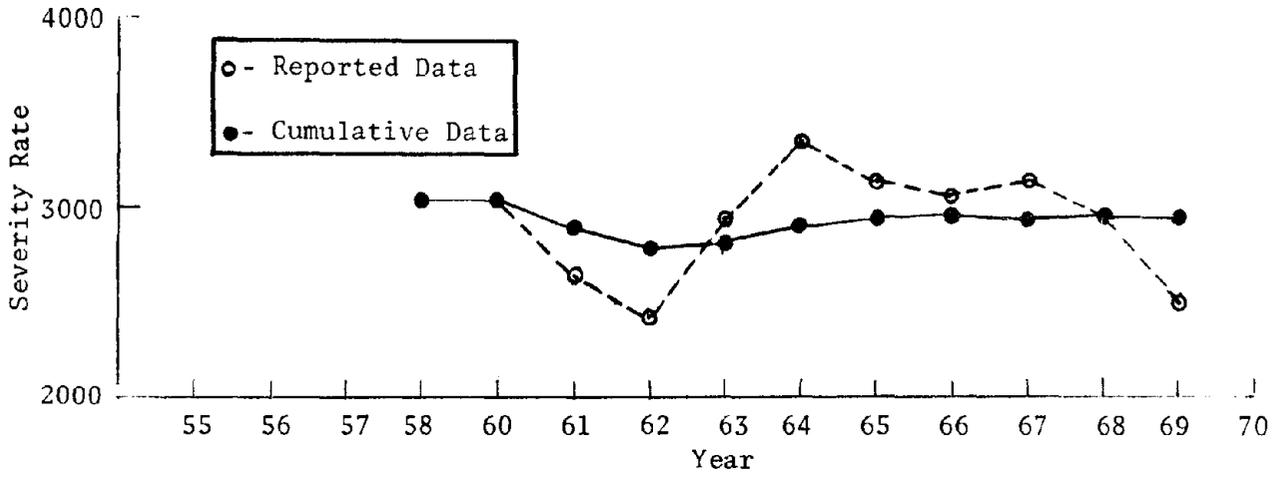


Figure 3-5. Lumber and Wood Products Injury Severity Rate (Ref. 3)

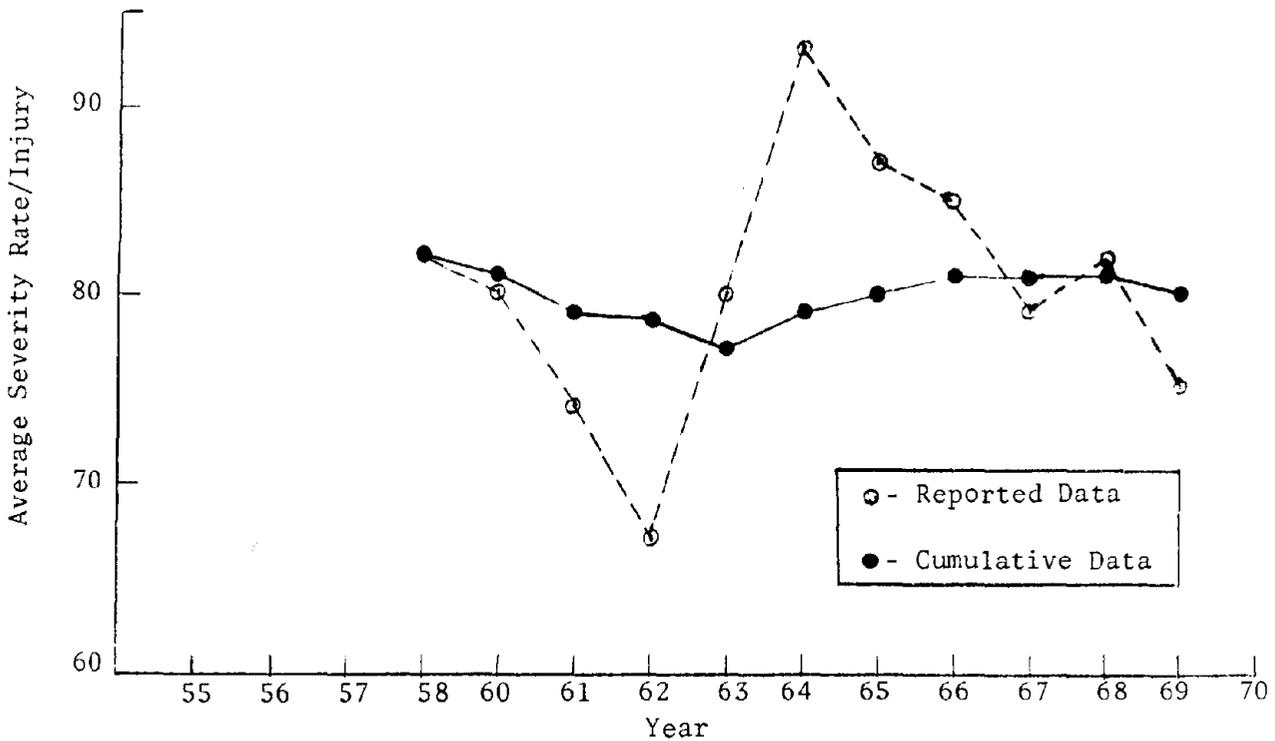


Figure 3-6. Average Injury Severity Rate for the Lumber and Wood Products Industry.

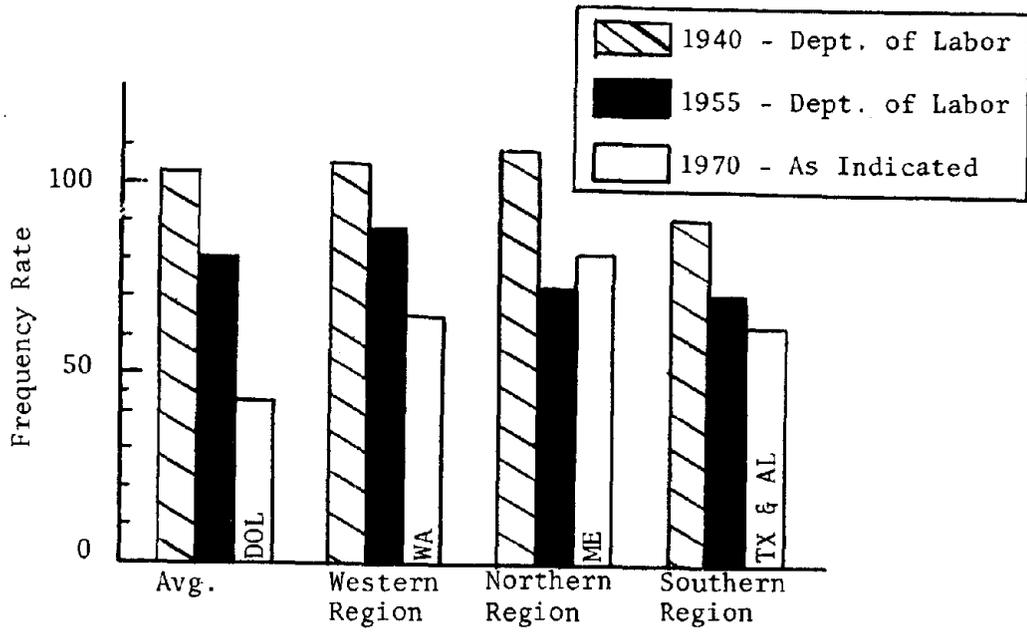


Figure 3-7. Frequency Rates in Logging by Geographic Region

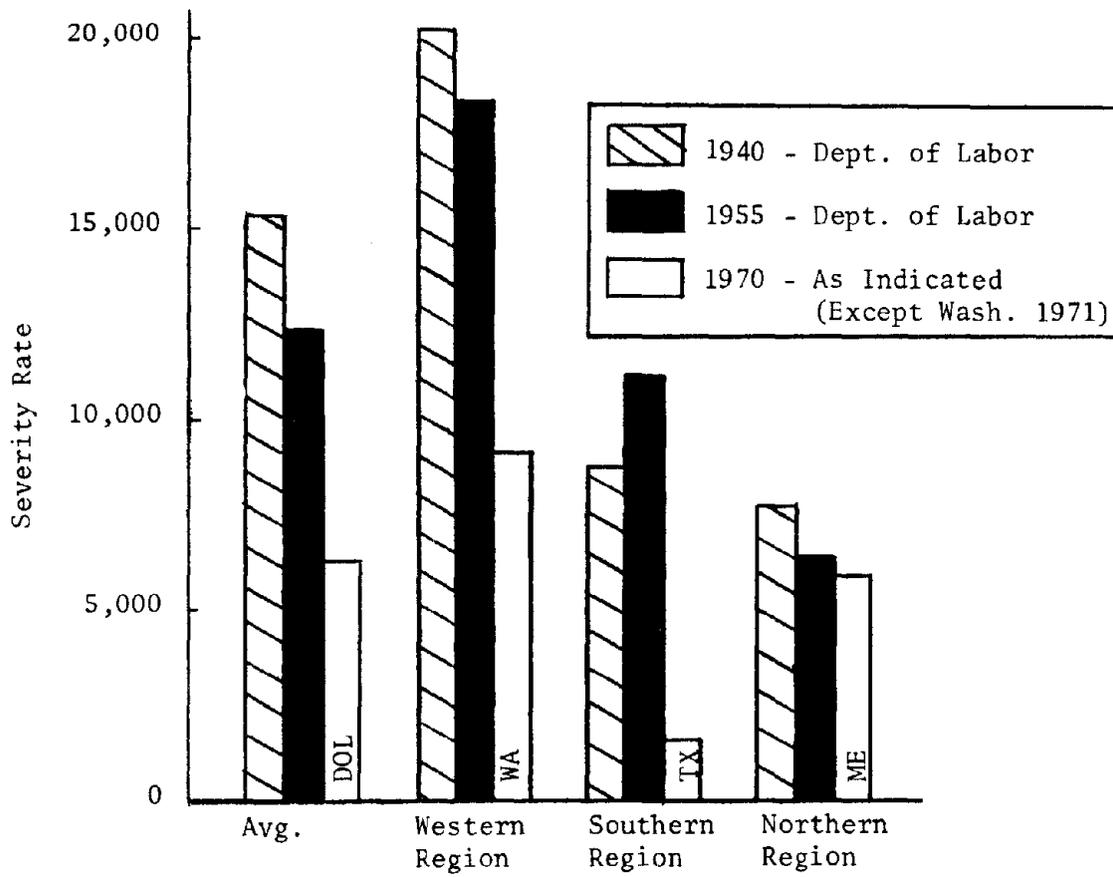


Figure 3-8. Severity Rates in Logging by Geographic Region

A seventh hypothesis becomes more likely as follows:

HYPOTHESIS 7. That incentives to reduce disabling work injury rates within logging have been greater than for the rest of the industry. A discussion of Workmen's Compensation Insurance premium rates is presented in Section I; this may be the type of incentive which can work differentially along occupational lines within the same industry.

GEOGRAPHIC AND TEMPORAL TRENDS

It is distinctly evident that the trend toward a reduced frequency rate for disabling work injuries for loggers is downward. This trend dates at least from 1940 to the present, as shown by figure 3-7, and by implication the trend is apparent for all of the geographic regions.

For the 1970 data of figure 3-7, the indicated states were the only ones for which frequency rates were submitted; but the data are suggestive of geographic trends. DOL data were not acquired for the 1970 time period to indicate geographic trend. It is significant to note that the data submitted by these "representative" states are all indicative of a higher frequency rate than the average published by the DOL for 1970.

A similar trend in severity rate is indicated by figure 3-8. However, the states shown appear to be more representative in terms of their distribution about the DOL mean severity rate. It is more interesting, however, to examine the ratio of severity to frequency rate as indicated by figure 3-9. This

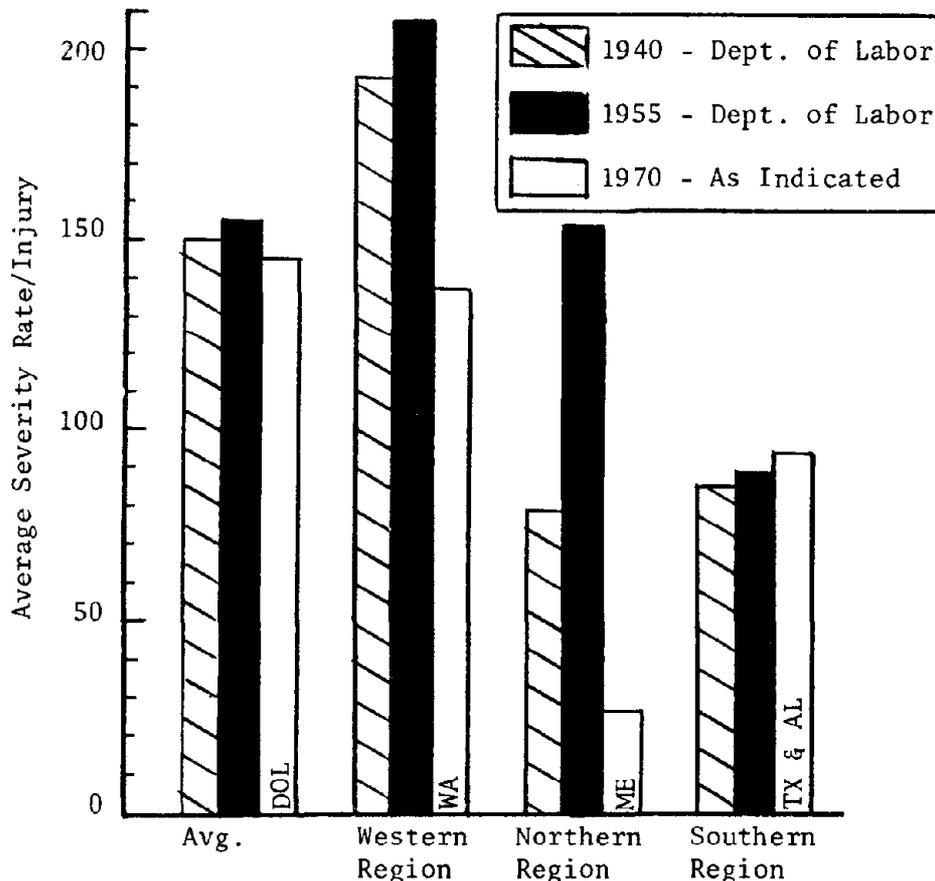


Figure 3-9. Comparison of Average Injury Severity Rate by Geographic Regions.

index for the DOL information shows insignificant variation among the three years selected at 15-year intervals and suggests that on a per injury basis the anticipated number of days lost has not changed over a 30-year period. It is to be recalled, however, that the 1940 and 1955 data are from special logging studies and that the 1970 data are from the annual survey.

With respect to geographic variability, the severity/frequency index shows very significant differences with the Western region reporting the more severe injuries. The Southern region trend, assuming that Texas and Alabama are representative of this region, is also indicative of constancy over the 30-year period. This appears, somewhat, to be expected in view of the field observations made in the South. Logging operations in many respects appear not to have changed significantly over the years and it would be anticipated that the hazards and the types of injuries which result are the same. Use of the chain saw in this region has, of course, replaced the axe and the cross-cut saw, but, if other conditions have remained nearly constant, would suggest that the chain saw has not contributed to a greater frequency or severity rate. This is a tenuous conclusion and no corroborating evidence is available.

The trend for the Western and Northern regions is suggestive that the modes of logging are changing and, along with this change, that there is a concurrent change in the types of injury. For both of these regions the severity/frequency index has dropped markedly in recent times indicating that injuries have become less severe.

The question of whether the indicated states are truly representative of their regions, or not, is less meaningful for this index of severity than are frequency rate or severity rate by themselves. For example, state codes etc., could have different impacts on these rates for each state within a region; however, the average number of days lost per type of injury would be expected to be the same for similar types of operations. Thus, the trend shown is of great interest.

CAUSES OF WORK INJURIES

In examining the causes of work injuries it was found that definitive information was even less available than were frequency and severity rate information. Nevertheless, a number of relationships were isolated; the following data presentations have been derived through statistical manipulations and, in some cases, using judgements to classify causes under a common terminology. Wherever possible and/or whenever the data can be more meaningful, they have been combined on a regional basis rather by state.

Types of Accidents

In figure 3-10 the percentage of classified injuries is shown for each type of accident. The types of accident are presented in rank order for the eight states for which data are available (five Southern states and three Western states). Also presented is a comparison of Southern States with Western states.

As in the case with "all industry" statistics for accidents resulting in injuries, the preponderance of injuries are associated with "falls or slips" and with "struck by or striking against". The major distinctions between Southern and Western states can probably be accounted for on the basis of differences in operational characteristics, but, at the present time the data

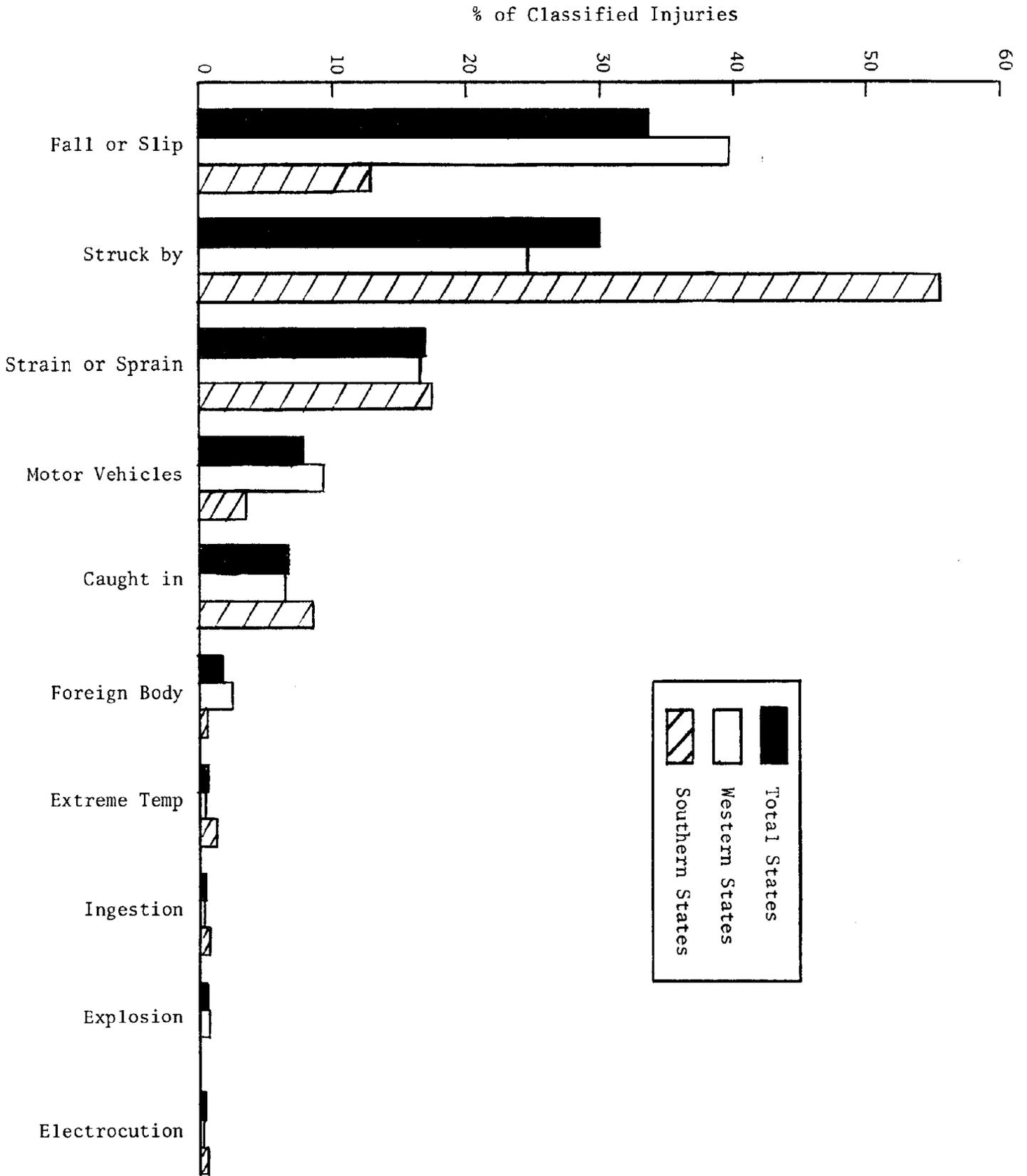


Figure 3-10. Types of Accidents Resulting in Disabling Work Injuries

available will permit only speculation. For example, the lower frequency of injuries due to falls or slips in Southern operations may be accounted for on the basis of relatively flat terrain compared with Western operations. However, by combining the percentages of injuries due to "falls or slips" and "struck by/striking against", there is little difference between Southern and Western operations. It is very likely that the methods used for coding these two classes of accident type for each of the two geographic areas was not consistent. Although state organizations generally follow the recommendations of ANSI Z-16 (Ref. 20) our source of information for the states of Kentucky, W. Virginia and Virginia was obtained from an independent survey of injury reports (Ref. 21).

For the other accident types shown in figure 3-10 their appears to be greater inter geographic consistency; but these types are less prone to subjective interpretation. Data obtained from Montana, as shown in figure 3-11, appears more consistent with the Southern data of figure 3-10 in several respects. However, a notable difference between the Montana data and that for all other states is the higher rate of eye injury producing accidents.

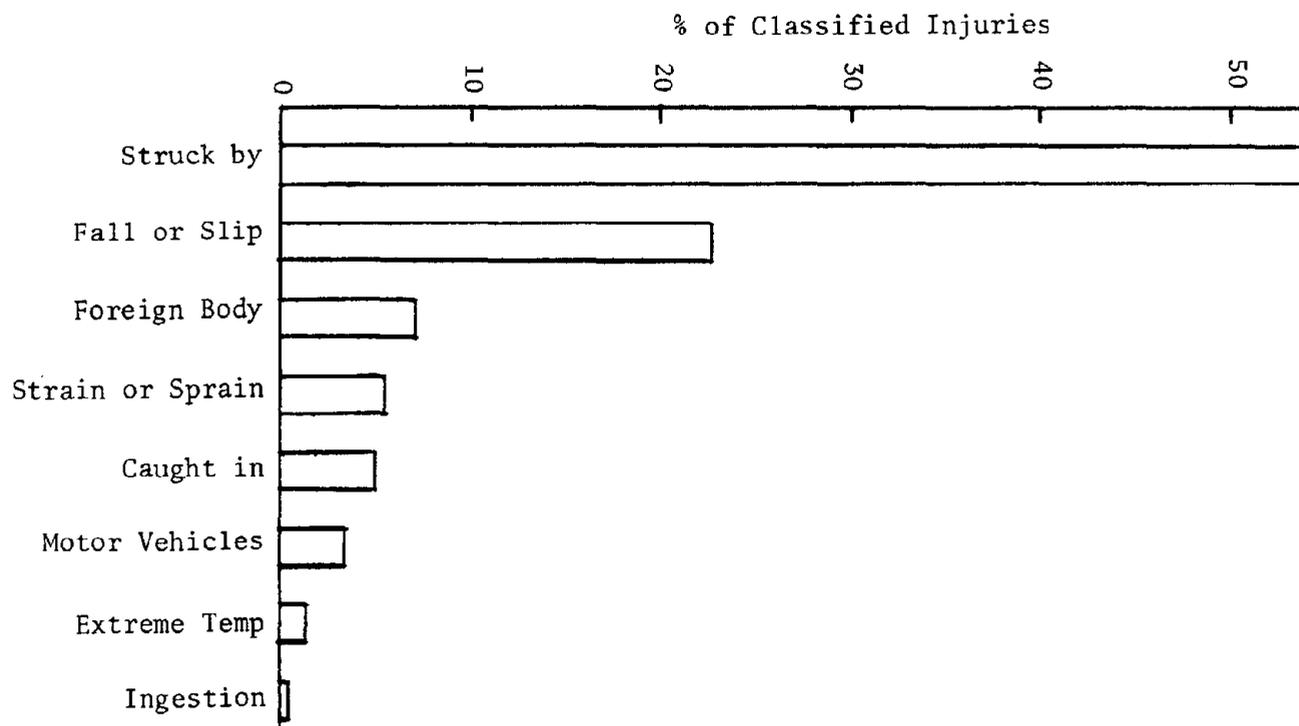


Figure 3-11. Types of Accidents Resulting in Injuries for Montana.

Agencies

In comparing the causes of injuries with respect to agency on a regional basis little distinction is observed as shown by figure 3-12. As would be expected, almost half of the injuries result from "lumber, logs and trees". The major distinctions between Southern and Western operations appear to be "hoisting apparatus" and "machines"; a major distinction in operations between South and West is the extensive use of cable skidding (yarding), in preference to vehicle skidding, in the West.

A more comprehensive identification of injury causes was derived from an analysis of Washington Workmen's Compensation Claims for non-fatal injuries.

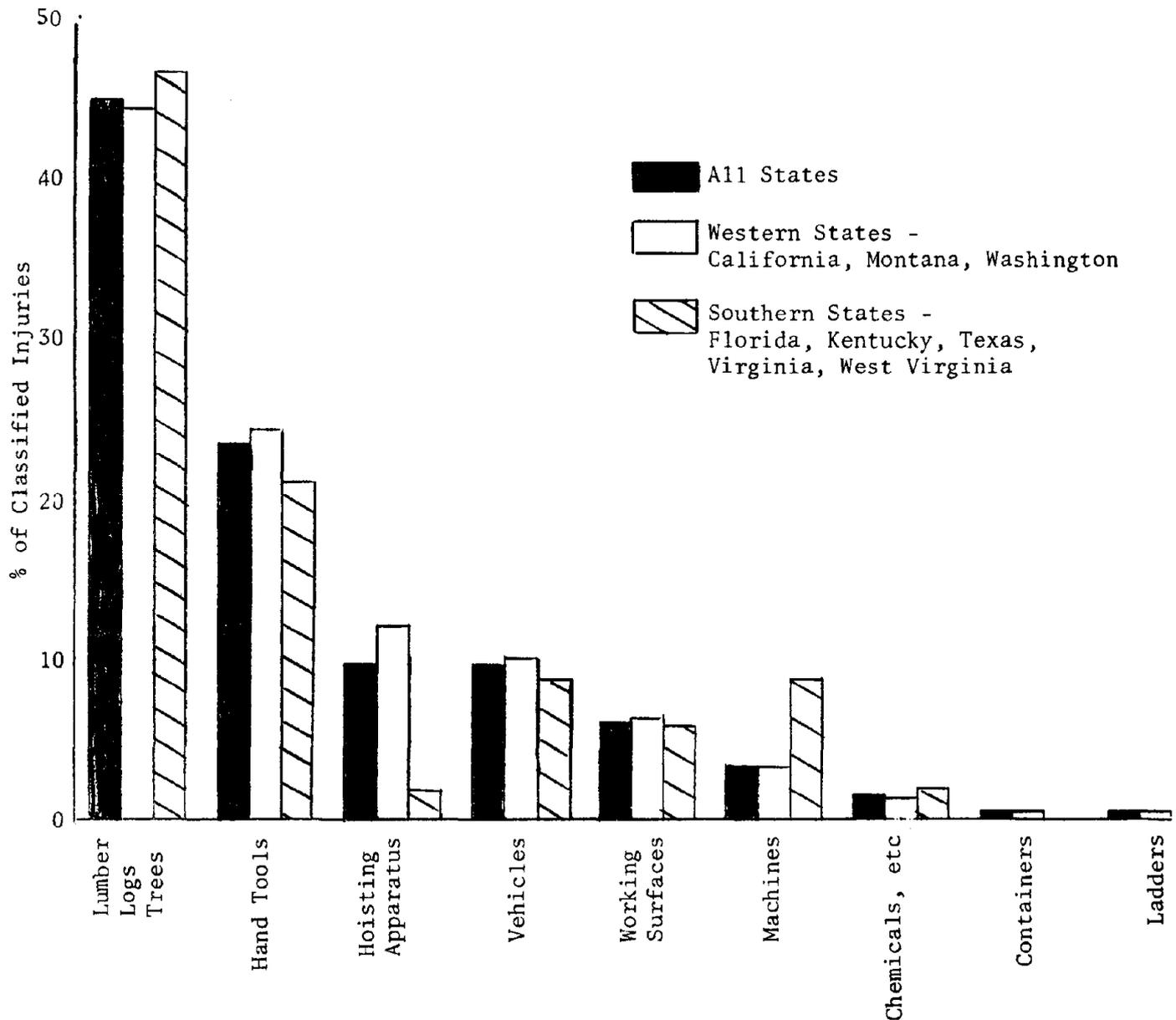


Figure 3-12. Agencies Related to Disabling Work Injuries

This summary is tabulated in figure 3-13 by rank-ordering each of the causes for two twelve-month reporting periods. For the four-year period omitted from figure 3-13, a more meaningful tabulation, grouping similar causes, is presented in figure 3-14. No attempts were made to combine the data of figures 3-13 and 3-14 since they were derived from different types of source information. In the case of figure 3-14, no distinction has been made between fatal and non-fatal disabling work injuries.

Limited information from one large company in Georgia is shown in figure 3-15. Although the total number of injuries reported by this company for an eight-year period was very small, a trend is indicated; however, the major significance is the implication of the chain saw in over 25% of the injuries and that the axe is still a major agent in disabling work injuries. Timber, in several forms, accounted for approximately 28% of the total injuries.

Data obtained from the APA (Ref. 23) are shown in tables 3-2 and 3-3 for its member organizations in the Northeast. Injuries involving chain saws have

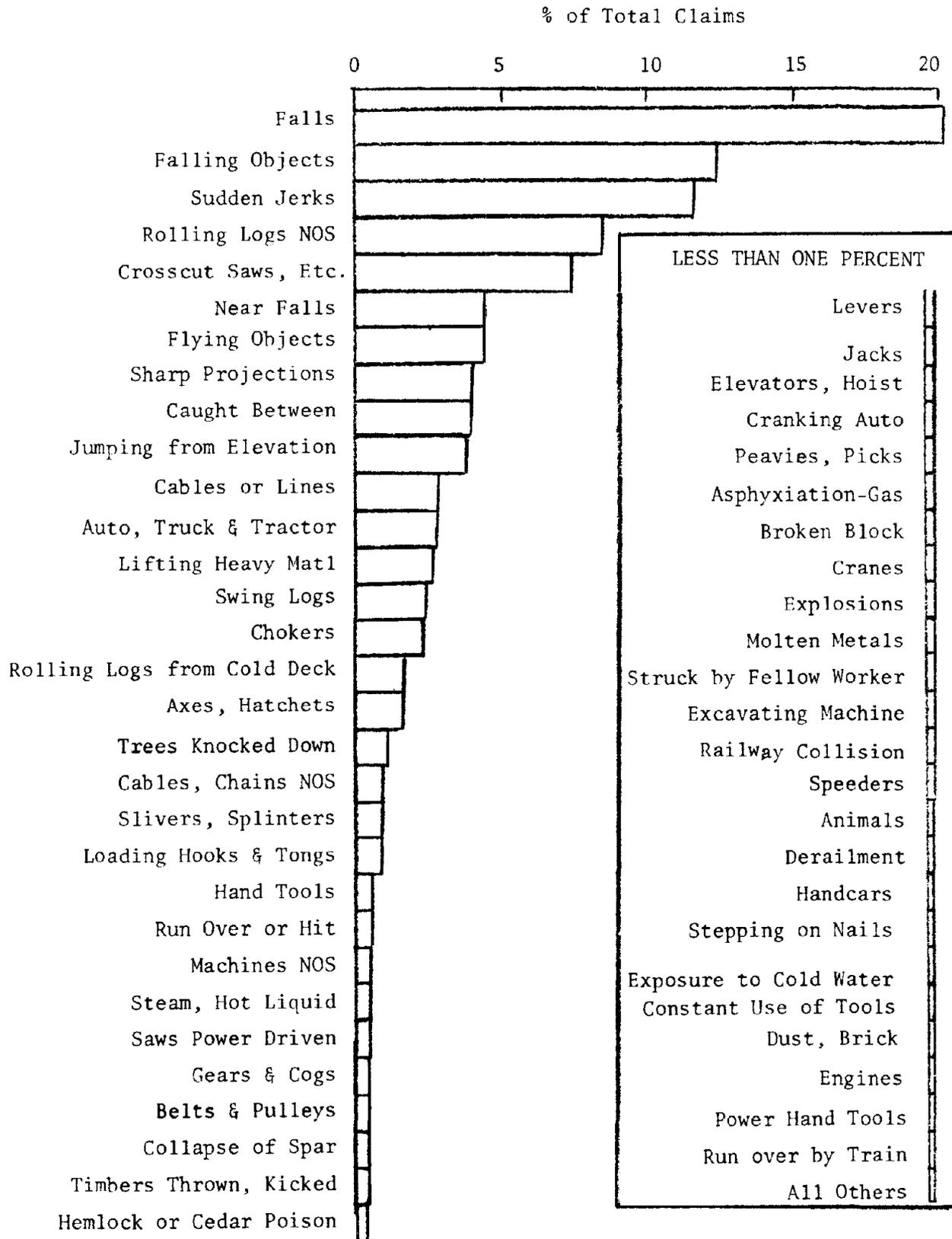


Figure 3-13. Distribution of Injury Causes for Washington (1965-66; 1970-71)
 N = 8373 (non fatal claims)

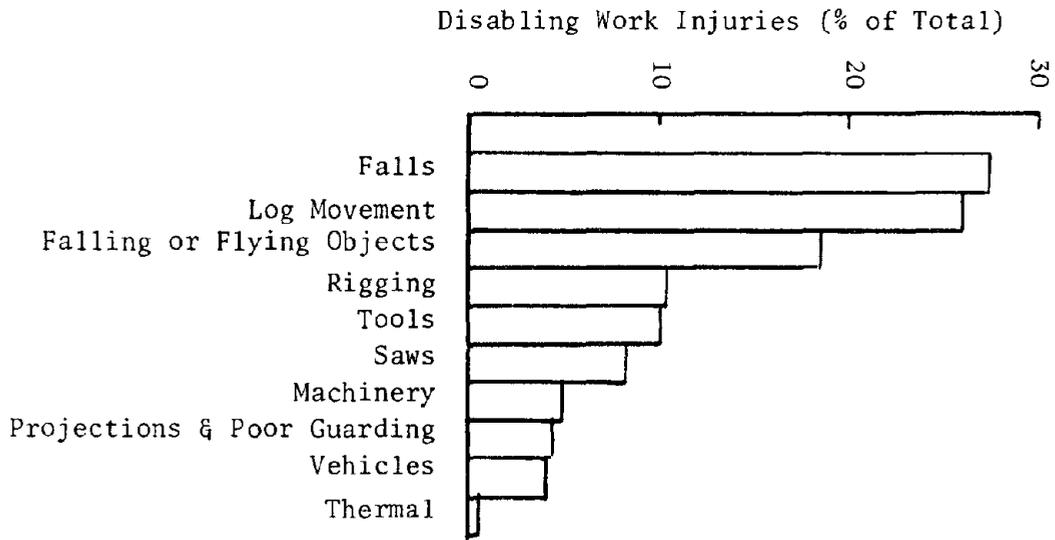


Figure 3-14. Cause of Logging Injuries (Washington 1967-70 Average).

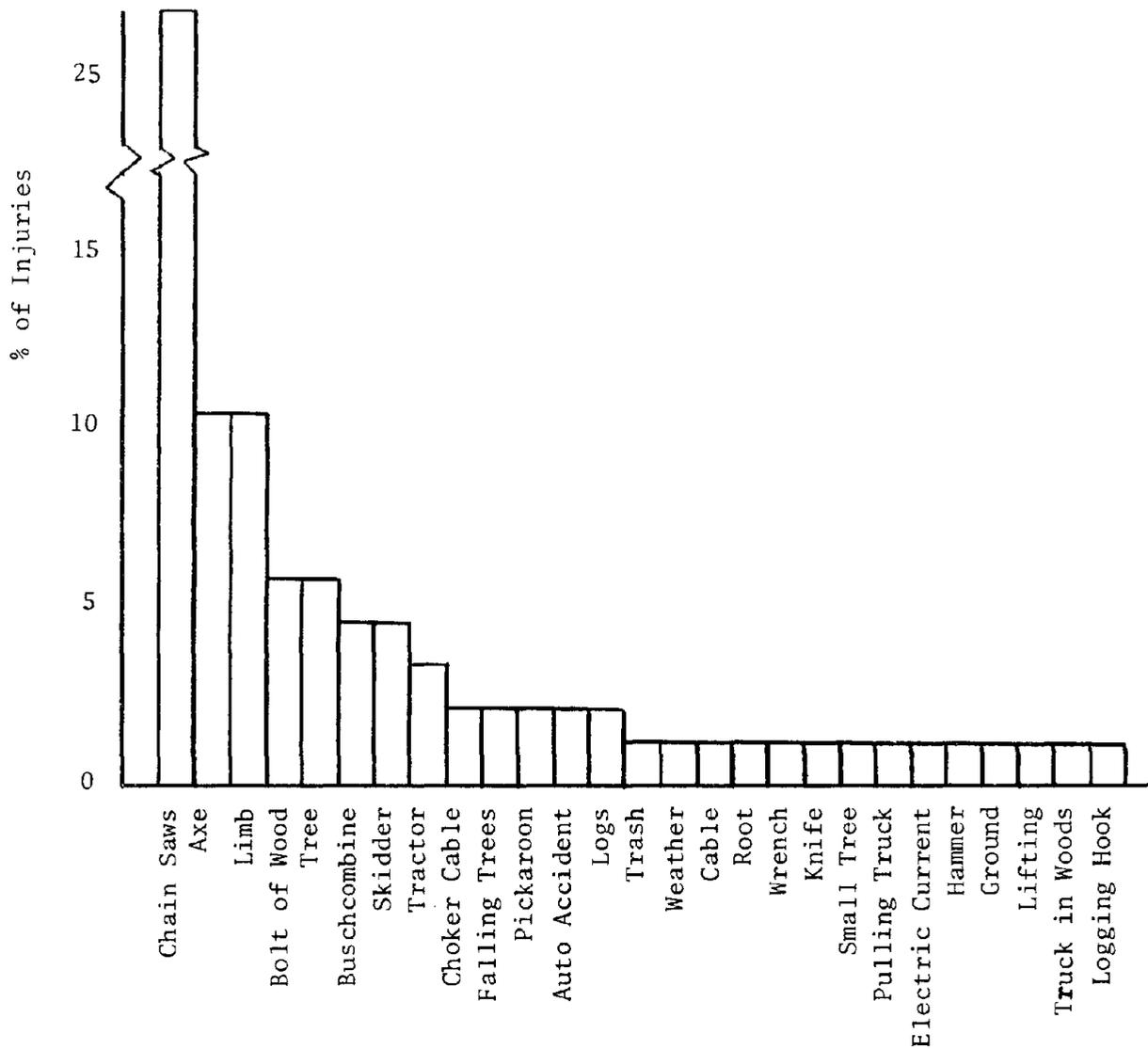


Figure 3-15. Logging Injuries by Causative Agent (Typical Large Southern Co. - 1964-1972)

Table 3-2. INJURIES INVOLVING CHAIN SAWS (APA Northeastern Division).

YEAR	MAN HOURS WORKED	TOTAL INJURIES	CHAIN SAW INJURIES		PERCENT
			ACTUAL	FREQ. RATE	
1958	4,134,837	204	49	11.85	24%
1959	4,259,702	212	56	13.15	26%
1960	4,202,842	235	68	16.18	29%
1961	3,385,833	149	47	13.88	32%
1962	3,407,886	126	32	9.39	25%
1963	3,384,809	122	43	12.70	35%
1964	3,678,007	114	31	8.43	26%
1965	3,428,359	116	28	8.17	24%
1966	4,349,288	157	40	9.20	25%
1967	4,193,596	121	27	6.44	22%
1968	3,491,215	91	20	5.73	22%
1969	3,353,719	70	15	4.47	21%
1970	3,374,132	102	35	10.37	34%
1971	3,015,688	79	26	8.62	33%
1972	2,696,924	61	23	-	37%

Table 3-3. NUMBER OF INJURIES (1958-72; APA Northeastern Division).

AGENCY	CUTTING	HAULING	OTHER	% TOTAL
Chain Saws	560	14	10	26.42
Machinery	47	54	23	5.61
Trees, Logs, Bolts	386	82	28	22.44
Hand Tools	126	49	31	9.32
Slips & Falls	166	72	73	14.07
Horses & Equipment	44	19	9	3.26
Infections, Minor Wounds	27	9	12	2.17
Falling Limbs & Stubs	144	11	2	7.10
Other	<u>106</u>	<u>30</u>	<u>76</u>	9.59
TOTAL	1,606	340	264	100
% TOTAL	72.67	15.38	11.94	
TOTAL DAYS LOST		155,628		
SEVERITY RATE		2,671		

accounted for approximately 26% of all injuries over a period of fifteen years. This is in agreement with the above record for a single Southern company. It is to be noted in figures 3-13 and 3-14, for Western logging, that the chain saw did not contribute as greatly to the injury rate.

The following data shows how the chain saw has been implicated in disabling work injuries for several Southern states (Ref. 21):

STATE	YEAR	PERCENT TOTAL INJURIES	
		FALLERS	BUCKERS
Virginia	1970	13.72	58.86
Kentucky	1971	42.86	
W. Virginia	1971	12.07	82.76

Table 3-3 compares the frequencies with which each causative agent is implicated in injuries. Again, these data are similar to those for the Georgia company as indicated by the 29% of injuries being caused by timber.

INJURIES AS A FUNCTION OF OCCUPATION

As in the case of fatalities, the felling and bucking occupations are most susceptible to disabling work injuries. Figures 3-16 and 3-17 show the distribution of injuries by occupation for Western and Southern type operations, respectively.

In referring to figure 3-16, it appears that the Washington injuries are distributed in about the same ratios across occupational specialties as they were for the Western region, as published for the DOL 1955 survey. The major discrepancies appear to be in the Montana data; although no job classification descriptions were obtained for each of the reporting entities it appears likely that the occupational coding used by Montana is not totally consistent with the Washington coding. It is possible that the high percentage of injuries to "laborers" (a classification not used in the Washington data) might well reflect other occupations, such as choker setters. Similarly, the high level of "cat operator" injuries in Montana may be found listed in the Washington data under "miscellaneous machine operators".

With respect to the representative Southern operations (Figure 3-17) it is noted that approximately one-half of the injuries occur to the fallers and buckers. This is consistent with the DOL 1955 survey of the Southern region and with the Montana data. The remaining distribution of injuries in the Southern states is less consistent and may be explained by changes in operational methods.

For the Washington data, figure 3-18 presents a probability of injury occurrence by occupation. These data are based on normalizing the injury data with respect to numbers of employees per work specialty. In comparing the injury trend with the fatality data from figure 2-1, it is observed that choker setters, chasers and riggers have the highest probability of disabling work injuries even though this classification ranks second in fatalities. Of even more significance is the "loader" classification. Although loaders suffer a greater expectancy of fatalities than would be expected if fatalities were normally distributed over all occupations, they suffer fewer disabling work injuries than would be expected.

In figure 3-19, the likelihood of an injury being a fatality versus a non-fatality is shown. While loaders have a low probability of suffering a non-fatal injury this figure shows that this occupation (in Western operations)

% of Total Classified Injuries

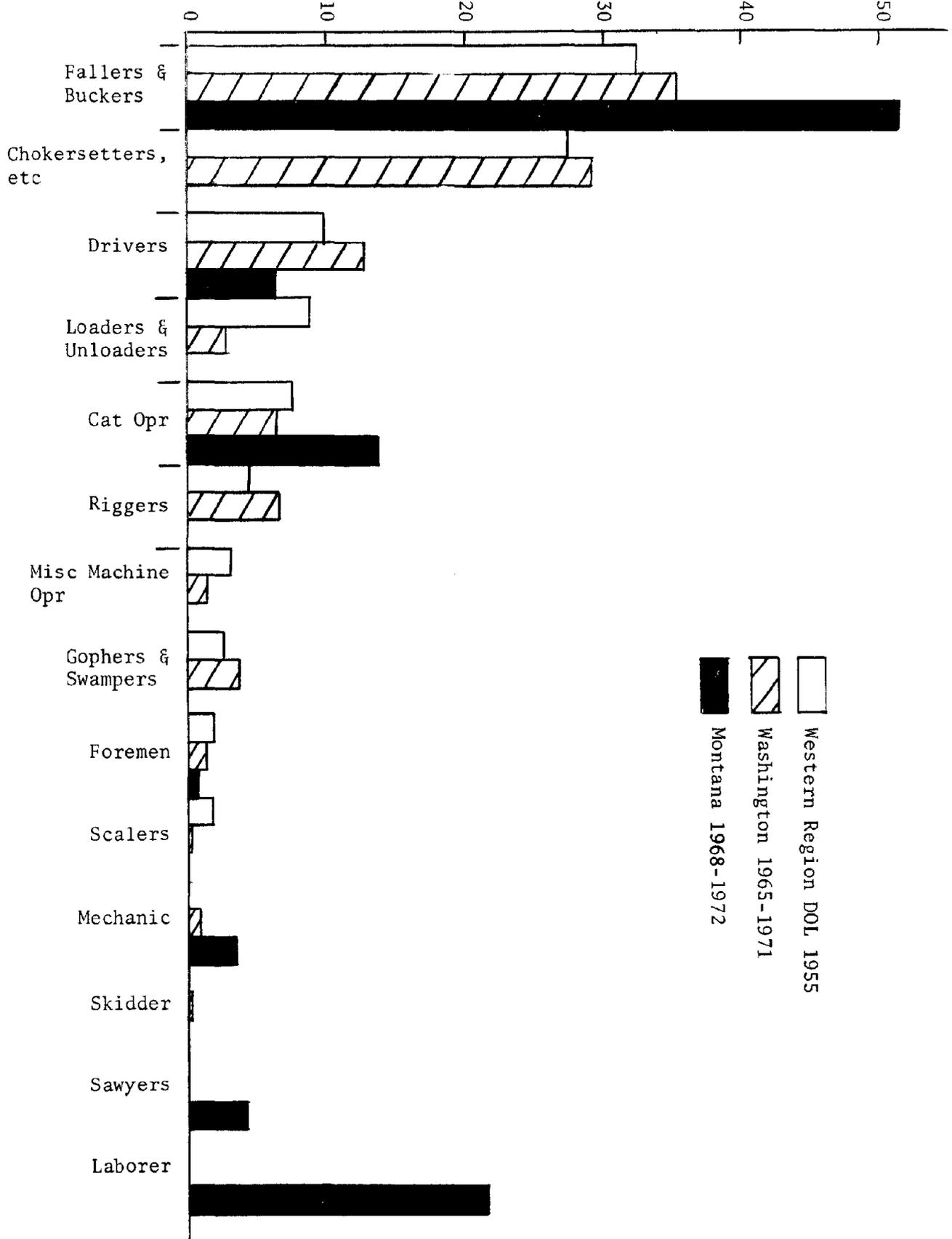
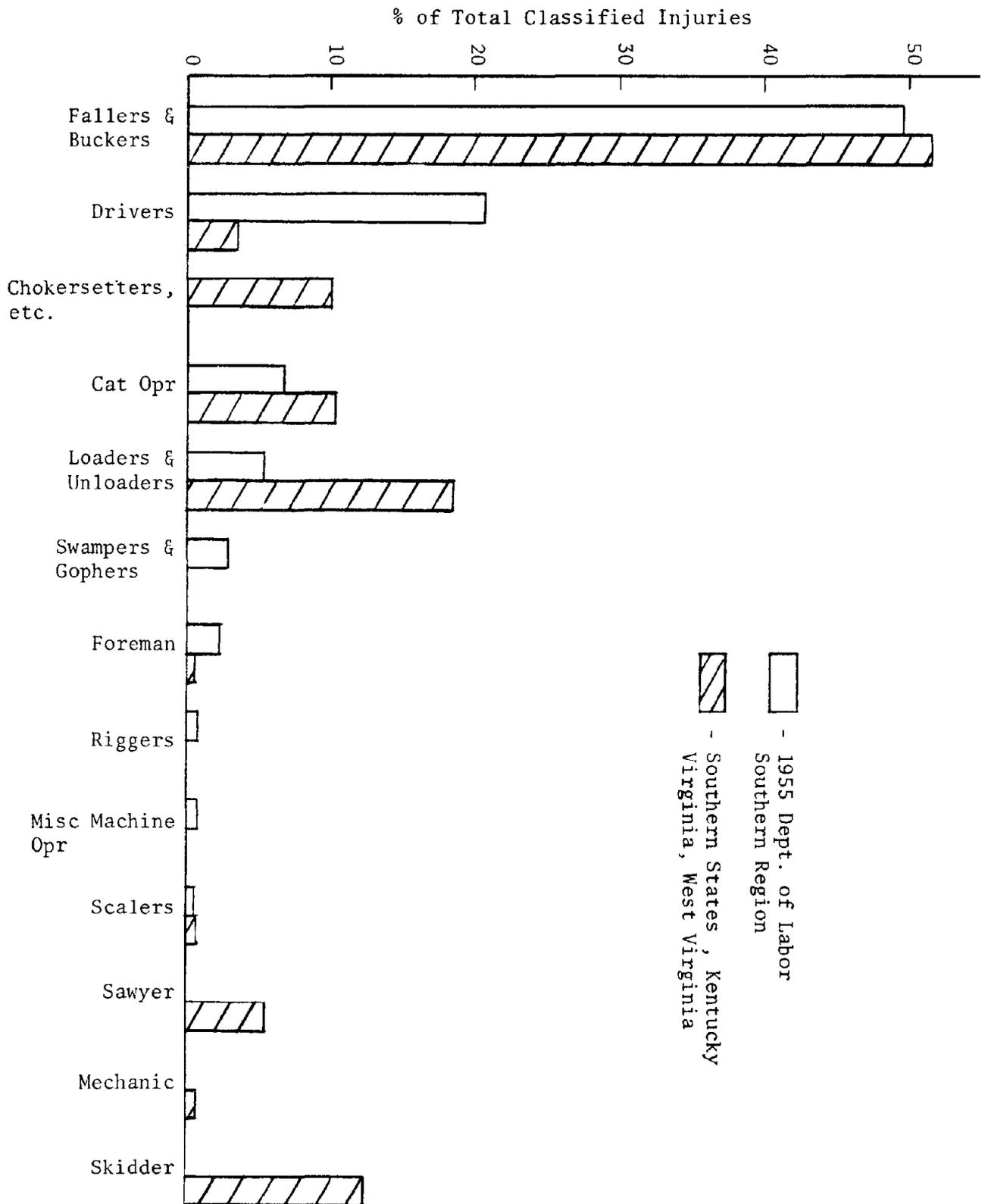


Figure 3-16 Disabling Work Injuries as a Function of Occupations in Western Operations

Western Region DOL 1955
 Washington 1965-1971
 Montana 1968-1972

Figure 3-17 Disabling Work Injuries as a Function of Occupations in Southern Operations



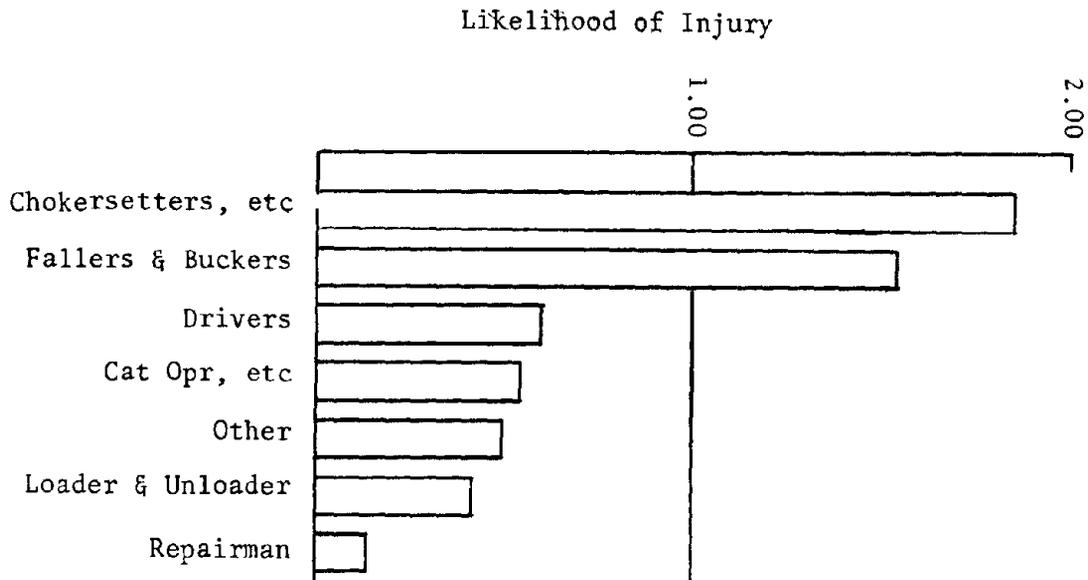


Figure 3-18. Occupational Comparison on Basis of Probability of Injury (Western Operations).

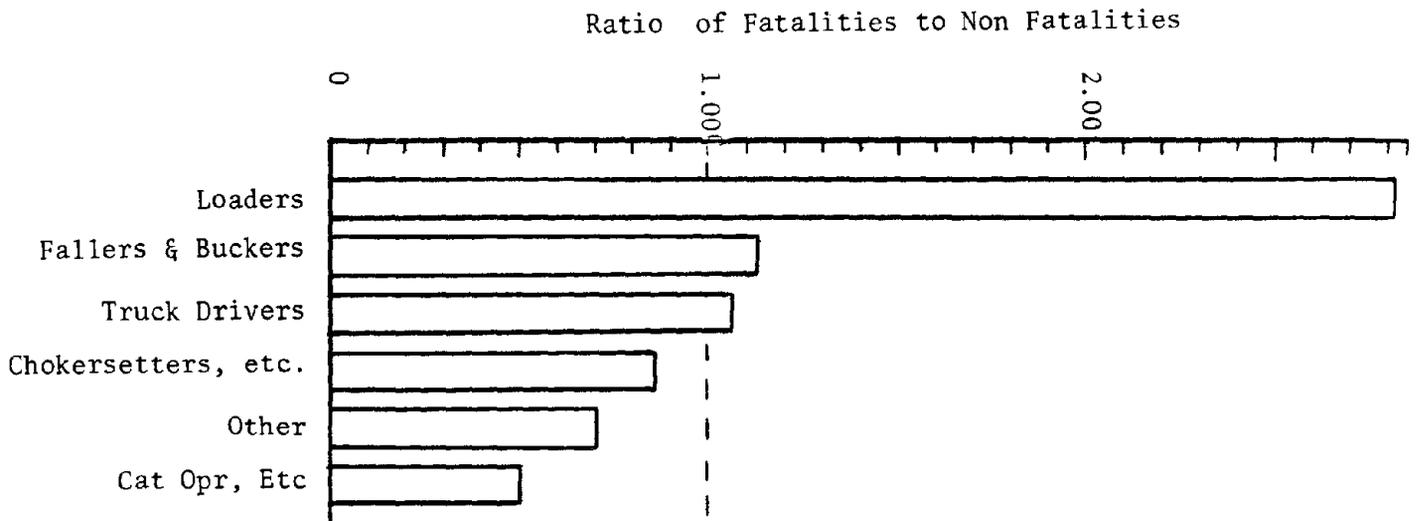


Figure 3-19. Comparison of Occupations on Basis of Probability that a DWI Will Result in a Fatality (Western Operations).

is the most hazardous in terms of contribution to injury severity rate. Fallers and buckers, and truck drivers have a nearly equal probability of surviving an injury and all other occupations have a higher probability of survival versus non-survival.

Similar types of information were not located for other geographic areas. The primary information deficiency is an indication of the numbers or ratio of employees within each occupational specialty.

The information in figure 3-20 provides some indication of injury occurrence by occupation in southern operations. These data indicate that limbers suffer the greatest number of injuries. When combining limbing and bucking the incidence of injury compares with the high incidence of chain saw injuries to buckers, as shown above.

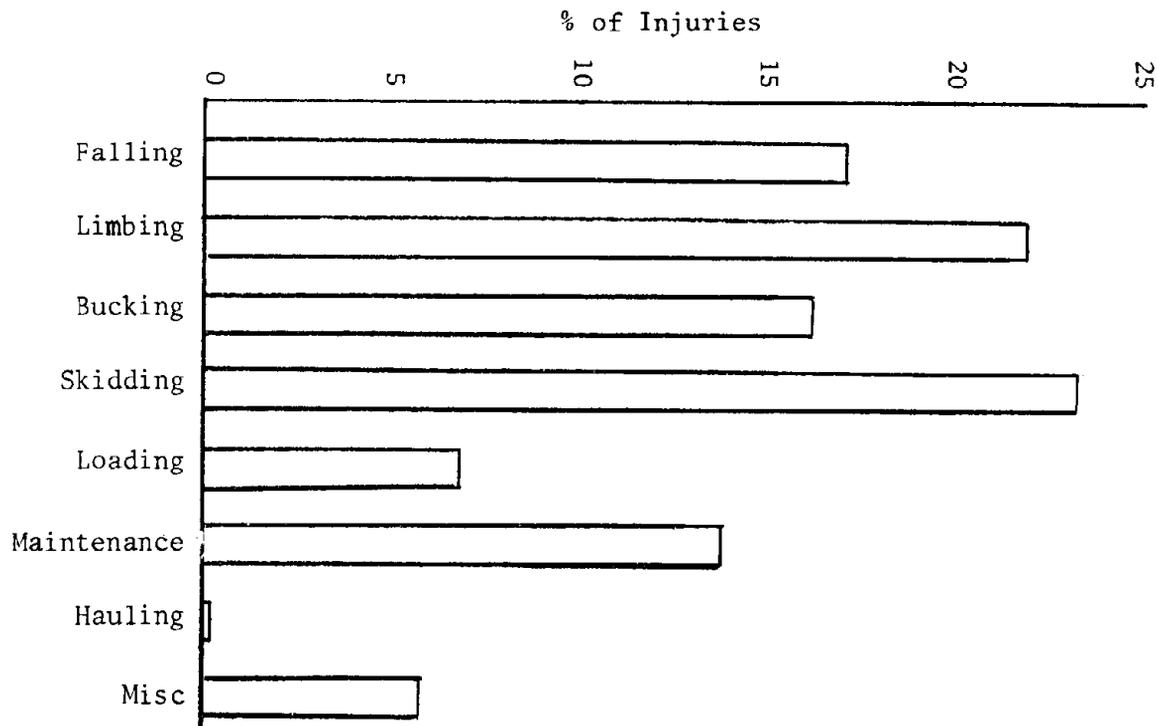


Figure 3-20. Logging Injuries by Activity (Typical large Southern Co.-1964-72).

LOGGER EXPERIENCE

For a number of states, where actual injury reports were available, it was possible to determine the relationship of logging experience to the incidence of injuries. In the cases studied, experience was identified as duration of time with a given employer and did not indicate total experience. As shown by figures 3-21 and 3-22, job experience is positively correlated with the probability of an injury; however, some discussion and qualification of this relationship are necessary.

For representative data from both the Southern and Western logging regions it is noted that more than 50% of the injuries occur within the first year of experience. The rate of occurrence is higher in the West with 40% of injuries evident within 3 months; in the South 30% of the injuries are reported during the first three months.

Variations among the reporting entities are apparent, though small in magnitude, for periods longer than one year. There is probably no significance to this; in processing the data it is noted that a larger sample extending over 40 years of experience was available for Washington though the Oregon data extended for about nine years of experience.

It is further expected that as level of experience is increased that loggers will be promoted to new jobs having a reduced hazard exposure and that the shape of these curves may not be completely valid. A more valid experience curve would use data normalized for population size with respect to total years of experience. Although an experience distribution was not available it is hypothesized that the curve will be more linear during the earlier years and will indicate an even higher rate of injuries during the first year of experience.

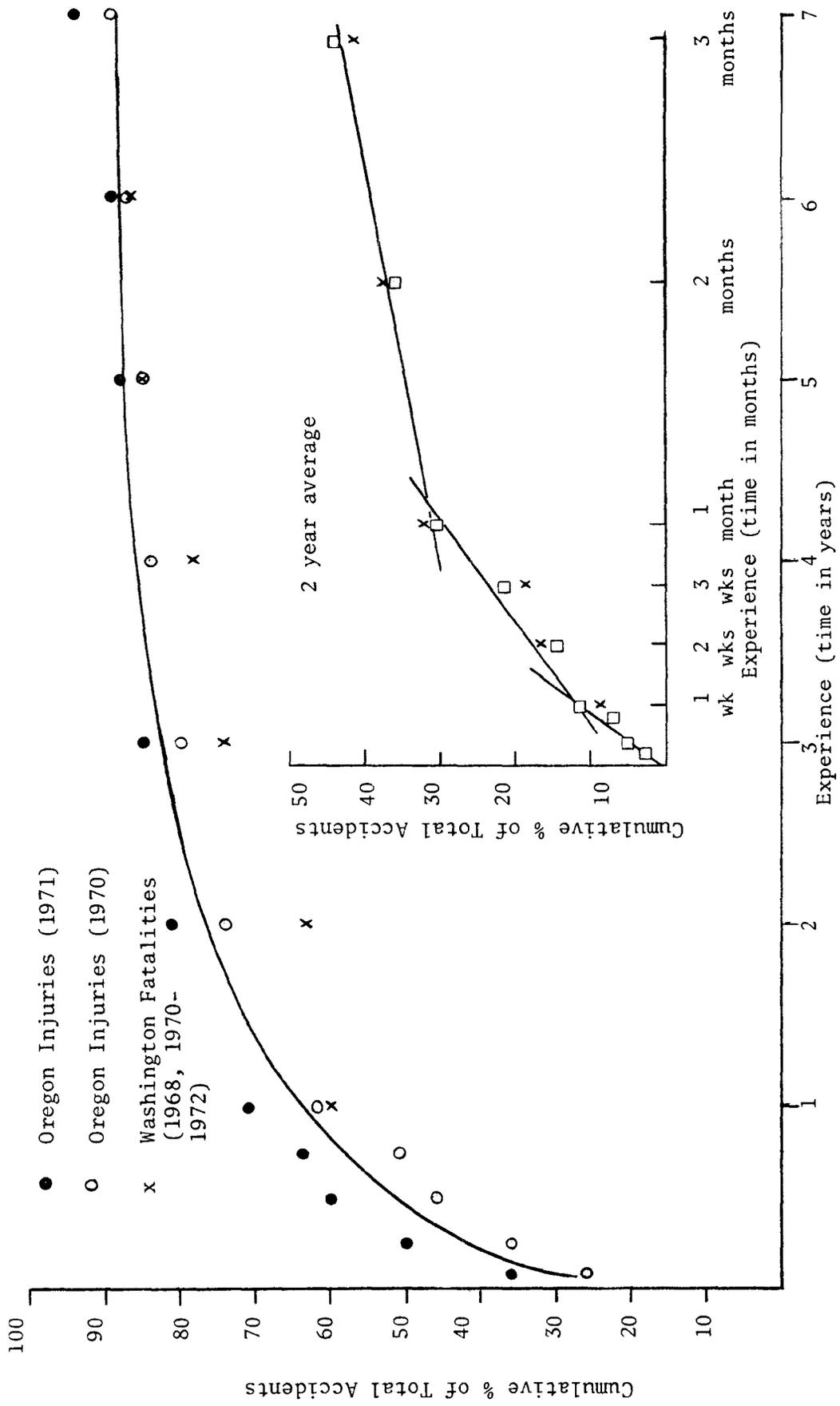


Figure 3-21. Logging Injuries in Western Operations by Time on the Job

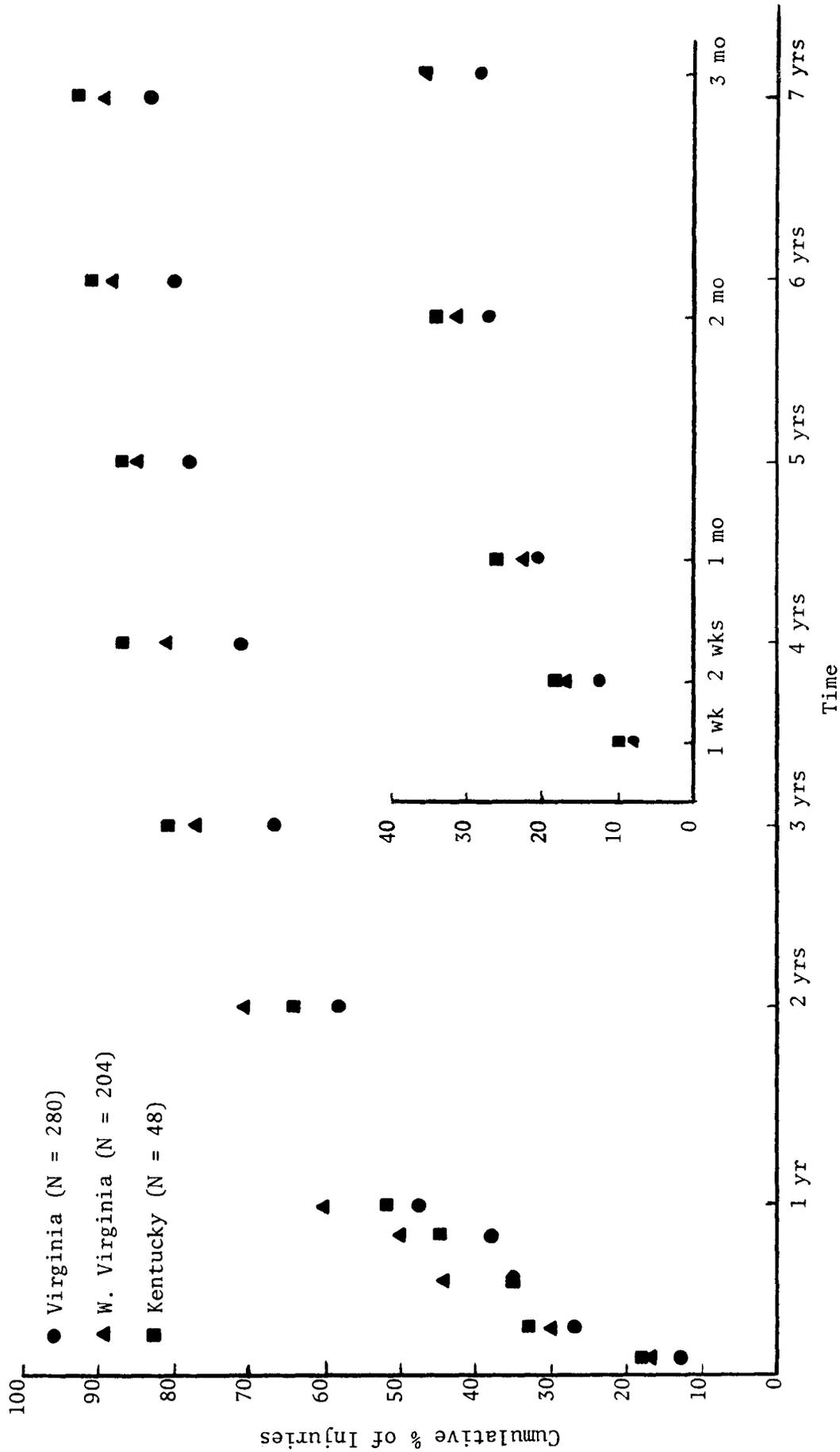


Figure 3-22. Logging Injuries in Southern Operations by Time on the Job

Also indicated by figure 3-21 is a comparison of fatalities and non fatalities. During the first three months there is remarkable similarity in the cumulative rates for the two types of injury.

TEMPORAL DISTRIBUTION OF INJURIES

The frequency of injuries occurring within discrete time frames was examined to determine whether any relationships or trends are evident. These time frames included month of the year, day of the week and hour of the day. For the most part, the data available did not distinguish among the occupational specialties; however, some distinctive data were processed.

Monthly Injury Rates

Figures 3-23, 3-24 and 3-25 show both monthly cumulative rates and monthly injury incidence as a function of percentage of injuries occurring on an annual basis. The highest numbers of injuries are associated with the spring and summer months. By reference to these figures it could be concluded that "new hires" (ie. low levels of experience with an employer) contribute greatly to this increased incidence of injuries.

Unfortunately, data were not located to establish a monthly frequency rate which would permit normalizing the data on the basis of numbers of employees. It could be hypothesized that a normalized monthly frequency rate would show greater constancy across months of the year.

The inconsistency between the above two hypotheses leads to a series of tentative conclusions as follows:

1. The incidence of injuries varies with respect to the rate of tree harvesting (refer to the work schedule information in Section I).
2. New hires are a constant percentage of total employment over the year (this is not expected to be totally valid; anecdotal information indicates that a large number of students are employed during the summer).

Although the Oregon and Southern state data appear quite similar, the variation noted in the Montana cumulative curve is believed to be related more to work schedule (and productivity) than to any other parameter. In data obtained from a large operator in Maine (Figure 3-26) the cumulative curve is quite similar to that of Montana. Discussions with a representative of the Maine company indicated that their harvesting rate was determined primarily by weather conditions. It was stated, for example, that typically little or no work is performed during April (because of ground thaw).

The only data acquired which distinguished between disabling and non-disabling work injuries was also obtained from the Maine company. This is shown by figure 3-27 which summarizes injuries only to cutters. According to the data reported by this company for a four-year period the number of non lost-time injuries is comparable to the number of lost time injuries for the cutting operation. Data were not provided to indicate the relationship of non lost-time to lost-time injuries for their entire woodlands operations. However, their cutters suffered 17.7% of all woodlands DWI during the 1971-72 time frame.

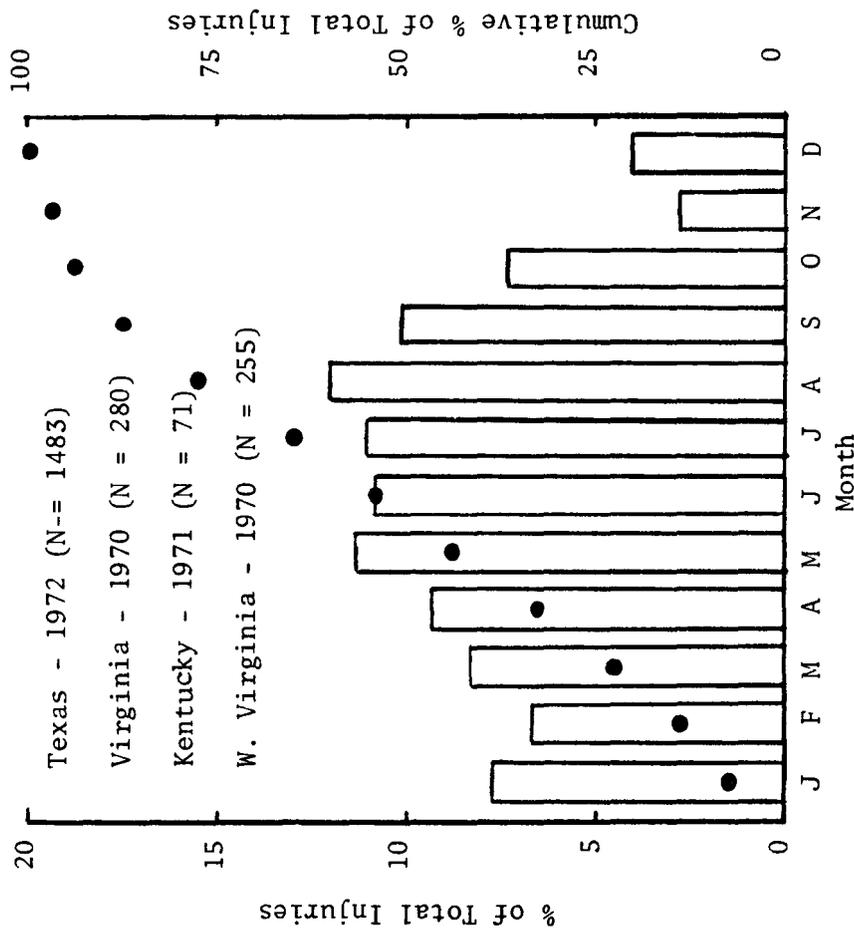


Figure 3-23. Annual Distribution of Injuries in Southern Operations.

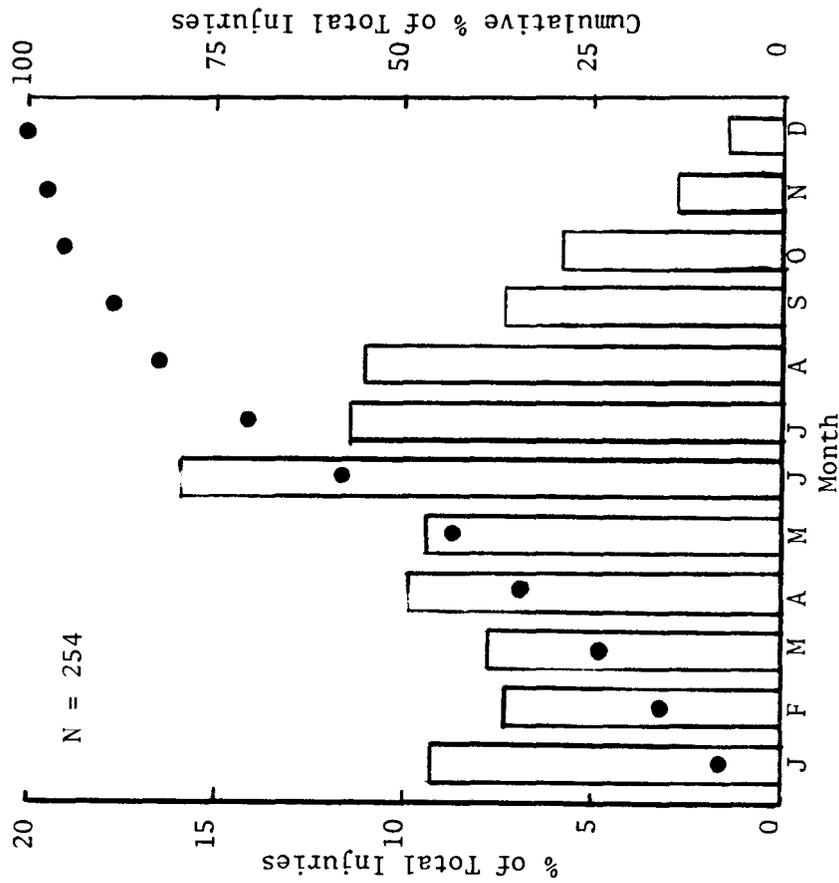


Figure 3-24. Annual Distribution of Injuries in Oregon (1970 - 1971)

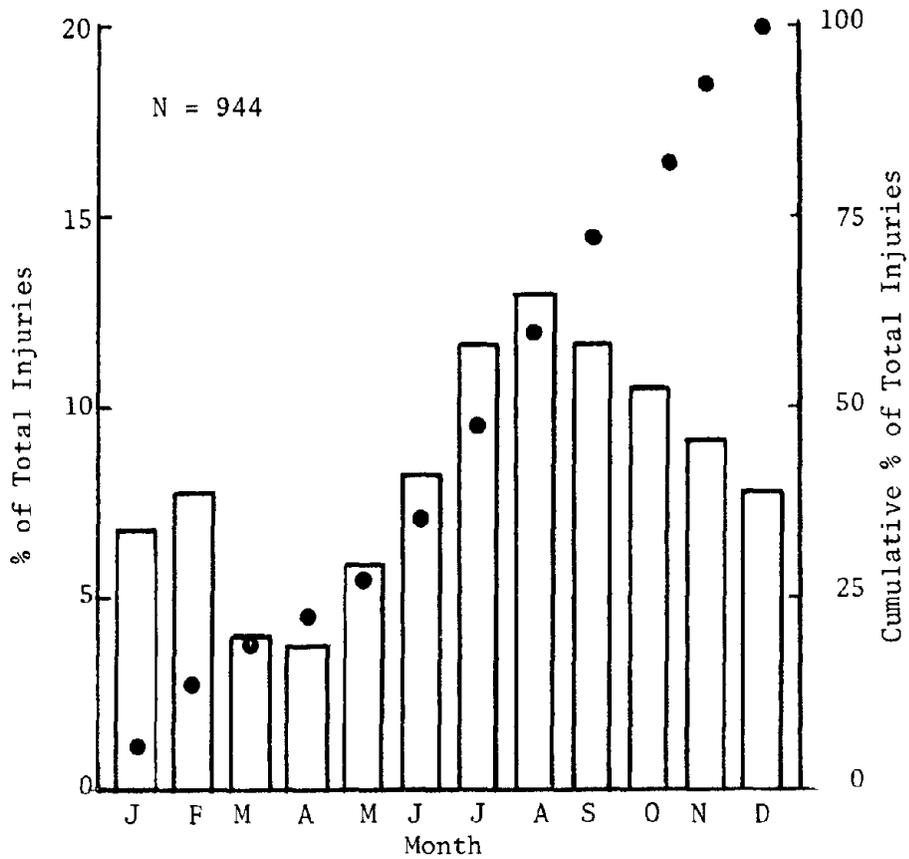


Figure 3-25. Annual Distribution of Injuries in Montana (1968 - 1972)

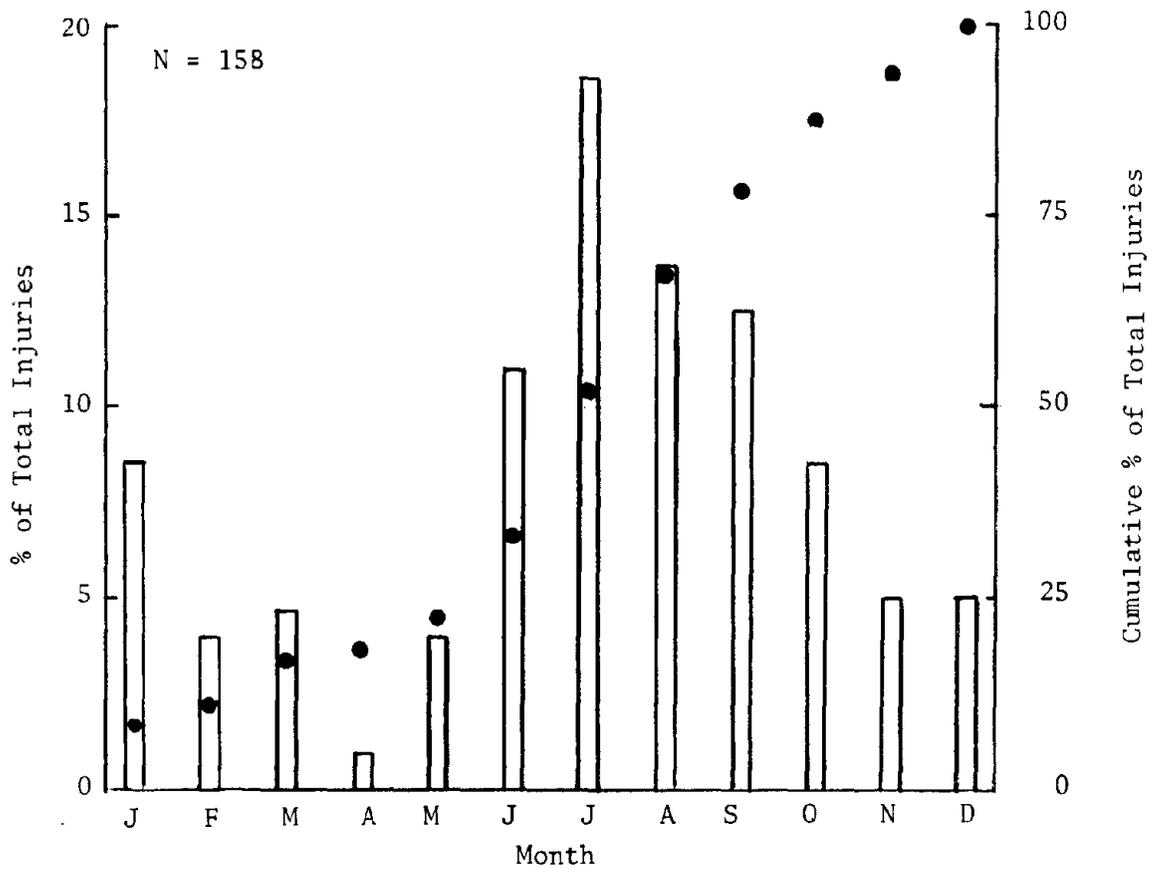


Figure 3-26. Annual Distribution of Injuries for Representative Maine Company (1971 - 1972)

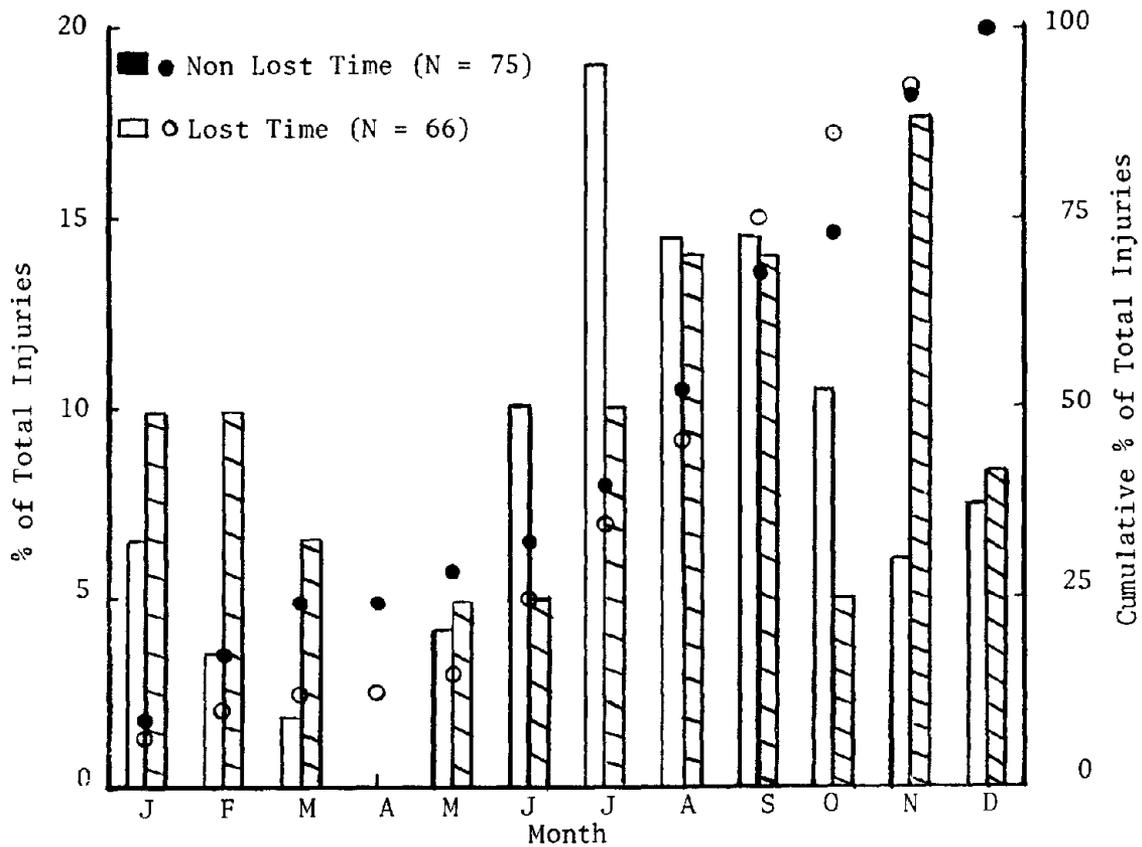


Figure 3-27. Annual Distribution of Injuries within Cutting Operations (representative Maine Company 1969 - 1972)

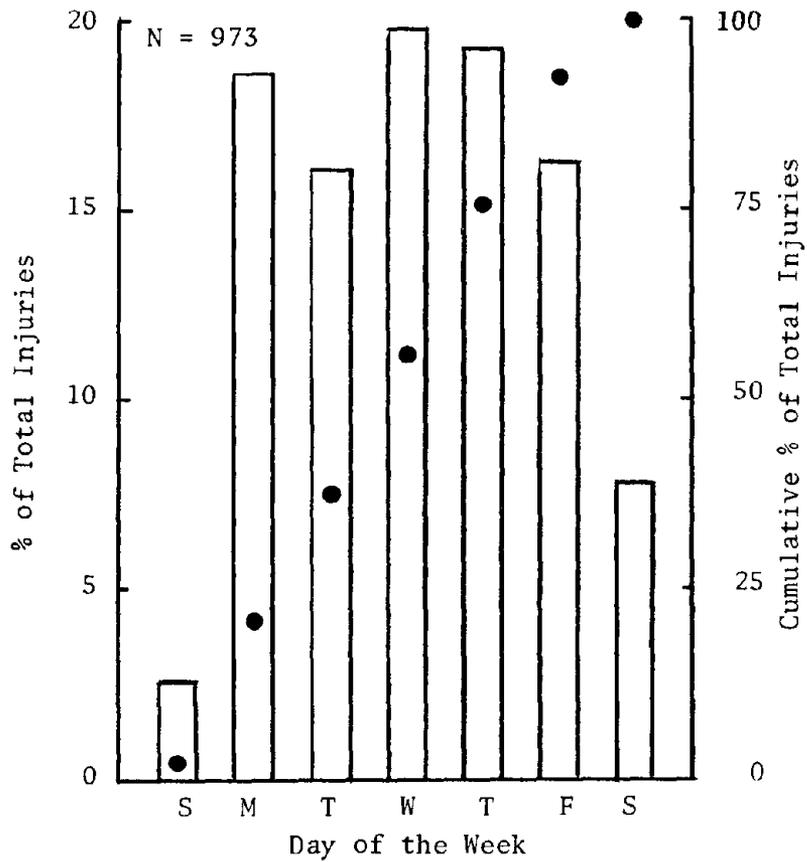


Figure 3-28. Weekly Distribution of Injuries in Montana (1968 - 1972)

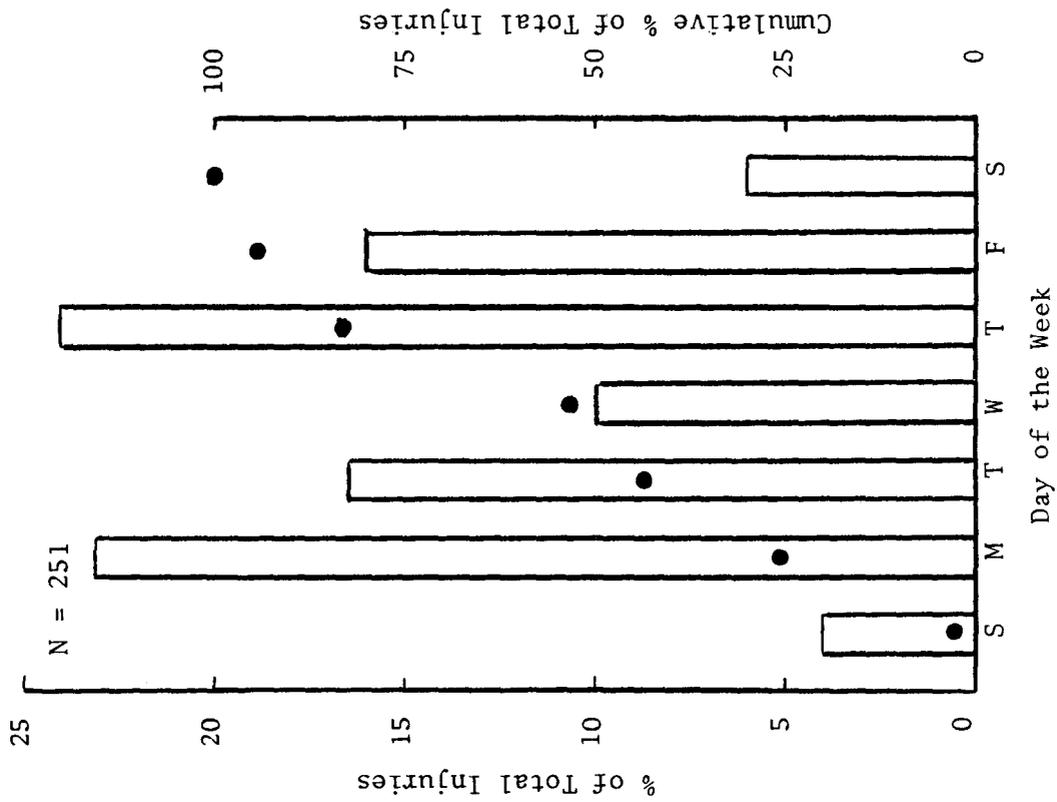


Figure 3-30. Weekly Distribution of Injuries in Oregon (1970 - 1971)

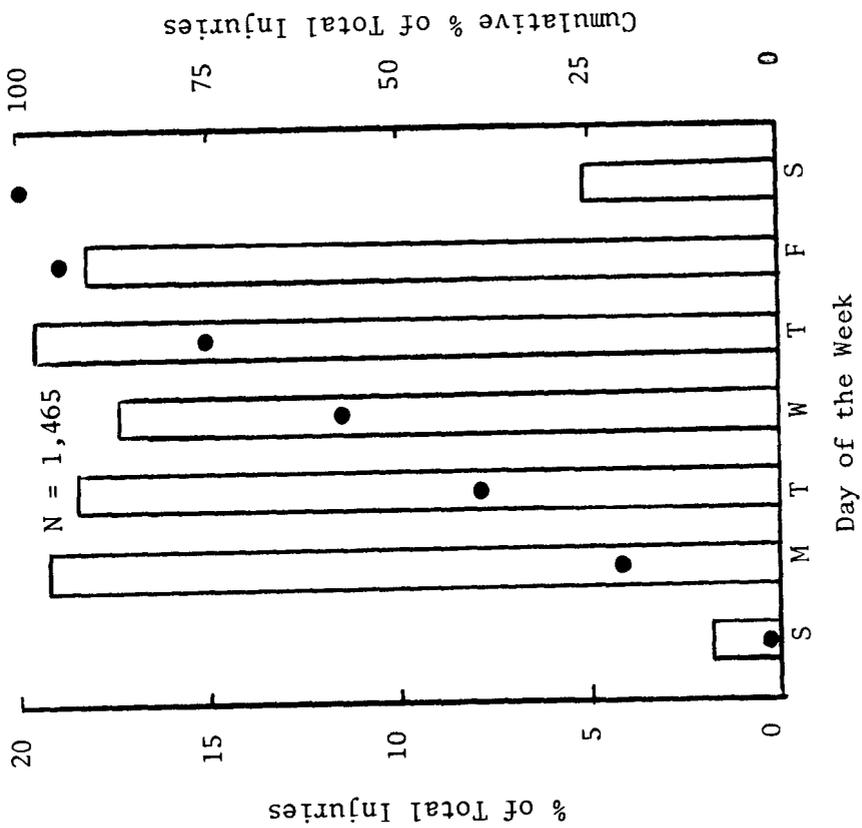


Figure 3-29. Weekly Distribution of Injuries in Texas (1972)

Weekly Injury Rates

Anecdotal information suggested that the occurrence of injuries might vary by day of the week. This was investigated with respect to three states which provided dates of injury; results are shown in figures 3-28, 3-29 and 3-30.

The Montana and Texas distributions are, for all practical purposes, identical and indicate that injuries occur with similar frequency over each day of the week. The relatively low occurrences of injuries on Sundays and Saturdays suggests what would be expected for days in which a majority of loggers would not usually work. The higher rates on Saturday (compared with Sunday) suggests that loggers in these states may work a 6-1/2 day week (especially in Montana).

Oregon data, on the other hand, shows greater variability with a reduced frequency recorded for Wednesday. No explanation is offered for this.

Daily Injury Rates

Data from three Southern states (Virginia, Kentucky and W. Virginia) were examined to determine injury rates as a function of time of day. The results are indicated in figure 3-31. As in the case of each of the other temporal parameters (above) the lack of information on number of workers available precludes a meaningful interpretation.

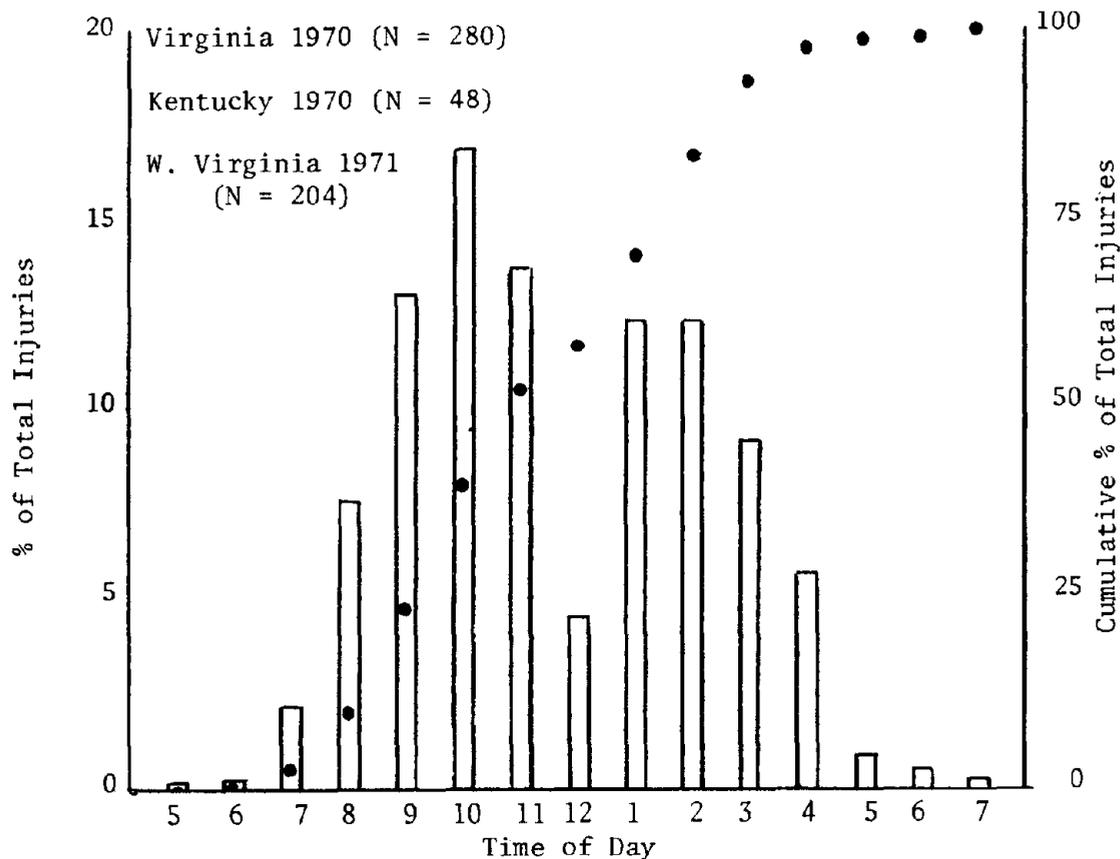


Figure 3-31. Daily Distribution of Injuries for Southern States.

BODY PART INJURED

Figure 3-32 presents a comparison of the distribution of injuries by body parts for logging and two other industrial classifications. Further comparison is shown between 1970 logging data (three states only) and the DOL 1955 data, with the Lumber and Wood Products Industry, and with the National Safety

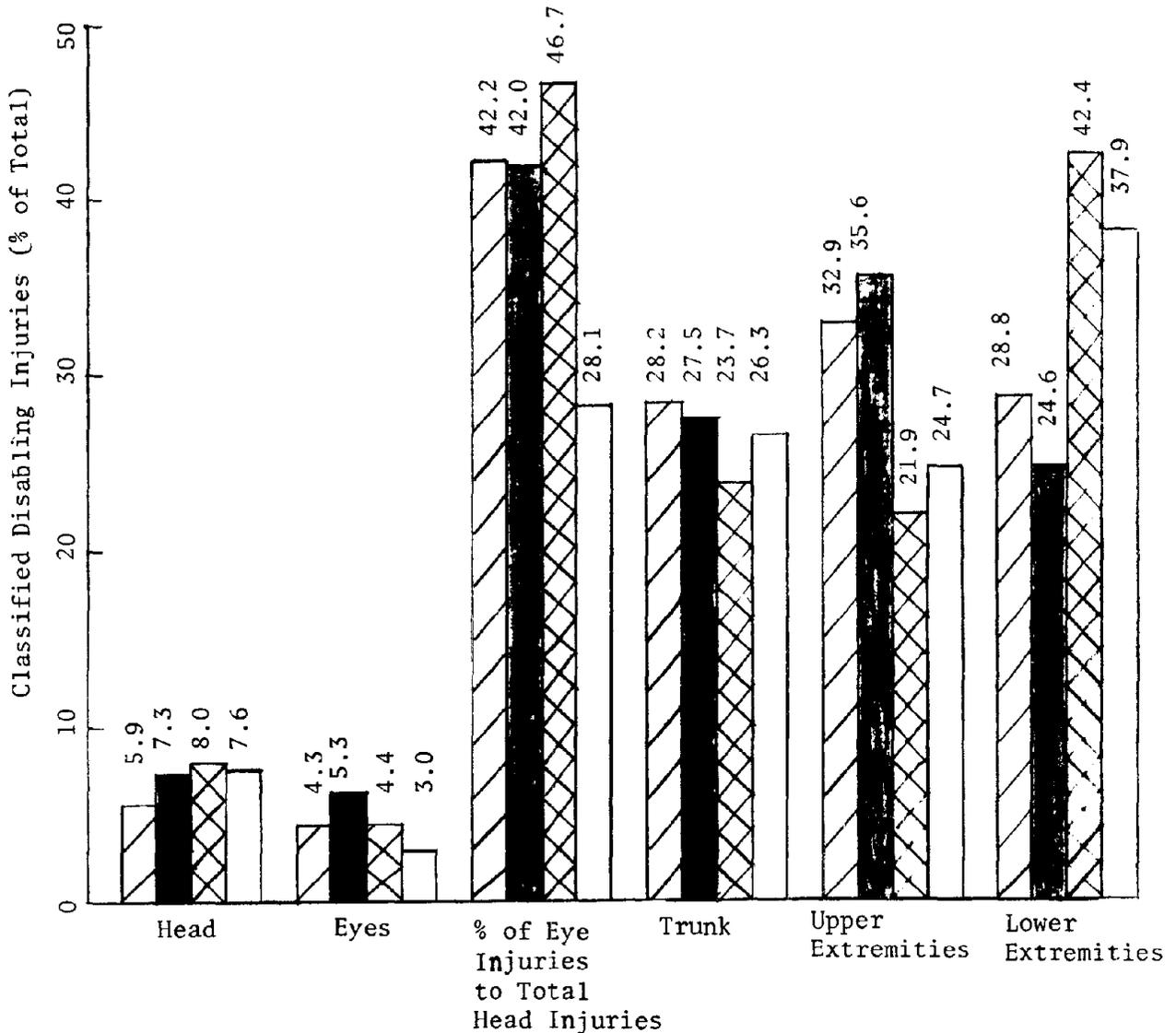
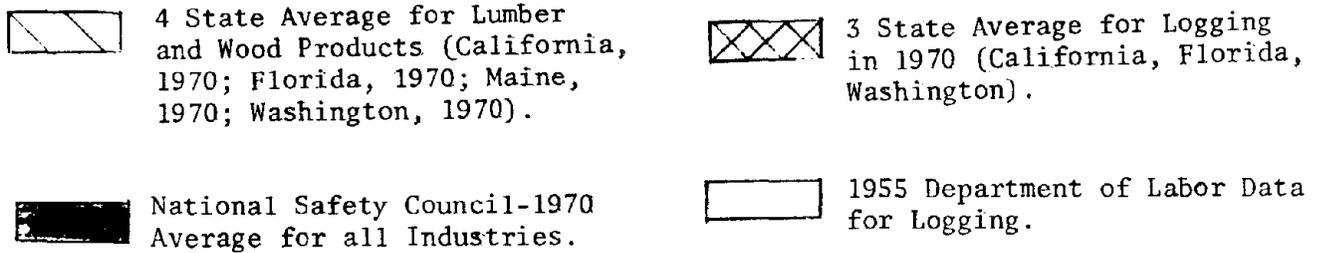


Figure 3-32. Comparison of the Distribution of Body Part Injuries for Three Industrial Classifications

Council (1970) average for "all industries". The major contrasts are noted as follows:

1. The Lumber and Wood Products Industry (LWPI) appears to compare well with the National Safety Council (NSC) average distribution.
2. In logging, there is a distinct increase in the frequency of lower extremity injuries and an approximately compensatory decrease in upper extremity injuries in contrast with both the NSC and LWPI data.
3. While head injuries appear somewhat comparable (logging is slightly higher) the increased ratio of eye injuries to head injuries appears significant. This is particularly noteworthy since logging eye injuries are slightly less frequent than the "all industry" average. It is also significant that the DOL 1955 survey showed a considerably lower ratio.

The conclusion which can be drawn from these observations is that over the years eye injuries have been decreasing but because of the greater use of helmet protection that eye injuries are becoming a greater proportion of the total injuries to the head. The suggestion is that helmets should have eye protection incorporated. Reservations on this suggestion are presented in Section I.

A major consideration should be for the use of protection to the lower extremities. The high frequency of saw injuries in both Northeastern and Southern logging operations lend credibility to the use of safety boots and leg and thigh pads discussed in Section I.

Data summarizing the body part distribution of logging injuries in greater detail are presented in figures 3-33 through 3-37. No explanations are offered for the differences among the five states.

NATURE OF INJURIES

The types of injuries associated with logging accidents are summarized by figures 3-38 and 3-39. Cuts and lacerations are the most frequent in both Western and Southern operations. For the Western states this was not expected because of the relatively low frequency of saw injuries in comparison with the Southern and Northeastern states. On the other hand, the high frequency of strains, fractures, etc., for Western states is not surprising because of the types of injuries previously indicated (slips and falls, impacts with rolling logs, etc.).

The data of figure 3-39 for a single Southern company appears comparable to the data reported for the Southern states. Discrepancies would be expected because of the low data base.

Figure 3-33. Montana (1968-1972) Injuries by Body Part

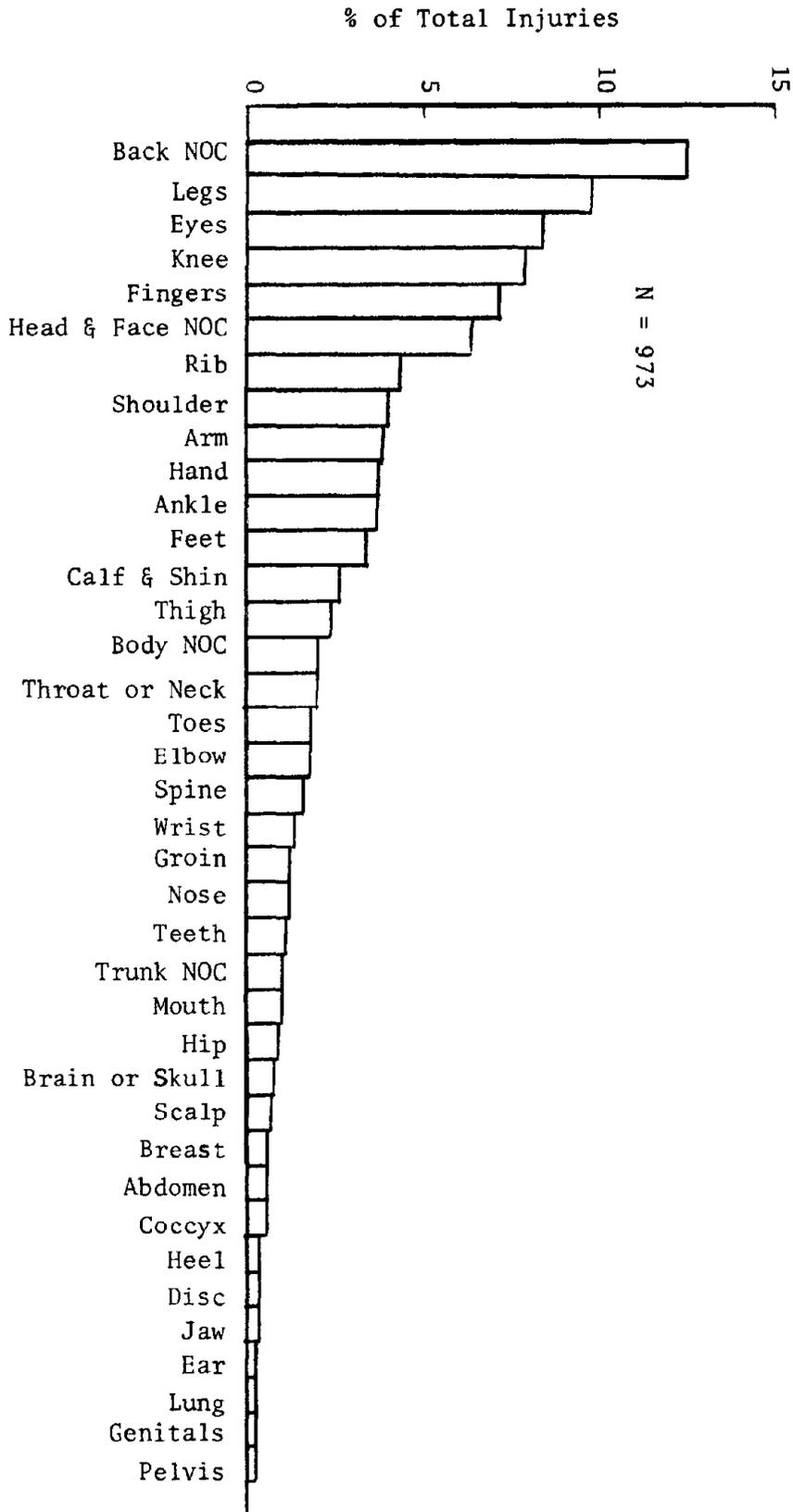


Figure 3-34. Texas (1972) Injuries by Body Part.

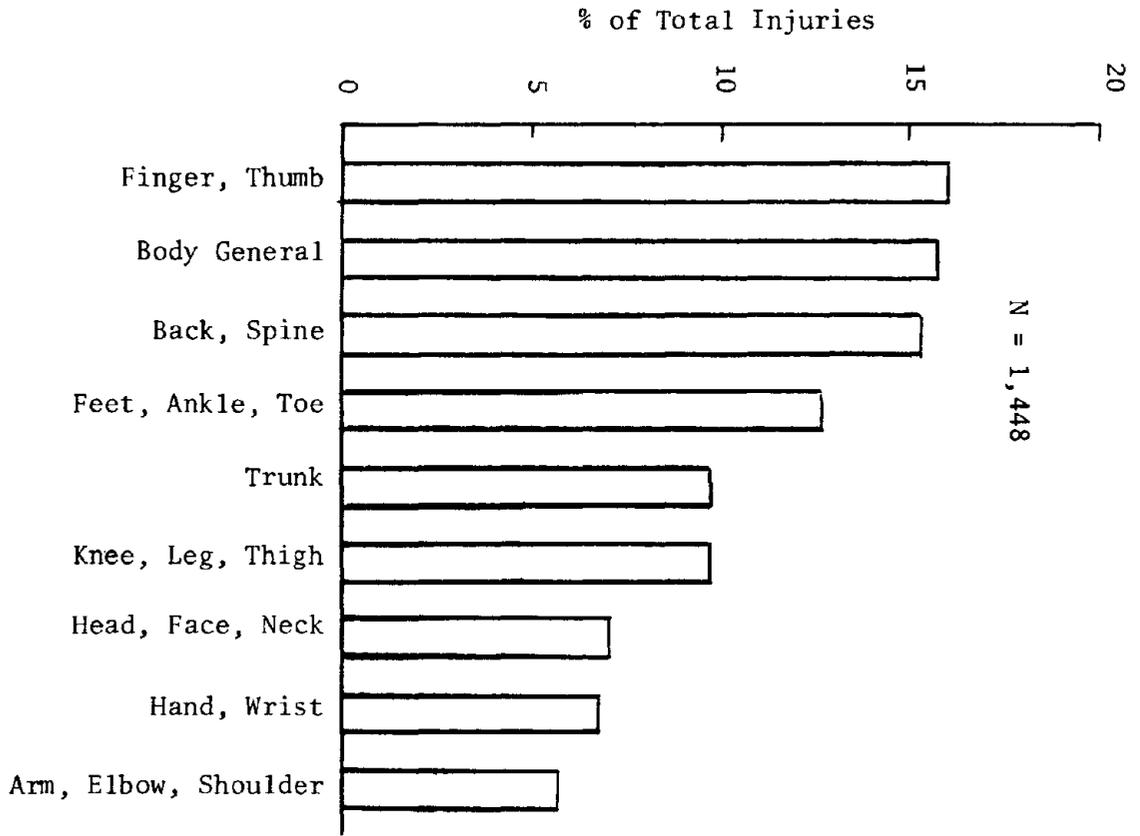
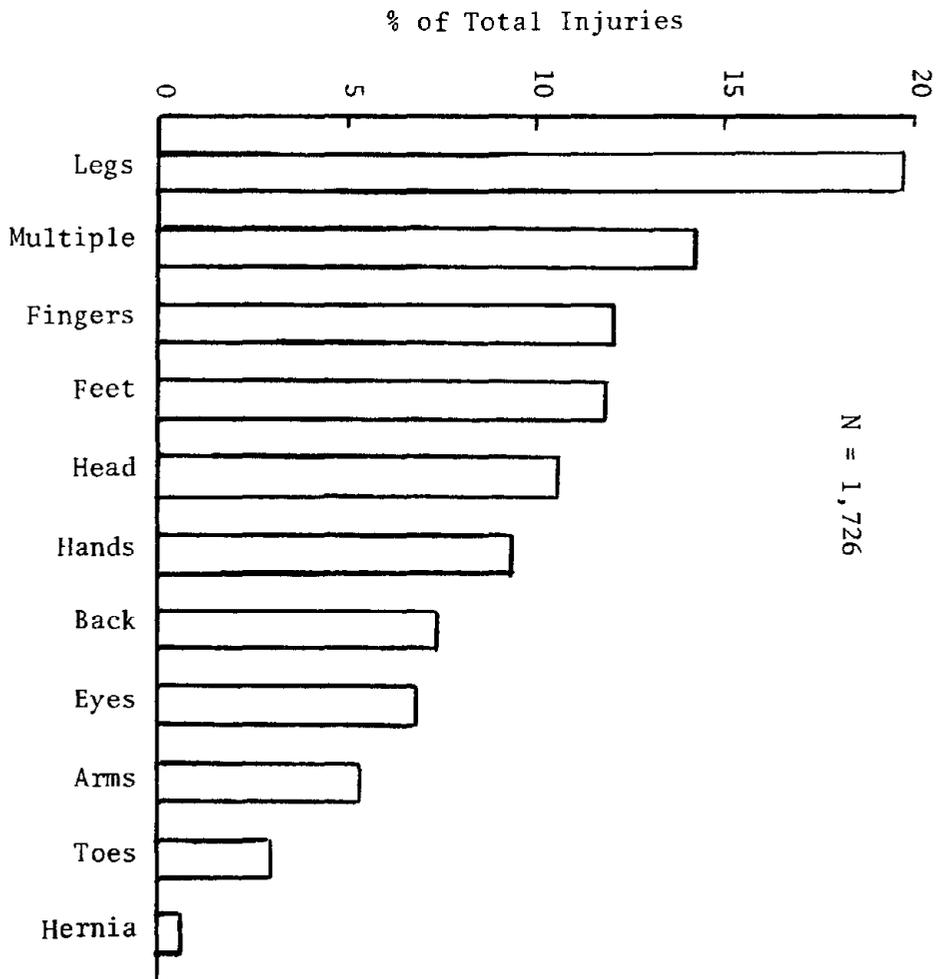


Figure 3-35. North Carolina (FY 69-70) Injuries by Body Part



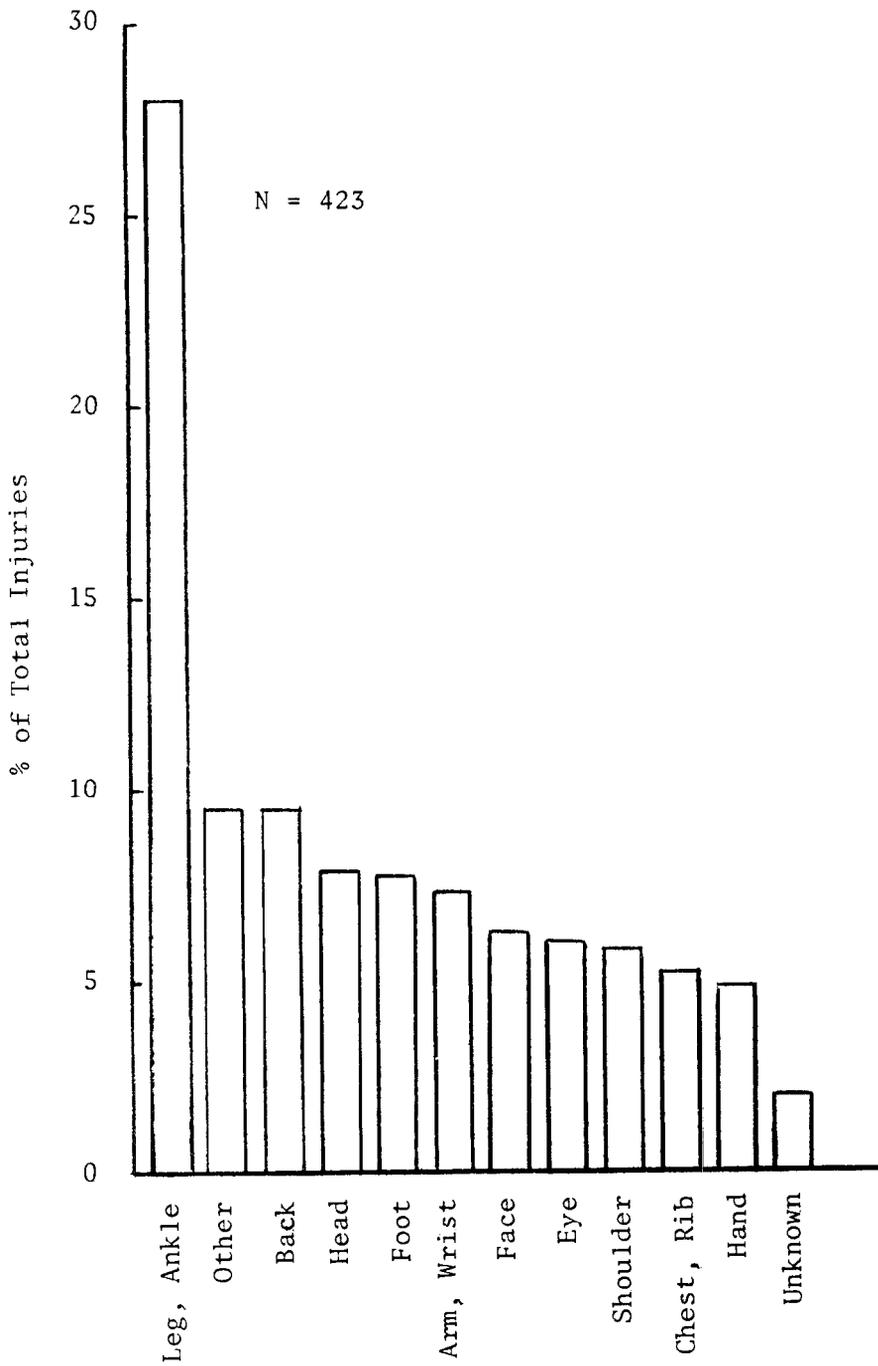


Figure 3-36. Virginia (1970) Injuries by Body Part

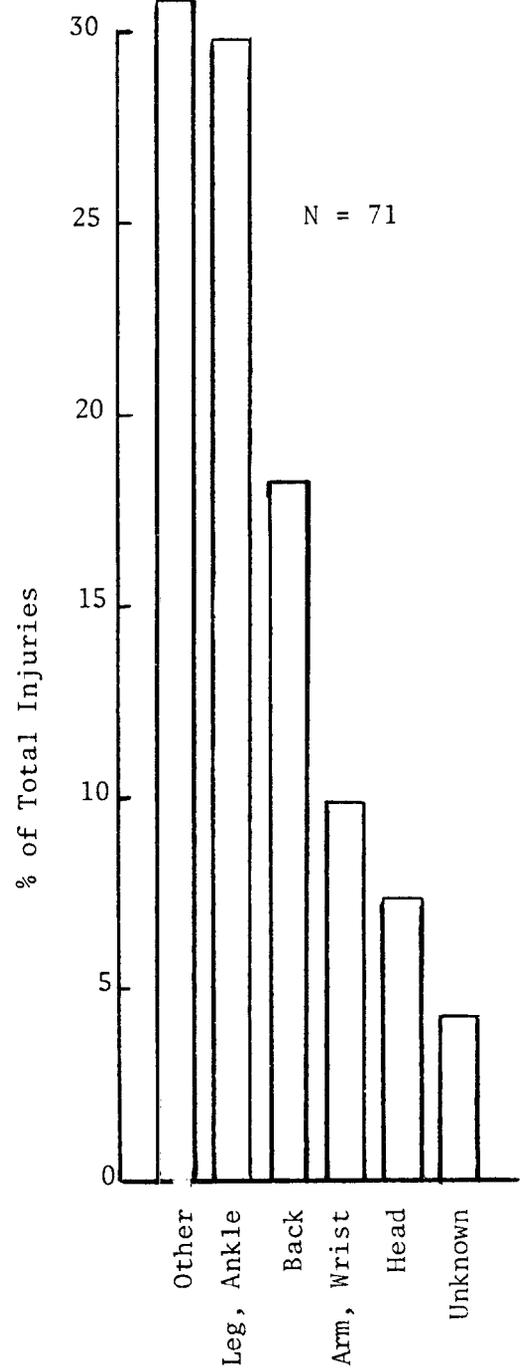


Figure 3-37. Kentucky (1971) Injuries by Body Part.

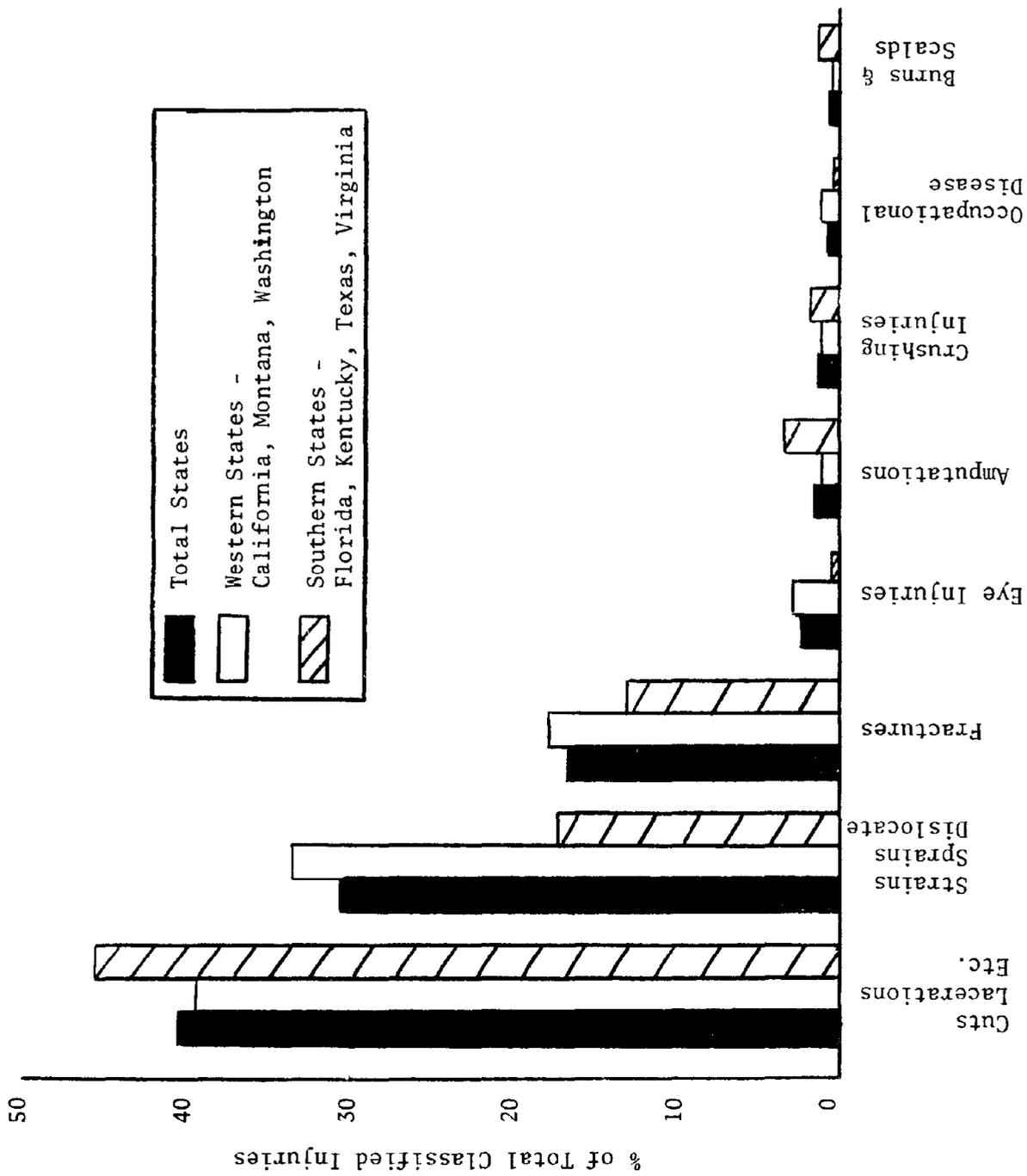


Figure 3-38. Nature of Injuries

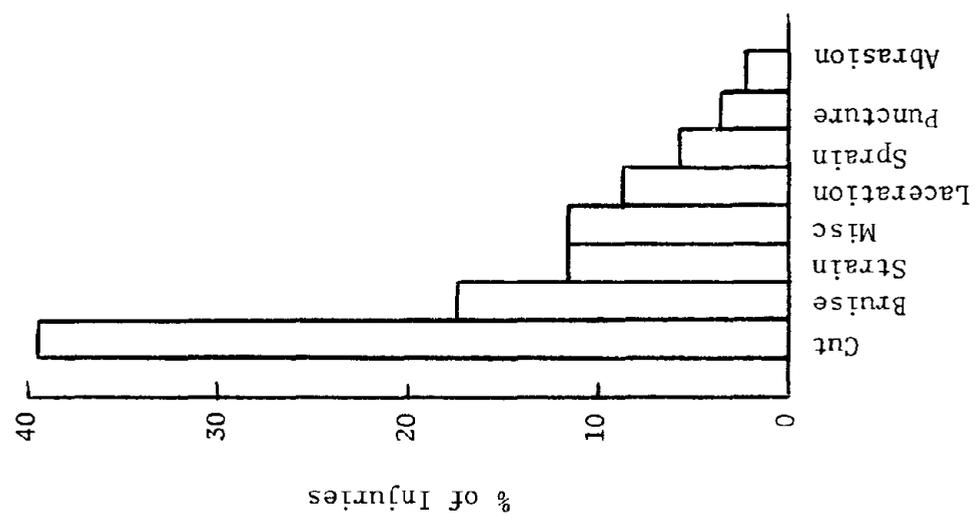


Figure 3-39. Logging Injuries by Type of Injury (Typical Large Southern Co. - 1964 - 1972)

Section IV

COSTS OF DISABLING WORK INJURIES

Data obtained from several states provided some indices of the costs of injuries to loggers. For the most part, these data excluded the costs of fatalities and are summarized in this Section.

GENERAL COMPARISON

Table 4-1 summarizes logging injury costs for selected geographic area and provides some comparison with the costs of injuries within the Lumber and Woods Products industry and with all industries. The general trend appears to indicate that logging injuries are most costly. In table 4-2, data from North Carolina has been processed to show that both medical and compensation costs of logging injuries exceed the averages for all other occupational injuries within the state. These costs are compared with those for Montana (Table 4-3) and for Washington (Table 4-4). While it appears from tables 4-1, 4-3 and 4-4, that Western logging injury costs are higher there has been no attempt to differentiate among the states as to Workmens Compensation payment policies.

OCCUPATIONAL TRENDS

Only Washington provided data which permitted the analysis of injury costs on the basis of logging occupational specialty. These relationships are summarized by figures 4-1 through 4-5.

In figure 4-1, the occupational specialties have been rank-ordered according to percent of total days lost due to injuries. The trend generally holds for the percent of injuries occurring within each occupation, as shown in figure 4-2 and for the percent of total dollars cost, as shown in figure 4-3.

On the other hand, the average number of days lost per injury (Figure 4-4) and the average cost per injury (Figure 4-5) show a different trend. Although several occupations show a greater average cost per injury and a greater number of days lost per injury it appears that the majority of occupations do not deviate greatly from the averages for each parameter.

COSTS OF INJURIES

Costs for injuries to logging personnel are shown in figures 4-6 through 4-8 for the State of Montana. Also indicated (Figure 4-8) is a comparison of costs between Montana and North Carolina for part of body injured.

Table 4-1. INJURY COSTS FOR SELECTED GEOGRAPHIC AREAS

GEOGRAPHIC AREA	NEW YORK 1969	¹ FLORIDA 1967-1971	TENNESSEE 1966	WASHINGTON 1966-1971	BRITISH COLUMBIA 1971
Average Cost/ Injury for all Industries	\$1,460	\$248	\$1,053	-	\$1,314
Average Cost/ Injury for Lumber & Wood Products (SIC 24)	1,276	326	922	-	2,051
Average Cost/ Injury for Logging (241)	932	392	-	\$1,368	2,418

1. Compensation benefits are paid when the injured worker is unable to return to work at the end of seven days. Should the disability extend beyond 21 days, compensation is paid from the date the disability began.

2. Non-compensable lost time: is an injury which results in the loss of not less than one nor more than seven whole days or working shifts from the employee's scheduled employment and does not decrease the employee's physical capacity. These are sometimes referred to as "disabling medical only".

Table 4-2. WORK INJURY COSTS - NORTH CAROLINA

YEAR	ACCIDENTS (ALL INDUSTRIES)	MEDICAL COSTS (ALL INDUSTRIES)	COMPENSATION (ALL INDUSTRIES)	LOGGING (% OF TOTAL)			
				ACCIDENT	MEDICAL COST	COMP. COST	TOTAL COST
1969	102,976	\$ 8,664,867	\$ 12,373,872	.77	1.12	1.95	1.61
1970	100,233	9,127,117	12,801,861	.93	1.41	1.95	1.73
AVG.	101,604	\$ 8,895,992	\$ 12,587,866	.85	1.27	1.95	1.67

Table 4-3. INJURY COST COMPARISONS

	TOTAL INJURIES	MED. \$	AVG. MED.\$	COMP.\$	AVG.COMP.\$	TOTAL \$	AVG.\$/ INJURY
NORTH CAROLINA FISCAL 69-70	1726	226,561	131	491,426	285	717,987	416
MONTANA 68-72	943	192,963	205	454,097	482	647,060	686

Table 4-4. WASHINGTON NON-FATAL INJURY COSTS

YEAR	NO. OF CLAIMS	TOTAL DAYS LOST	AVERAGE DAYS LOST	TOTAL AWARDS	AVERAGE COST PER CLAIM
1965	1849	137,885	74.57	\$ 1,787,126	\$ 966.54
1966	1691	141,936	83.94	1,722,419	1,048.15
1967	1559	164,965	105.81	2,241,514	1,437.79
1968	1488	124,266	83.51	1,889,458	1,269.80
1969	1521	140,188	92.17	2,056,295	1,351.94
1970	1555	147,256	94.70	2,284,187	1,468.93
1971	1278	158,302	123.87	2,533,346	1,982.27
AVG.	1536	144,971.14	92.75	2,080,621.71	1,331.17

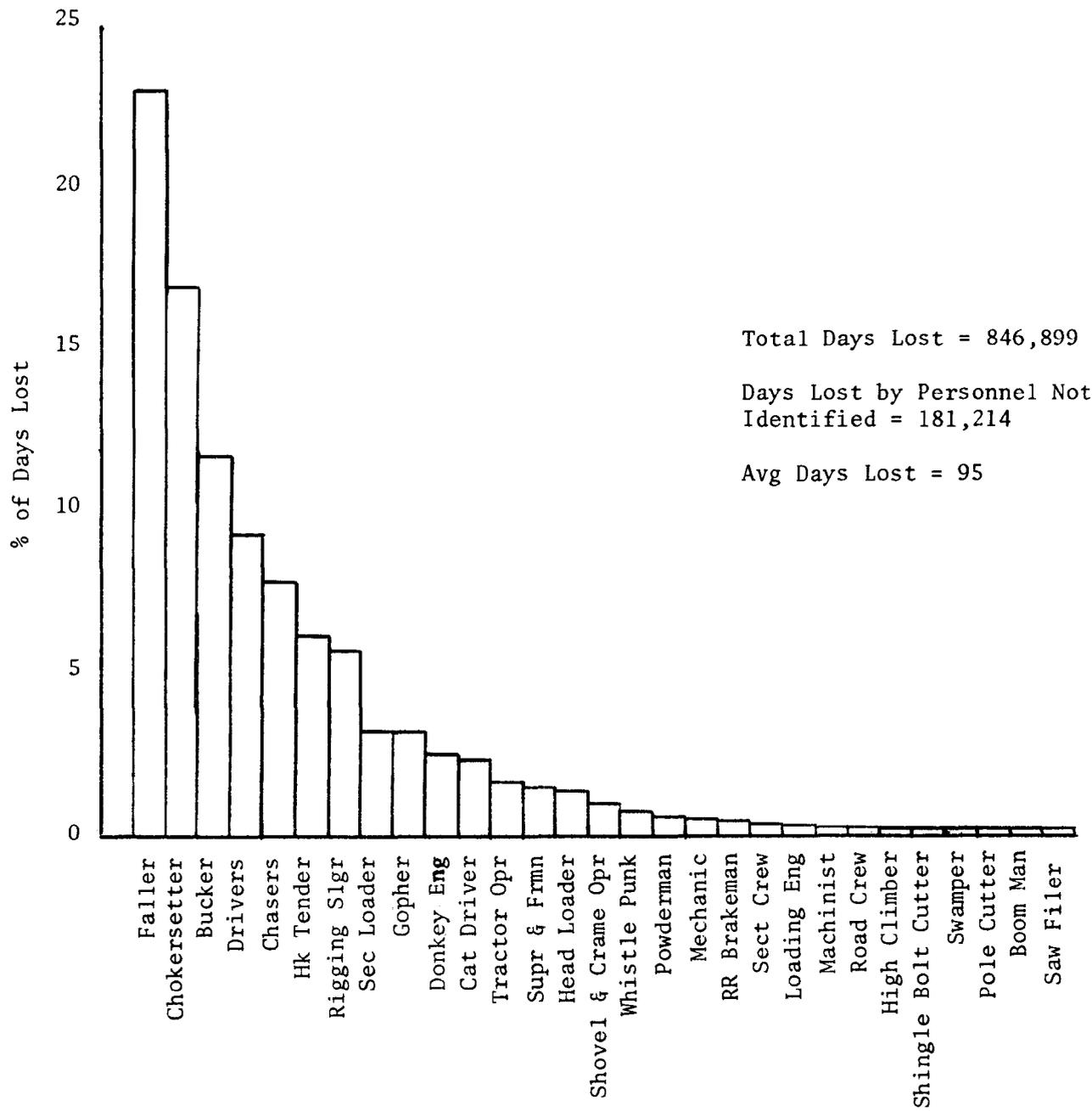


Figure 4-1. Comparison of Injury Severity for Logging Occupational Specialties (Washington 1966-1971)

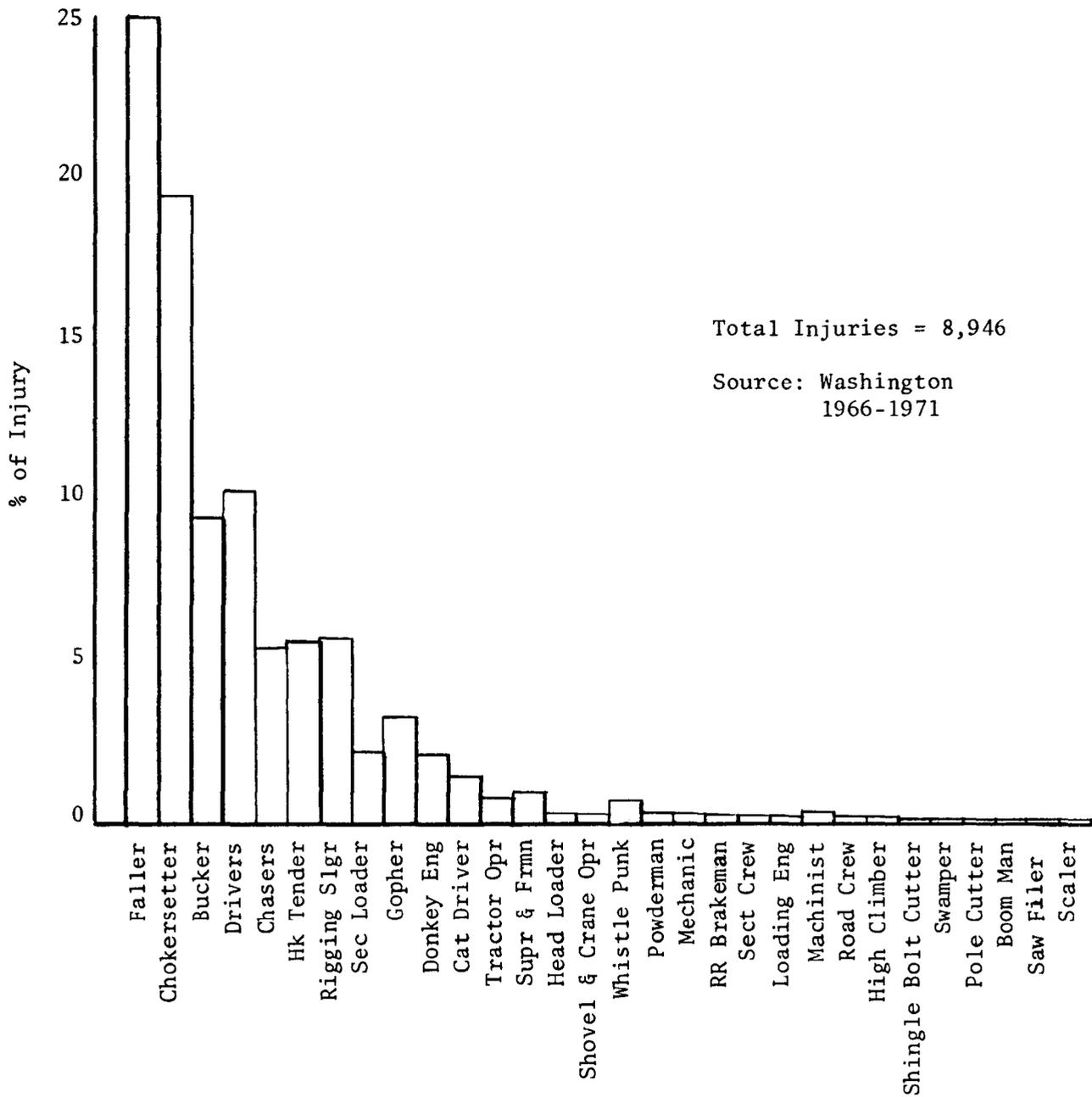


Figure 4-2. Comparison of Injury Frequencies for Logging Occupational Specialties (Washington 1966-1971)

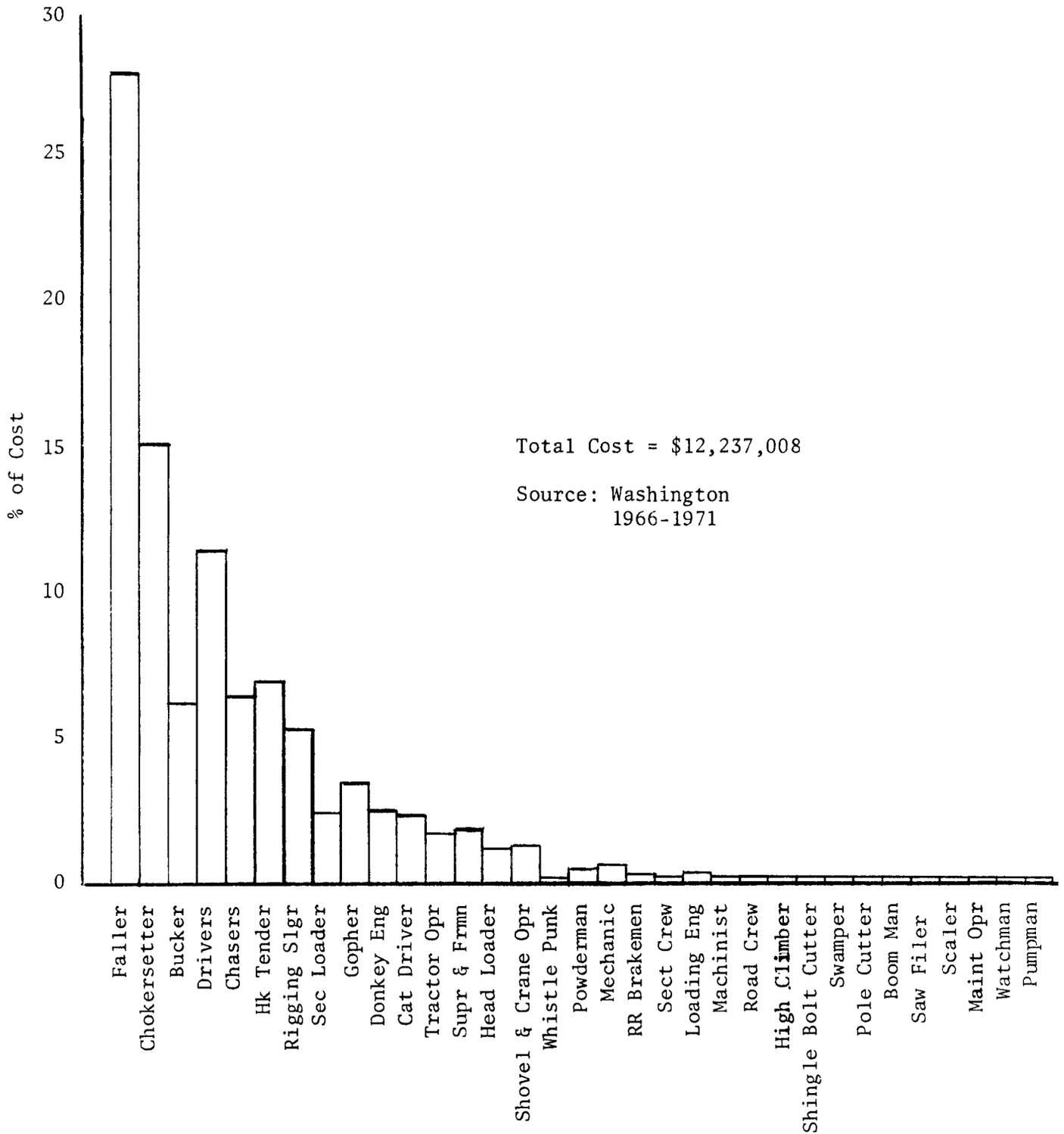


Figure 4-3. Comparison of Average Cost/Injury for Logging Occupational Specialties (Washington 1966-1971)

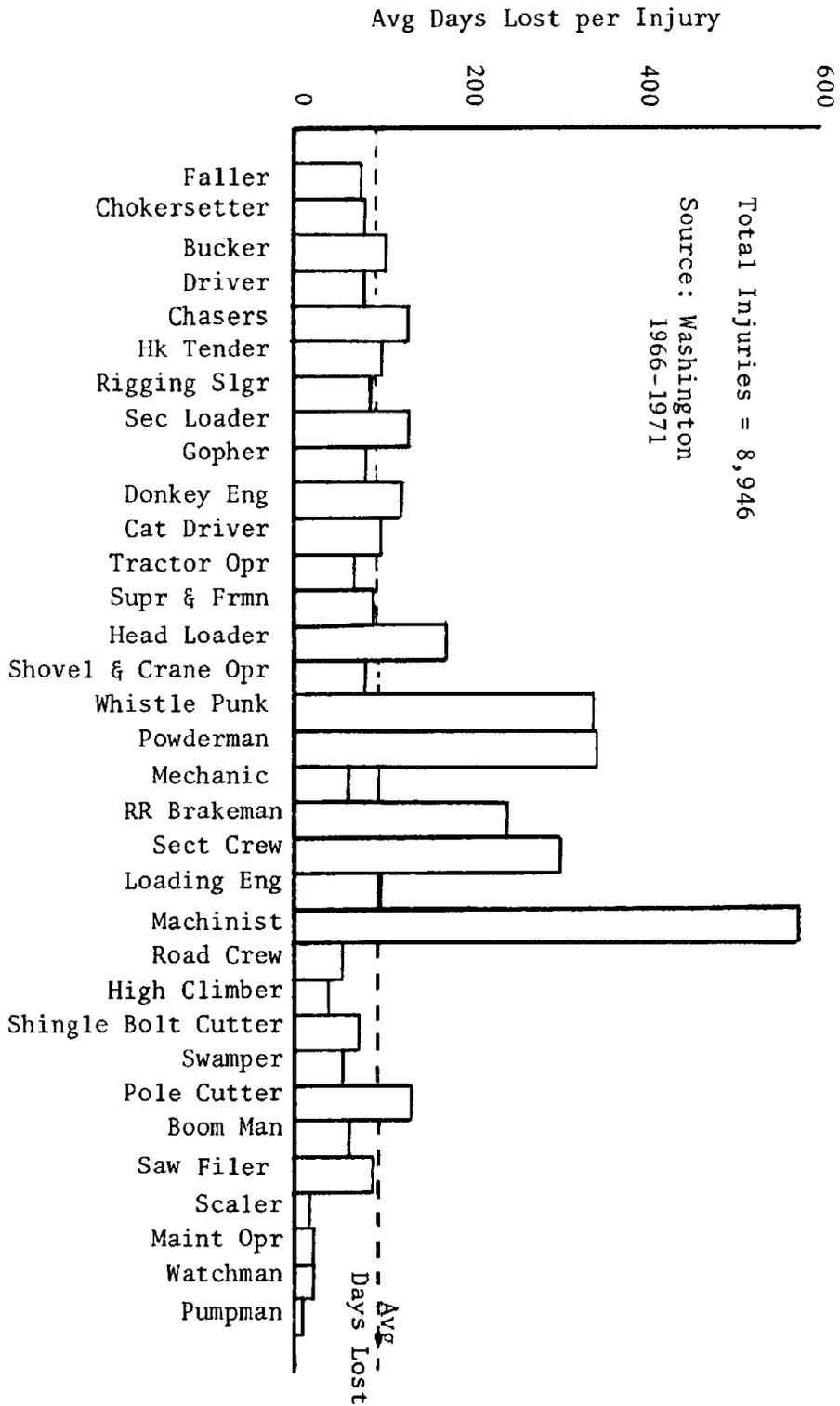


Figure 4-4. Comparison of Injury Severity for Logging Occupational Specialties (Washington 1966-1971)

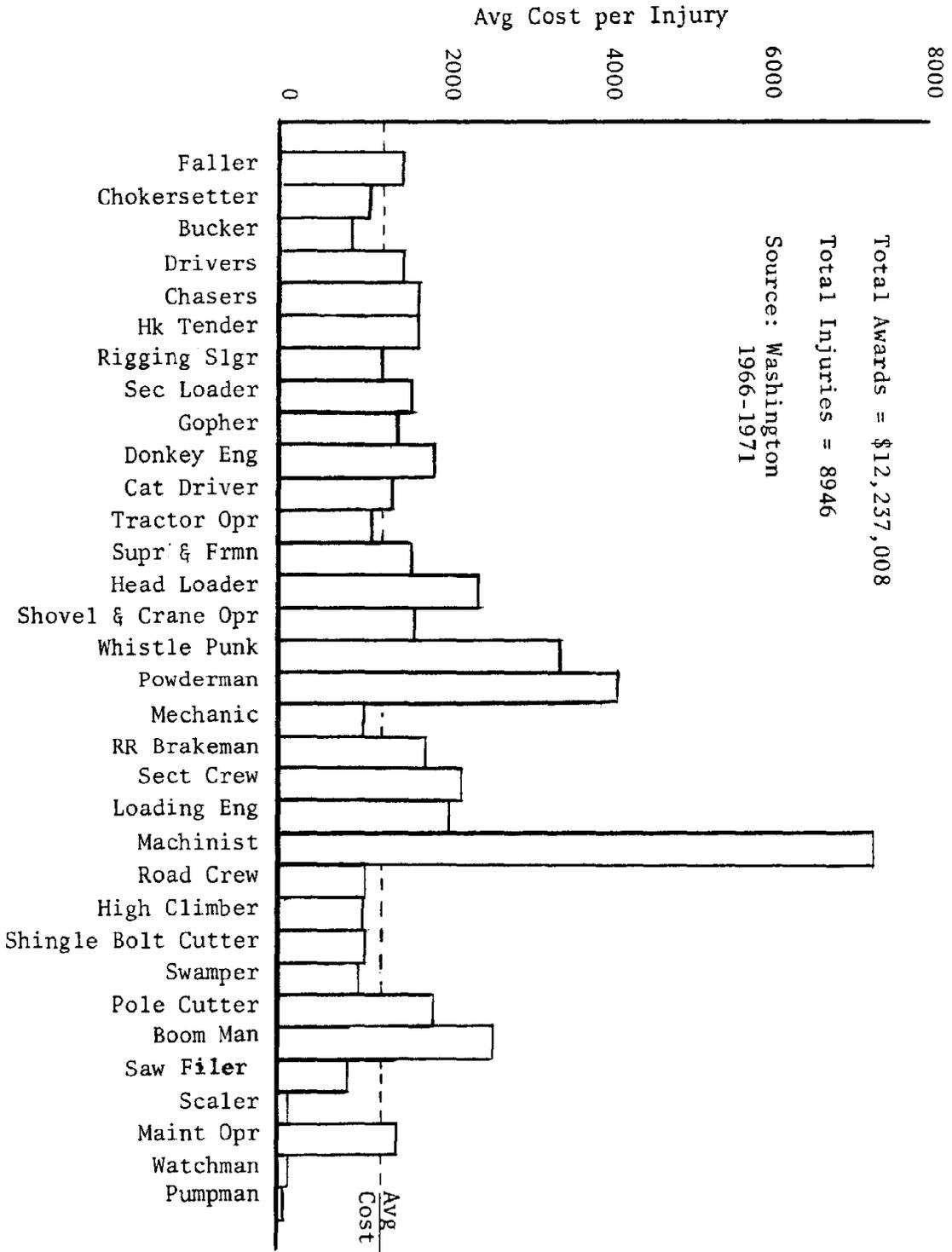


Figure 4-5. Comparison of Injury Costs for Logging Occupational Specialties (Washington 1966-1971)

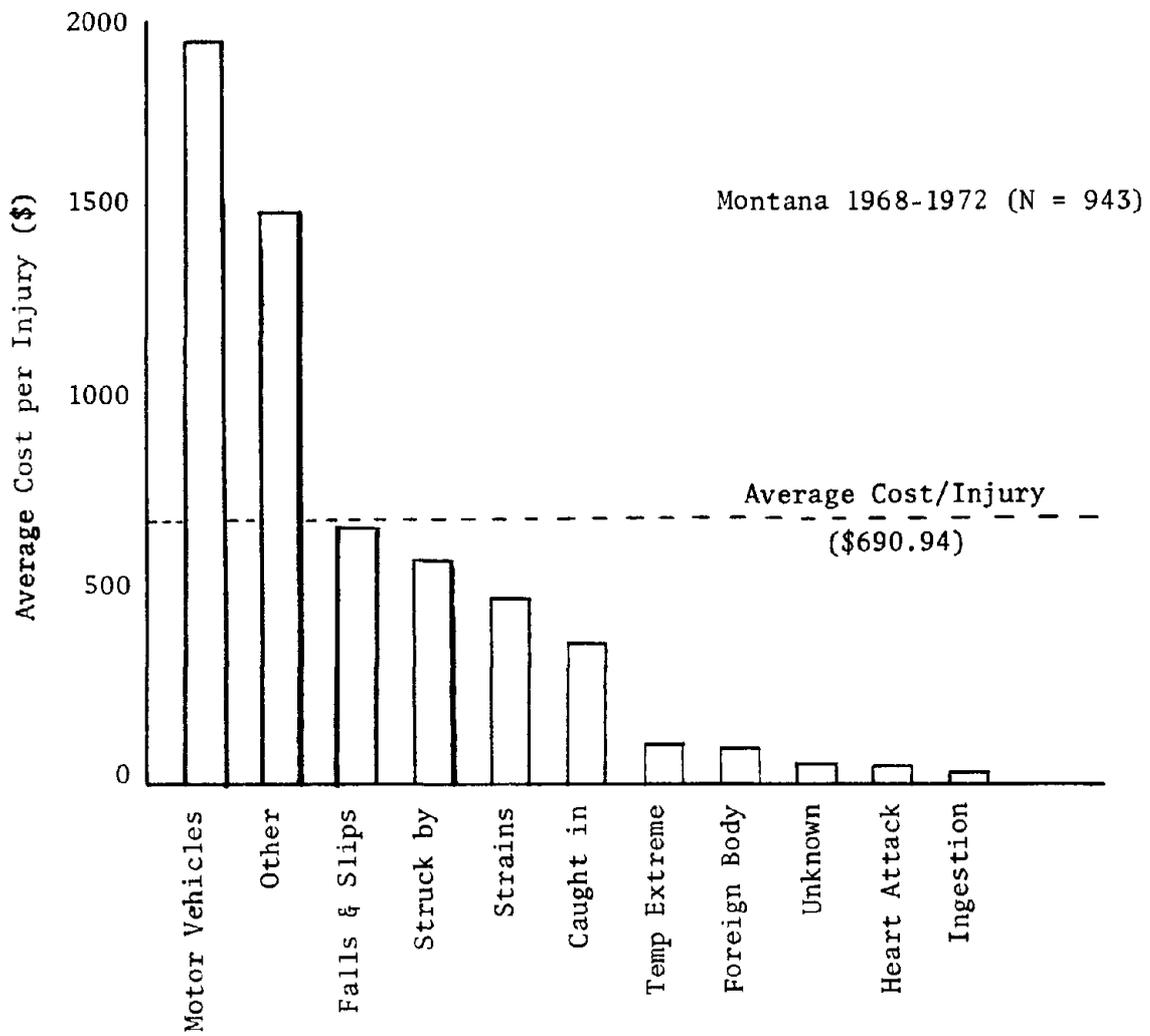
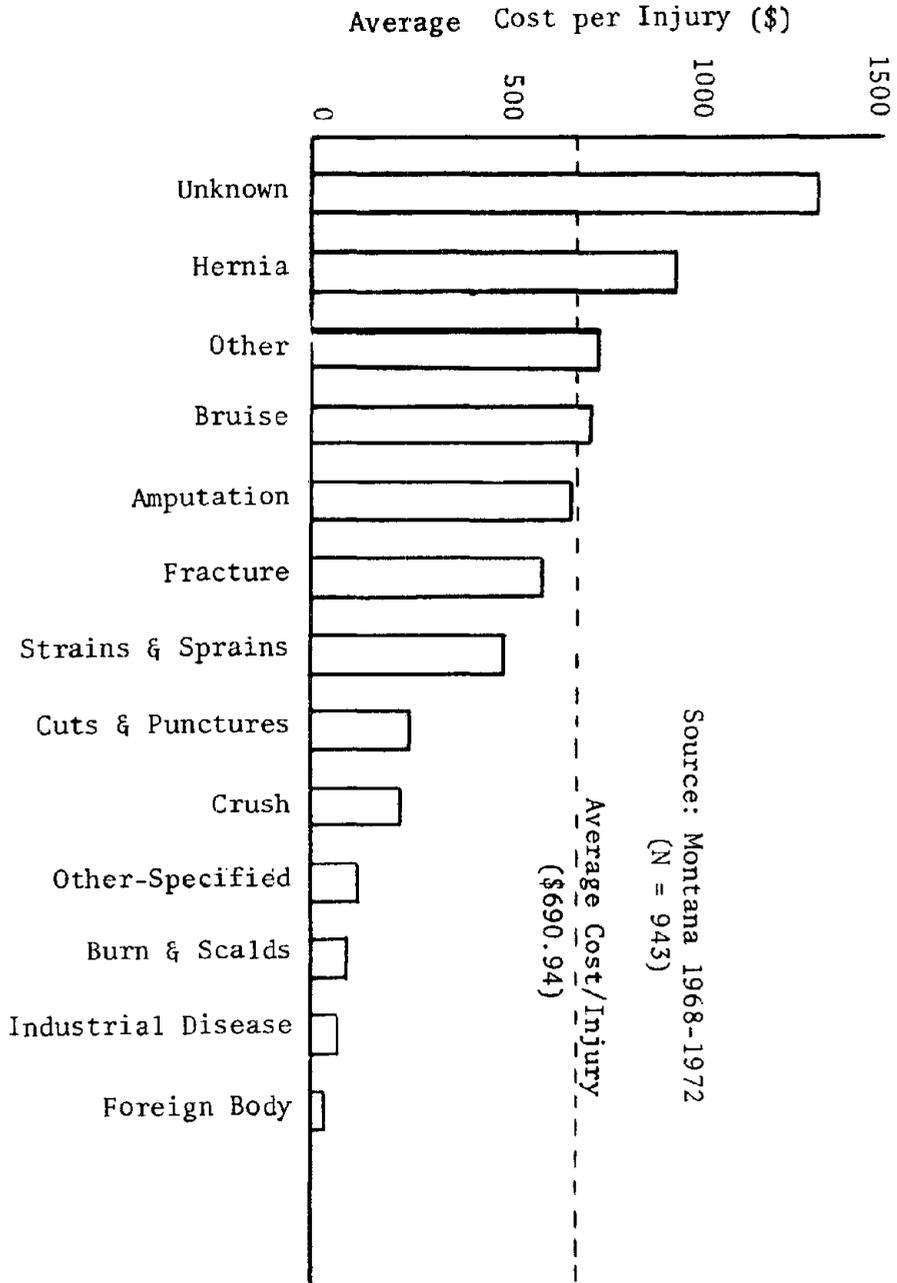


Figure 4-6. Comparison of Average Costs per Injury by Types of Accident

Figure 4-7. Comparison of Average Costs per Injury by Nature of Injury



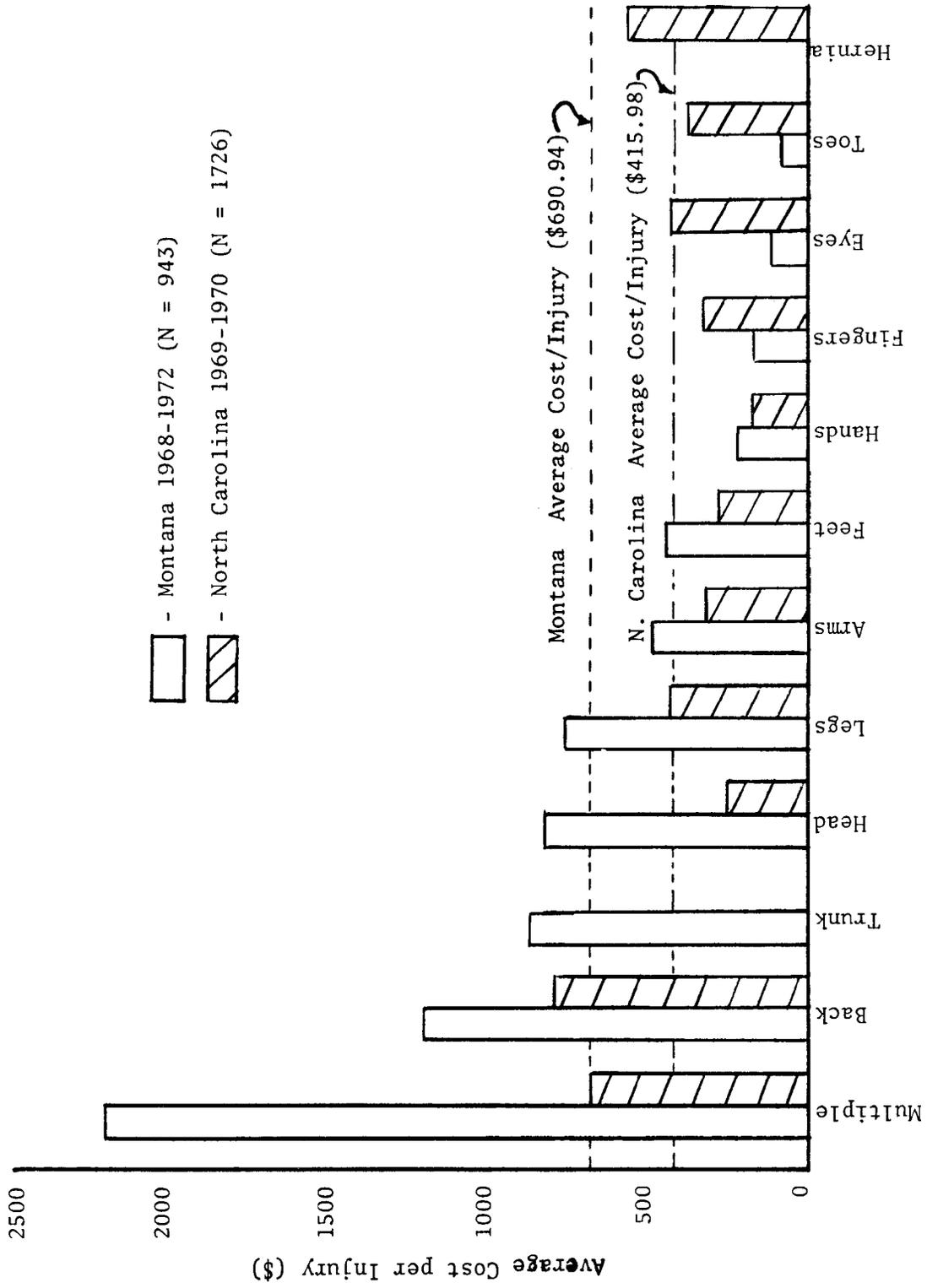


Figure 4-8. Comparison of Average Costs of Injuries to Each Body Part

Section V

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APPENDIX A

LOGGING OPERATIONS/TASKS DESCRIPTIONS

While logging methods employed across the United States differ with respect to how the job is performed there are five basic steps in the harvesting of trees, as shown by figure A-1. Each of these steps is described in this



Figure A-1. General Model of Logging Operations

appendix and each description contains information from observations in Northern, Southern and Western operations. The terminology used in this appendix was derived from existing practice; however, no attempts have been made to use the terminology commonly observed in each geographic area. Reference to the glossary of terms in Appendix E will provide definition of the terms used in this presentation, as well as other terminology.

Photographs were taken at each observation site and those used were selected to graphically describe the type of operation; in many cases photographs taken in the West may be presented alongside of an Eastern photograph to describe the same type of operation. To facilitate the use of these photographs as an independent part of this report they have been merged as a photographic album in Appendix F. The photographs are referred to as "Plates" rather than as figures.

GENERAL BACKGROUND

While figure A-1 describes the five basic steps in tree harvesting it is to be recognized that variations in each of these steps are practiced. These variations will be evident, not only on a geographic basis, but in operations carried on within a given community, as well.

The descriptions within this appendix are intended to summarize those operations observed during the study. The following is a listing of the contents of this appendix.

	Page
PRE-LOGGING OPERATIONS	A-5
OPERATIONS PLANNING	A-5
Computer Programming	A-5
Layout of Logging Operations	A-5
Logging Camp Planning	A-7
Logging Road Construction	A-7
Logging Sequence	A-8
Equipment Selection and Maintenance	A-8

FELLING AND BUCKING OPERATIONS	A-11
OPERATIONS PLANNING AND SUPERVISION	A-11
TREE FELLING	A-13
TECHNICAL CONSIDERATIONS	A-13
Analytic Skills	A-13
Manipulative Skills	A-14
Energy Expenditure Demands	A-15
FIELD OBSERVATIONS - FELLING	A-16
Felling Crew Size	A-17
Interpersonnel Distance	A-17
Brush Clearance and Escape Routes	A-19
Tree Cutting	A-21
Tree Cutting Machines	A-23
Snag Felling Considerations	A-24
Felling from Spring Boards and Chopping Platforms	A-25
TREE BUCKING	A-25
Technical Considerations	A-26
Analytic Skills	A-26
Manipulative Skills	A-26
Energy Expenditure Demands	A-26
Field Observations - Bucking	A-26
Bucking at Felling Site	A-26
Bucking and Limbing at the Landing	A-28
Miscellaneous Bucking Activities	A-28
CHAIN SAW OPERATIONS	A-29
TRANSPORTABILITY	A-29
SAW REFUELING	A-31
SAW STARTING	A-32
SAW OPERATION	A-33
Noise and Vibration Generation	A-33
Eye Protection	A-33
Saw Guarding	A-33
LOG TRANSPORTATION - IN FOREST	A-33
SKIDDING OPERATIONS (Skidder Vehicle)	A-34
Skidder Vehicle Characteristics	A-35
Skidder Vehicle Alternative Uses	A-36
Injury Potential	A-36
YARDING OPERATIONS	A-36
Southern Cable Skidding	A-36
Cable Yarding	A-37
Cable Rigging Installation	A-37
Choker Setting Operations	A-38
Log Haulage	A-39
Other Cable Yarding Methods	A-39
ADDITIONAL CONSIDERATIONS IN LOG HAULAGE	A-39
LANDING OPERATIONS	A-40

LANDING AREA DESCRIPTION	A-40
OPERATIONS WITH VEHICLE SKIDDING TECHNIQUES	A-40
LOG LOADING	A-41
Manual Loading	A-41
Grapple Loading	A-42
Fork Loading	A-42
Truck Loading Requirements	A-43
LANDING OPERATIONS HAZARDS	A-44
LOG TRANSPORTATION OPERATIONS	A-44
TRUCKING ROUTE	A-44
LOG DUMP OPERATIONS	A-45
Log Sorting	A-45
Log Scaling and Marking	A-46
Preparation of Logs for Further Transportation	A-46
Rafting	A-46
Train Transport	A-47
MISCELLANEOUS OPERATIONS	A-47

PRE-LOGGING OPERATIONS

A large number of preparatory operations are often necessary before tree harvesting can begin. It is within these pre-logging operations that a large number of hazards to logging personnel can be initiated or eliminated. Also, because logging is a continuous and repetitive operation, problems introduced during the first exploitation of a forest can remain as a hazard to future cuttings many years in the future.

Many of the pre-logging operations continue as a support function during harvesting. The following discussion is, therefore, based primarily on observations of the continuing support and on conversations with logging personnel.

OPERATIONS PLANNING

Forest areas subject to logging operations include federal, state, local and private ownership tracts (both owned and leased). Within each of these jurisdictions there are criteria established which will impact on the procedures used for harvesting and hauling of the timber. While maximum recovery of merchantable timber is a dominant criteria, preservation of the land's quality subsequent to logging is most often the primary requirement. In the past, operations were often planned primarily to reduce harvesting and haulage costs. This change in logging philosophy appears to have made operational changes necessary which have in many instances resulted in the reduction of injury frequency with respect to volume of wood recovered; however, it has also introduced a number of hazards which were not as significant in the past. These will become evident in the following discussions.

Computer Programming

The extent to which computer analysis of logging operations is employed was not identified. However, the American Pulpwood Association has sponsored research in this area; Reference 4 describes one phase of this research and development effort. Included in this program was the development of a Forest

Model and the evaluation of various harvesting techniques on the basis of a cost-benefits analysis. Comparisons were made between manual and machine harvesting techniques, types of equipment used, species of trees, etc. While personnel safety was not included as a primary set of input information to the cost-benefits analysis, a preliminary review of the modeling technique suggests that it is feasible and highly desirable.

Layout of Logging Operations

Two forms of logging, clear cutting and selective cutting, are practiced. In clear cutting all of the trees within the planned harvesting area are felled. In selective cutting only trees which are marked for felling are harvested leaving other trees to continue their growth. The rationale for selecting one or the other of these methods is primarily a silvicultural matter; however, different logging methods are involved in each method. While injury data did not differentiate between these practices it is strongly suspected that selective cutting introduces a number of hazards which could be avoided in clear cutting. These hazards result from the preservation of obstructions which do result in injuries, such as the increased frequency of falling trees impacting other trees, and constraints on selecting the direction in which to fall a tree.

In determining the procedures to be used in logging and the layout of the logging area, the planner relies upon cruise maps, aerial photography and upon the road availability within the area. He must assess the natural geographic contours and determine the need and location of logging roads, skidding trails, landings, etc. He must determine sequence of logging, type of equipment required, etc.

The planner's constraints should, and often do, include consideration of the least hazardous layout. However, several logging company representatives interviewed revealed the growing incidence of hazards arising from constraints placed on their operating procedures by governmental agencies (both state and federal). These constraints are related to ecology and conservation considerations and are highlighted by the following examples:

1. The need for establishing buffer zones (or strips of uncut timber) and restrictions on the cutting of large areas of mature timber has increased the incidence of blow-down. At least in the case of buffer strips, the loggers claim that the buffer strips are not located in naturally sheltered areas (from the wind) and there is a high probability of tree uprooting while crews are hauling logs adjacent to the buffer strip. As a consequence of the large quantity of merchantable timber involved in blow-down, many contracts are being awarded by the Forestry Service, and others, to recover the timber. It is claimed, and apparent from observations, that working in these areas increases personnel hazards because of the haphazard way in which the wind fells trees.
2. Restrictions on road building within a cutting area and further constraints placed on the locations and sizes of landings have influenced the use of down-slope yarding which can initiate slides and log rolls toward the base of the slope where the landing personnel are located. Landing areas are often located at the immediate base of the slope; loggers suggest that the landing be placed at a distance from the base to provide a safety strip in the event of falls.

3. Restrictions of landing dimensions are accompanied by a high density of workers and equipment. Because of the compaction of landing operations the probability of accidents and injuries increases.
4. Road construction constraints are introducing at least one major hazard - an increase in the number of blind spots where drivers are unable to see oncoming traffic. Logging companies report restrictions on the removal of trees at sharp curves, and the removal of rock formations, to increase driver visibility.

Data are not available to indicate that these situations have increased the incidence of injuries. However, based on the injury-producing relationships identified during this study, and statements by loggers, it is reasonable to predict that an increased frequency of injuries will occur within the above situations. As a consequence, it is recommended that intergovernmental agency coordination be instituted where decisions can affect worker safety.

The sequence of planning operations is performed at several levels beginning, for example, at the level of the forest manager and filtering down to the independent contractor. Thus, the responsibility for effective planning rests at each level.

Logging Camp Planning

Safety codes were reviewed dealing with the development and maintenance of logging camps. These are included in the code summaries of Appendix B. It is to be noted that most of the codes deal primarily with sanitation and hygiene. Although visits were made to logging camps little effort was devoted to this type of operation. It is also to be recognized that the logging camp has almost become a thing of the past; because of the availability of good transportation, loggers can now travel long distances each day to and from logging sites.

Plates F-1 and F-2 show what is believed to be a unique type of logging camp. This camp has been built on a log raft and is reported to be suitable for towing to new locations as logging sites are changed. Communication with this camp is by boat and airplane and by radio/telephone.

This camp, as well as other camps visited, are isolated and, especially during bad weather conditions may be impossible to reach rapidly in the event of injuries requiring immediate medical attention. This problem also relates to the logging sites in many areas of the country.

Logging Road Construction

The building of logging roads is usually the responsibility of the logging company. Where roads are already in existence the logger is responsible for maintaining their condition and it is evident in many instances that the logging company considers this operation as one of the most important, as well as the most expensive.

Roads are constructed of varying qualities from the type shown in Plate F-3, to extensively gravelled or even paved roads. Skidding roads, as shown in Plate F-4, must also be planned although they are not as demanding.

The basic requirement in road construction is that they are capable of handling the types of equipment and weights involved in each type of operation.

Maximum weight and size limitations for public highways used in log transportation are not always observed when using logging roads even though their construction does not meet state highway standards. Some companies use trucks of special design to transport loads exceeding highway limits when their routes do not involve leaving private rights-of-way.

Nevertheless, road construction for logging purposes must be cognizant of weather conditions versus road surface quality and the traffic patterns and density. In Plate F-5, a truck is shown with its rear wheels mired in the mud and requiring the use of a skidder to push it loose. Similar instances were observed elsewhere when icing made it impossible for crew vehicles as well as trucks to climb a gentle slope.

Vehicle roll-over due to high speed, poor road maintenance etc., is involved in a large number of injuries and fatalities. However, actual road construction introduces a great many hazards to the road builders. For example, the use of explosives is extensively treated in many of the state codes. For most harvesting operations explosives are seldom used for anything except road construction. In one company's operation, drilling and blasting are used to obtain gravel for road surface maintenance. This operation was so extensive that the company developed the machine shown in Plate F-6 to break rock into gravel.

Another company used a specially modified skidder, Plate F-7, for grinding stumps to the ground to ensure smooth road surfaces.

Logging Sequence

The sequencing of logging operations is especially important for avoiding injuries due to interference of competing operations. Observations indicated that the concern of operators for preventing interference ranged from the complete separation of operations on both physical and temporal bases to an apparent attitude of non concern. In the former, it was observed, for example, that felling and bucking operations may have been performed in isolation from other operations and six months prior to the schedule for skidding and yarding. In the latter, tree felling and skidding and truck loading may have been in simultaneous performance both geographically as well as temporally.

Logging company size and geographic relationships were observed. Regardless of geographic considerations the small, poorly funded companies appeared most prone to combining operations, since their cash flow requirements demanded rapid delivery of logs to the customer. However, subcontractors which specialize in one or another of the logging operations, and work for the larger companies, are not necessarily confronted with this hazard; they are paid by performance of their particular job rather than on delivery of an end-product.

With respect to geographic relationships even large companies are confronted with the problem of product durability. An example is the Southern pine forest where trees begin to decay rapidly after felling and cannot be left on the ground for transportation in the future. This problem also impacts on the Southern pulpwood industry's ability to stockpile large quantities of logs.

Equipment Selection and Maintenance

A large number of equipment items ranging from hand tools to large log loading and haulage systems are required for logging operations. The capabilities

of the equipment selected are matched against the characteristics of each operation. While the larger logging operators generally maintain a large variety of equipment, and are able to substitute freely as unforeseen circumstances arise, the small independents appear to "make do" (Plate F-8). It was a common observation that the smallest operators appeared to use older equipment requiring maintenance; down time for a machine during maintenance procedures meant that their operations would cease.

In the selection of equipment a primary requirement is to ensure that the equipment is capable of handling the loads intended. A common occurrence in logging is for the operator to upset his vehicle when handling loads exceeding the design limits of the vehicle. In Plate F-9, a tree harvester is shown which had just been righted after a turn-over. The operator had just completed the cutting of a 24-inch diameter tree (this machine had a rated capacity of 18 inches) and was rotating the boom to place the tree on the ground. The weight of the tree exceeded the vehicle's stability limits, when the loaded beam was off-center, and pulled the vehicle over.

Another problem noted in the use of equipment was the lack of operator protection. Many vehicles were observed in use without canopy protection. Many companies have retrofitted older equipment with canopy frames which meet OSHA regulations. However, even newly delivered equipment must be retrofitted before use. For example, one company reported that their tree harvesting machines were incapable of withstanding heavy loads to the canopy. Consequently, they performed a retrofit. It is to be noted that this tree harvester was manufactured by a foreign concern.

Inquiries to equipment manufacturers have identified several problems of which they are aware. Generally, these companies state that they "have done all they can to bring their product into compliance with standards specified under OSHA" and/or that they recognize that design problems still exist on which they are working. One company indicated that noise is the "most bothersome problem, as well as hardest to control; in many cases it is impossible to reduce noise to the desired level" of 90 db.

Most companies indicate versatility of their machines, relying on adaptations for each logging job. One company supplied the information in Table A-1 which shows the cost of various items which they market. A very significant cost is the estimated operating expense per year for these machines. Both anecdotal information and direct observations of small operations using these types of equipment indicate that the smaller independent operators perform little maintenance on their machines; presumably to save on operating expense. It has also been reported that many small operators who invest in equipment, to substitute for manual operations, run into financial difficulties trying to pay their loans.

One company provided the following comments relative to operator and other personnel safety in terms of their equipment designs:

1. Falling objects - protection is given by heavy-duty canopies.
2. Limbs whipping - protection is given by the sweeps, posts and screens.
3. Jill pokes - protection is given by the metal skirts, screens and heavy-duty fenders

Table A-1. TYPICAL EQUIPMENT AND OPERATING COSTS

	PRICE F.O.B. FACTORY	COST PER 2,000 HR YEAR W/O OPERATOR
D9 Crawler w/canopy, straight dozer, tilt cylinder, winch	\$114,000	\$50,000
D8 Crawler w/canopy, straight dozer, tilt cylinder, winch	77,000	36,000
D7 Crawler w/canopy, straight dozer, tilt cylinder, winch	56,000	26,000
D6 Crawler w/canopy, straight dozer, tilt cylinder, winch	48,700	22,000
D5 Crawler w/canopy, straight dozer, tilt cylinder, winch	34,500	16,600
D4 Crawler w/canopy, straight dozer, tilt cylinder, winch	23,500	10,400
988 Loader w/canopy, fork and clamp, and counterweights	88,000	42,000
980 Loader w/canopy, fork and clamp, and counterweights	68,000	32,600
966 Loader w/canopy, fork and clamp, and counterweights	48,800	20,000
950 Loader w/canopy, fork and clamp, and counterweights	37,100	15,600
930 Loader w/canopy, fork and clamp, and counterweights	29,200	13,500
920 Loader w/canopy, fork and clamp, and counterweights	23,000	10,500
950 Tree Harvester	58,000	31,000
977 Crawler loader with fork, clamp and winch	43,000	23,000
955 Crawler loader with fork, clamp and winch	35,500	13,500
518 Skidder with grapple	26,185	14,000
12F Motor grader with scarifier	36,500	15,000

4. Broken cables flying - protection is given by the screens and metal skirts.
5. Access - getting on and off - anti- skid decks, fenders - handholds and steps (where they can be maintained)
6. Can't hold on a slope - we've heard a few reports, but always lack details on the actual condition of the brakes on the machine involved.
7. Rollover accidents - heavy-duty canopies, now ROPS (rollover protection system)
 - seat belts were optional, and are now standard with ROPS, but the very low percent of usage precludes getting the maximum protection available.
8. Man on the ground struck by the machine - poor work practices, and/or poor communications with the operator.

With respect to modifications made to machinery, in attempting to comply with OSHA regulations, it is suspected that companies often react with insufficient information. Plate F-10 shows the result of one company's attempt

to improve operator accessibility to his cab. The ladder itself was well constructed; however, several hazards were introduced as follows:

1. The ground supporting the ladder was not flat and normal to the climbing access.
2. The ladder was placed in position without anchoring it to the vehicle.
3. The distance between ladder rungs was approximately 18 inches; far in excess of an acceptable distance for the using population.
4. To gain access to the cab the operator had to react laterally against the ladder in swinging his body through the access way.

In another example, a ladder attached to the vehicle was not considered much more adequate (Plate F-11). Distance from the ground to the first rung was excessive and mud caking on the operators boots would have induced slippage on the narrow diameter, smooth rungs.

Field maintenance and repair of equipment is common practice. Maintenance personnel are often employed, by large operators, to travel from one logging site to another to perform repairs as required (Plate F-12). However, the larger operators also maintain large maintenance and repair facilities at a central location.

FELLING AND BUCKING OPERATIONS

This is the initial operation in producing logs and is generally recognized as the most hazardous of all logging operations. The most prevalent technique involves the use of gasoline-powered chain saws for cutting down the tree, removing limbs and for sectioning the tree into transportable lengths. Within many logging operations, bucking is performed at the tree felling site and both operations may be performed by the same man.

OPERATIONS PLANNING AND SUPERVISION

Control of tree felling and bucking operations is exercised by the logging crew foreman. His crew size may vary considerably and, typically, he will assign personnel to a working crew which is assigned to a "side" or work area. The number of sides used depends upon the area of the stand being logged.

Fellers and buckers are usually assigned as a team to work a side. However, within each two-man team either man could perform both felling and bucking tasks.

The basic planning constraints on the foreman (in addition to production planning) are to ensure that safe separation distances are maintained between the felling/bucking teams, that trees are not felled across skid roads (or other roads) and that trees are felled in the same direction with their long axes pointing toward the skidding road. A secondary constraint, which has greater emphasis in operations involving incentivized wage plans, is to team logging personnel according to production capability.

TREE FELLING

Several approaches to the felling of trees are employed; by consensus, the following is the method accepted as a good practice:

TECHNICAL CONSIDERATIONS

As indicated in Sections II and III, the felling of trees is the most hazardous of the logging operations. In considering the technical characteristics of the felling task, by comparison with other logging tasks, it can be concluded that the feller must possess a high degree of analytic skills as well as manipulative skills and ability to work at high energy expenditure rates.

Analytic Skills

The tree feller is surrounded by a large number of natural hazards, many of which he must confront directly rather than avoid. Unlike most other occupational environments where positive steps can be taken to eliminate or isolate the worker from the hazards, the feller works with the primary hazards with an objective of avoiding injury through analytic judgements based primarily on experience. He also presumes agility to avoid having an accident.

Before initiating the felling of any tree he must first assess its characteristics and those of the trees in the surrounding area. While his first concern is to select a falling direction which minimizes the probability of tree impact (ie. to preclude product damage) he must be able to recognize what may happen, in terms of his own safety, should an impact occur. The following lists the types of dangers which require analytic skills:

1. A direct impact with another tree can cause breakage with the suddenly propelled part flying in a trajectory affected by impact angle, force of impact, and mass of the timber. Flying timbers are implicated in both fatalities and other disabling work injuries; because of their velocities they can be expected to present hazards to personnel in locations somewhat remote from the felling site.
2. Dead trees (snags) or branches are particularly vulnerable to dislocation in the event of tree impacts. These can be expected to possess greater initial velocities since less energy is dissipated during fracturing of dead wood than of viable wood.
3. Breakage of limbs or trunk fracture and separation of bark are known to occur as a direct result of vibration force distribution during tree cutting. This is reported to be most prevalent in the felling of snags.
4. Trees which are under tension which is released during cutting are especially hazardous and require special precautions in cutting. The feller must anticipate the springback direction; in many logging operations the feller is advised to seek assistance from supervision before proceeding with the felling of such trees.

In addition to the above hazards which require discrete judgements based on the prevailing situations there are, of course, a number of hazards for which definitive procedural rules are applicable and promulgated. These are discussed below.

Manipulative Skills

The tool handling abilities required of fellers do not appear to be particularly stringent; the degree of training given and the feller's mastery of discrete rules in tool handling appear to be the major consideration in effecting safe work procedures. Notwithstanding, statistical evidence highlights the chain saw as the most frequent agency for disabling work injuries in Eastern operations.

In controlling the chain saw, it is incumbent upon the logger to maintain its stability during both operation and portation. The typical chain saw is configured (Plate F-13) with two discrete handles or hand-hold positions permitting either right or left-handed operation. Plate F14 shows the bow saw used in the South. Starting of the saw's engine requires that one hand is firmly gripped to one handle with the saw on the ground. The bar and chain should not be in contact with anything during starting. The starter cord is pulled and after guiding the starter cord back onto the take-up reel the second hand also grips a handle.

During the cutting operation both hands must continue to stabilize the saw with the most likely occurrences being saw kick-back and binding within the cut. Between the effecting of the undercut and initiation of the back-cut the saw motor is stopped during movement of the feller around the tree. When the tree begins to fall the motor is also stopped and the feller is advised to move away from the tree along the predetermined escape route.

In addition to manipulative skills with the chain saw, other tool handling skills may be required. It is not always possible to ensure that a tree will fall in the required direction or that the saw will not bind during the cutting operation, even though an undercut has been made. Often there is need to use a wedge, during the cutting process, which is installed by sledging techniques. (Axes and mallets have been observed in use for this process). The recommended procedure is to stop the saw when inserting the wedge. Often the back cut is completed without effecting tree fall and wedging is used to tilt the tree out of its gravitational alignment.

A variation of wedging which has been observed with smaller diameter trees is the use of a pole to tilt the tree and induce falling and occasionally fellers have been observed pushing directly on the tree (Plate F-15).

Use of axes by fellers is somewhat infrequent in the actual felling operation. Their use is limited to rare cutting operations and for utility purposes. The following is a composite listing of axe uses observed in logging operations:

1. Installation of wedges.
2. Testing of dead tree (snag) condition prior to initiating felling.
3. Clearance of brush around tree to be felled.
4. Some limbing operations.

Energy Expenditure Demands

Of all logging tasks, those of the tree fellers and buckers appear to be most demanding in terms of energy expenditure levels. Anecdotal information

acquired during observations of Eastern pulpwood logging operations indicated that great difficulty is met in hiring and retaining logging personnel to perform chain saw operations. Machine operators were reported to be not as scarce and by implication the sources of this anecdotal information felt that the work is too physically demanding to attract this type of employee.

Elements of the felling task which appear to be largely absent from other logging tasks or less significant in terms of total energy expenditure were identified as follows:

1. The feller carries or supports the weight of a chain saw during most of his production activity. He exerts energy on the saws continuously during the cutting operation.
2. The feller often performs his work on uneven ground which increases energy demand for maintaining body stability and movement from tree to tree.
3. Generally, increased task performance difficulty results during winter when snow impedes movement.

Fatigue in fellers is further accentuated by the impact of body heat storage even under relatively cold conditions.

The period of work for the tree feller is typically of the same duration as for other logging occupations. This duration will vary across operational lines and nominally ranges from 8 to 10 hours per day with an average work week of 40 hours. The annual work duration is also variable. This aspect is discussed in Section I.

In a number of large company operations it is reported that many of the loggers own their own chain saws and in some cases the logger also owns the skidding equipment. In such cases, the logger spends additional time, maintaining and repairing this equipment, beyond the nominal hours spent in logging tasks.

FIELD OBSERVATIONS - FELLING

In actual practice the procedures used for tree felling have been observed, at some sites, to follow what has been stated as good work practices and at other sites to be somewhat questionable. In general, the crews of large companies tend to follow the consensus safety standards; however, even the employees of the large companies practice non-standard procedures which may or may not be associated with the occurrence of injuries. The frequency of deviation from standard practices appears greater in small-sized operations though some small-sized operators demonstrated extreme diligence in following the consensus good practices standards.

Data were not available with which to comparatively evaluate logging operations tending to deviate from these standards. The only trend which could be observed is that large companies report injury frequency rates which are lower than the national rates determined by the Department of Labor.

In the following, the felling procedures and anecdotal commentaries are presented to describe the incidence and probable ramifications of the procedures

observed. No overt attempts to differentiate on safety between large and small operations are intended; however, geographic differences will be evident and safety implications will be apparent from the indications of well-organized versus gippo or small sub-contractor operations which do not evidence firm safety programs.

Felling Crew Size

Most felling operations observed involved a single logger. The apparent distinction in those operations which involved two-man teams was tree size, where only the larger trees in Western operations (eg. Douglas Fir) evidenced a two-man or greater requirement. This is not a uniform operational procedure with a number of large company as well as small company operations being performed with the "single-jack" concept.

The two-man crew works with the second man performing as an assistant (his primary function might be to effect the wedging operation; both members of the crew could alternate as feller and assistant). In most cases of two-man operations, both members of the crew performed limbing and bucking tasks. Although two states indicate standards involving the use of two-man powered saws, our field observations did not include representation of such operations.

Even in operations where the single-jack method is used there was evidence that the assistance of another feller was obtained when particularly hazardous situations prevailed. This mode was observed when trees were "hung up" during the fall. It was stated by one Western company representative that this assistance request system was part of their standard operating procedure and would apply not only to hung trees but to bad leaners, trees under tension, large snags, etc., as well.

Two-man felling crews were not observed in any of the Eastern pulpwood felling operations. Nor was there any observation of any cooperative efforts in the felling of trees. In those Eastern pulpwood felling operations using feller-bunchers, the felling crew consisted of a single machine operator. However, support personnel were in evidence within the local area.

In terms of felling crew size there was no quantitative evidence that a two-man crew could provide for greater individual safety in most of the felling operations observed. The practicality of such teaming was apparent with the large diameter trees where tree felling time could be reduced with one man wedging and the second man sawing; this parcelling out of work appeared to reduce the fatiguing effort which would be involved for one man.

Interpersonnel Distance

While logging standards recognize the hazards of falling trees and flying timbers to loggers working in close proximity to each other, the maintenance of safety zones between fellers or other logging personnel is not always practiced. The general standards prescribe:

1. That interpersonnel distance shall not be less than twice the length of the trees being felled.
2. That a warning signal be given by the feller to indicate that a tree is about to fall.

3. That a warning be given to the feller by personnel who want to enter the felling area and that an approval signal is returned before area traversal is made.

In some operations all of these standards are followed. However, in most operations observed, there was a general absence of warning signals and in a significant number of operations the distances between fellers appeared to be of little concern.

That all three of these standards are necessary and will reduce the frequency of injuries is implicit. Even with knowledge of the intended tree fall direction, there is considerable anecdotal evidence that in practice the tree feller is not always in full control of the direction (refer to wedging task below).

In addition, there is a high frequency of tree contact during falling with a high probability of tree parts breaking loose and flying large distances in any direction. While we have not located any statistical data on the linear distances or directions travelled by flying timbers, it is suggested that the 200% safety distance may not be adequate. The energy levels associated with the impacts of large trees and the resilience of trees snapping back after bending under the forces of a falling tree suggest large propulsion energy inputs to flying timbers.

Brush Clearance and Escape Routes

One of the apparently least practiced precautions is the clearance of brush in the felling area around the tree and over the selected escape route. The function of this clearance is to ensure non-interference with the use of tools and with the logger's rapid retreat from the felling site as soon as the tree begins to tilt.

Clearance for tool operation requires a smaller area for chain saw felling than for axe felling; however, in the use of wedging techniques with either a mallet or axe, the clearance must include room for axe swing. In actual observations it has been noted that cutting operations are often performed with brush obscuring portions of the saw; it is believed that in such instances the logger may not observe small tree movements indicating that the cut is closing on the chain with the high probability that saw kickback is imminent.

Should saw kickback occur, the presence of obstructions in the cutting area could bind on the chain, thereby increasing the potential for injury from the saw. The presence of brush or other obstructions not only restricts or impedes reflexive evasive body maneuvers, but may also influence the feller to assume a less stable body position.

The need for an escape route is equally critical and especially so in the areas where the terrain is rugged and speed of movement away from the falling tree is impeded. The consensus of standard logging practices is that the point of escape should be "well back and to one side" and that the feller rapidly traverse the escape route as soon as the tree begins to fall. None of the standards specify what the safe distance should be, but in some standards a recommendation is made for the feller to protect himself behind a tree.

The primary hazard of the falling tree is the possibility of barberchairs. Nominally this condition is precluded by proper under cutting; however, the need for an escape route is also required for evasion from falling limbs or bark.

A number of situations observed or anecdotally reported which can have major impact on the effectiveness of an escape route are as follows:

1. Often the felling of a tree will involve escape up an extreme slope.
2. Situations, such as Plate F-16, where the escape route takes the feller under previously hung-up trees (this hazard is further discussed below).
3. Ice formation or snow accumulation which is not clearable.

Tree Cutting

In felling trees, the recommended good practice is to first undercut followed by backcutting. In general practice, the undercut is usually used with only the larger diameter trees; however, there is no evidence of criteria for tree sizes above which undercutting is necessary. Our observations indicated that even with tree diameters of 9-inches, and more, undercutting was not always used.

In Plate F-15 a tree is being felled where the feller did not undercut and is using body leverage to ensure the desired direction of tree fall. A number of questionable practices are evident in this picture including:

1. The use of inadequate head protection.
2. Operation of a chain saw with one-hand.
3. A high potential for the feller to fall forward on his saw if the tree should suddenly lurch forward.
4. An obstruction at his rear (the felled tree) over which the feller could trip if he were to move backward suddenly to correct body orientation if the tree were to rapidly fall.
5. Felling the tree with the saw bar at an angle to the ground; with the poor body orientation it would be expected that the saw could lurch forward at the end of the cut and dig into the ground with the introduction of a new hazard especially if the saw were to contact a rock, etc.
6. In this picture (as well as many others) evidence of too rich a fuel mixture to the saw engine is observed by the bluish white smoke.

The feller pictured in Plate F-15 is also shown in Plates F-16 through F-19. Notwithstanding the hazards identified above, Plate F-17 shows the feller in a more erect position watching the tree fall; it is noted that he is standing directly behind the tree and did not make any attempt to retreat.

The cut shown in Plate F-18 evidences an undercut indicating that this same feller was making judgements as to when an undercut is necessary. None of the standards reviewed indicate exceptions to the undercutting rule;

Reference 5 published by the Western Wood Products Association, firmly states; "Every tree must have an undercut of sufficient depth to insure that it will fall where planned". There is obviously room for debate on the reasonableness and necessity of this rule when felling very small diameter trees. This is an area which should be further investigated.

This sequence of photographs appears to indicate a lack of planning in terms of personnel safety. By the orientation and locations of felled trees it can be seen that this feller is following an inconsistent felling direction pattern. (Plate F-19 shows variations in fall direction of about 180°). The feller is working toward the direction of fall and as a consequence is putting ground obstructions into his path of forward travel. By continually advancing into the stand of trees the feller significantly increases the number of trees which do not fall clear, hanging up as shown in Plates F-16 and F-17. Not only does the hung-up tree create a hazard under which the feller continues to work the probability of impacting the hung-up tree with another falling tree persists (eg. breakage with the possibility of a flying timber).

Logging standards and recommendations are quite consistent in establishing that under-cutting is to remove a wedge approximating one-third of the tree's diameter. The purpose of this is to change the center-of-gravity with respect to initiating tree lean in the required direction. As the back-cut is made the lean becomes more pronounced and prevents closure of the back-cut on the saw.

A frequent observation made, which was somewhat widespread geographically, was that undercutting is limited to one-quarter of the tree diameter and sometimes less. A gross analysis indicates that the depth of cut required may vary as a function of tree diameter, degree of lean, and by mass of the tree. It is evident that if the undercut is too shallow that no effect of undercutting will be achieved and could result in greater binding forces on the chain during the back-cut. The objective is to effect tension forces at the back-cut area and to distribute or concentrate compressive forces at the hinge joint; the following are the considerations to be made in effecting an undercut:

1. Too small an undercut will not affect direction of tree fall.
2. Too small an undercut may well concentrate compressive loads in the back-cut area thereby increasing the incidence of chain binding and kick-back.
3. Too large an undercut will result in chain bind and kick-back during the under-cutting step.
4. In a leaning tree, the undercut on the lean side could result in exceeding the tree's limits in tension and thus result in premature falling of the tree before making a back-cut.

A study of these relationships is recommended particularly since adherence to the consensus of 1/3-diameter may be very hazardous with leaning trees. None of the standards or other references used suggest deviation from this value. Some standards do cite the need for special precautions to be taken with heavy leaners.

The situation with trees that are hung-up is a generally recognized hazard which is not always eliminated immediately, or steps taken to avoid it. Further discussion on this hazard is presented below.

As tree size increases, the feller's job begins to change somewhat. The bow-type chain saw (Plate F-14) which is extensively used in the southern pulpwood forests, along with the more typical chain saw (Plate F-13), apparently becomes less suitable but is still used (Plate F-20). In addition, the needs for wedging, side cuts (or cornering) and corner cutting as the means for controlling tree fall direction becomes more important.

Wedging

Wedging is used for both the prevention of saw binding during back cutting and as a means for ensuring tree fall in the planned direction. In some standards there is a prohibition of the use of metal wedges; wood wedges are prescribed (in some cases soft metal) and are inherently safer if the chain should make contact. Nevertheless, metal wedges are in evidence, and at least one large company provides them to their loggers. This company did not report any relationships of injuries to the use of metal wedges. One company reported the use of nylon and plastic wedges.

Wedging has been observed in use for two basic techniques; in the first the wedge is installed to maintain separation of the two back-cut faces during sawing. The feller in this case alternates between sawing and wedging, generally using the flat end of an axe as a mallet. Precautions necessary during this procedure include removal of the saw from the undercut area and engine shut-off prior to the start of wedging.

In the second type of wedging observed, the feller had completed both an undercut and a back-cut with the tree not beginning to fall. Support of the tree was apparently maintained by the intertwining of branches with other trees (in this situation branch adhesions may have been caused by ice formation on the branches) and the compressive loads concentrated at the hinge joint.

In this latter case, wedging was apparently not a planned or routine practice and the logger was not equipped with wedges or an axe. While the tree was tenuously suspended he cut a wedge and fashioned a mallet using wood from a small tree.

Tree Cutting Machines

Where small diameter trees are the predominant product being harvested the industry has introduced the harvesting machine. At the present time only a few are in operation but it is anticipated that their utilization will increase. Although these machines were only observed in the Northeastern and Southern operations, one equipment distributor indicated that they have introduced the tree harvester into Western operations.

The tree harvester operates with two hydraulically actuated blades acting in scissors fashion. The cutting device (Plate F-21) is attached to a boom (Plate F-22) and is placed at the base of the tree. The tree is clamped by a yoke on the cutting device and is severed. The tree is then lifted, rotated laterally and dropped to the ground. Plate F-23 shows the result of this scissors cutting action.

The boom of the harvester is mounted to either a tracked (Plate F-24) or a rubber-tired vehicle capable of moving progressively as the trees are felled.

Although the performance of the tree harvester has been reasonably acceptable it is not yet problem-free. Maintenance requirements are reported to be high and operator proficiency is somewhat lacking (anecdotal information indicates poor operator performance as contributing to the high maintenance costs).

In terms of personnel safety, use of the tree harvester promises to reduce the number of injuries associated with tree felling. Essentially the operator is seated within a completely enclosed work station (Plate F-24). The most serious hazard confronting the operator is the possibility of the machine overturning; this high probability will limit use of such machines on rugged and sloped ground. Further, it is evident that many of the machines will require improved canopy protection and especially in the glassed areas where penetration by limbs, etc. might be expected as a not infrequent event.

Snag Felling Considerations

The dead tree, or snag, constitutes one of the most severe hazards within the logging industry. Because it provides little or no value for lumber or pulp there is little desire to fell it even though it is known to be a hazard; the felling of a snag is also recognized as hazardous.

The occurrence of snags, as a ratio to healthy trees, was not determined; however, as indicated in Plate F-25 which shows the result of blowdown, the ratio of snags can be quite high. In this plate, it is observed that snags have a reduced tendency of being blown down since it has little or no foliage to catch the wind.

In good logging practice, it is generally recognized that snag felling is mandatory but requires special attention. A snag, shown in Plate F-26, was observed in a Western forest. Although this was a virgin cutting operation the snag's diameter, compared to the healthy trees surrounding it, suggested that it was a remnant of a previous catastrophe. In observing the activities of the felling team it was noted that they gave the snag a healthy respect. Their activities involved felling the trees around the snag where they were confident they could control the direction of fall so as not to hit the snag. They tested the snag with an axe to determine soundness of the wood and to find out whether or not the bark or branches might break off due to vibration forces.

During the period of observation the fellers were seen to fell other trees and periodically examine the snag. They were not observed performing the actual snag felling which was indicated as probably not occurring until the following day.

In examining Plate F-26, one of the fellers appears to be carrying a chain saw on his shoulder; this was not noted during the on-site observation but is generally considered to be an extremely hazardous practice. The major point to be made of this observation is that even in very safety-conscious operations loggers still make errors which can be costly.

Another example of hazards which can develop is shown in Plate F-27. This

picture shows a part of a tree, which had become broken off at the top, lodged precipitously across the branches of other trees. The stump of the broken tree is discernible in the foreground. Although this hazard could be clearly seen from the logging road no attempts were made to bring the hazard down; no plans to do so were reported.

Felling From Spring Boards and Chopping Platforms

A technique in felling large diameter trees, especially those having large root bases, is the use of spring boards. It is reported that this approach has all but disappeared except in the felling of large diameter redwoods.

The technique was not observed but it was described by one logger as follows: Notches are cut in the tree stump (Plate F-28) into which are inserted spring board irons. A wooden platform is constructed on top of these irons and used as a work platform for the felling crew.

State codes relating to this operation are included in the summary of Appendix B.

TREE BUCKING

The bucking operation involves the cutting of felled trees into sections which are manageable with the available transportation techniques. While tree length skidding is now used extensively in most logging regions bucking at the felling site has not been completely eliminated.

Potentially the bucking operation is equally hazardous with the felling operation. However, injury statistics indicate that this operation is either proving to be less hazardous or more likely that the hazards are more predictable and good work practices are better defined and followed.

The bucker who works at the felling site is within the least controlled environment which generally suggests the desirability of tree length skidding to a landing before major bucking operations are begun. When working at the felling site, the bucker is exposed to most of the same hazards as the feller, as well as those introduced by the bucking operation. Often it is the feller who also performs the bucking operation.

The following is a general description of the bucking operation:

Sectioning of the felled tree into transportable lengths includes the removal of protruding limbs, which may impede transportation, followed by the cross-cutting of the log. Typically, both cutting operations are performed with a powered chain saw; however, the axe still persists as a tool for the limbing task.

While it is possible to perform this operation with the bucker standing on the ground adjacent to the tree, the bucker often finds it advantageous to walk along the top of the tree. In good practice the tree is blocked to prevent rolling, and wedging is used to prevent saw binding within the cut.

Trees which are not adequately supported over their entire length re-

quire special precautions during bucking and at times there is a requirement to use a form of undercutting with large diameter logs.

Technical Considerations

In practice it is implicit that bucking operations are not considered to be as demanding of high skill levels as are felling operations. Generally, it was determined that many of the personnel performing bucking and limbing tasks had little logging experience when starting this job. An exception prevails in the practice of Western large tree logging operators where it is usual to develop logging skills in less demanding tasks first.

Analytic Skills

In the limbing and bucking tasks the need for analytic skills is primarily for the avoidance of accidents. In general, the hazards which prevail are readily recognized and the number of alternatives which require judgements in selecting appropriate task procedures are considerably reduced over those faced by the feller.

The two basic hazards to the feller are associated with the saw (and the axe) and the possibility of log movement during bucking and limbing. In terms of the saw and axe, the avoidance of injury is primarily a manipulative skill along with a recognition of what causes saw kick-back. In terms of log movement the buckler must recognize unstable lie positions of the log and the directions of roll which the log or cut segments may take when released from their restraint. In flat surface bucking areas there is considerably less hazard than on irregular or sloped surfaces.

Manipulative Skills

The buckler must be proficient in the use of saws, axes and wedges with a skill level not unlike that of the feller. The rules in using these tools are identical to those followed by the feller.

Energy Expenditure Demands

There is some evidence that the performance of bucking and limbing tasks are less strenuous than tree felling, based on caloric intake studies. However, during observation of the tasks it did not appear to be significantly less demanding than felling.

Field Observations - Bucking

Bucking operations in Western logging appears to be the most hazardous. This interpretation is based upon the combination of large masses and extreme irregularity of ground surfaces.

Bucking at Felling Site

As a minimum, even with tree length skidding, limbing is performed at the felling site. The purpose of this limbing step is to remove protrusions from the tree trunk which may snag and impede the log's travel through the forest.

In one Western logging operation observed the felling, bucking and limbing tasks were performed consecutively by a single logger. The steps taken were as follows:

1. After felling the tree, the logger moved from the butt end to the tip of the log using his chain saw to remove all limbs as he travelled (Plates F-29 and F-30). As indicated in Plate F-29 the logger moves along side of the log, or as shown in Plate F-31, moves atop the log. Also in evidence in Plates F-31 and F-32 is the tendency for logs to pile up on each other and to be suspended with one end pointed skyward.

The need for "sure-footedness" is implicit in this operation where the potential for severe injury from the saw in the event of a fall is high. Because of the large number of limbs to be cut there was an observed tendency of buckers to maintain the chain saw in operation as they travelled down the log thus increasing the potential for injury.

The potential for log roll is ever present in this situation; it is also possible for the buckler to inadvertently initiate roll through cutting a limb which is supporting the log's weight.

2. In Western operations, logs are often of such length as to preclude tree length skidding or yarding therefore dictating the bucking into smaller lengths. Because these trees are used primarily for lumber production the requirements are for accuracy in bucked lengths; the buckler usually wears a tape measure fastened at his waist and after fastening one end of the tape (or string) to the butt end will walk along the log (Plate F-32) marking each desired segment length. After marking these segments he initiates bucking.

The bucking of logs under the conditions shown in Plates F-29 through F-33 is considered extremely hazardous. The basic rule followed is for the buckler to always maintain a position uphill of the log (a large number of fatalities are cited due to buckers being hit by logs rolling down hill). It is not always possible to follow this rule; consequently blocking of the log is essential.

3. As shown in Plate F-30 when logs are bucked and the center of gravity is shifted on irregular terrain the movement can be in an up-down direction as well as in a roll direction. Such tendencies must be expected and suggests that the bucking of a log segment should not follow a firm sequence; the further suggestion is that logs are moved prior to bucking when massive movements are to be expected in their originally resting positions.

The requirement for loggers to obtain assistance when confronted with such potential hazards is established by some state logging codes and by the standard operating procedures of some operating companies.

4. In some operations, felled trees, including those which have been limbed and/or bucked, may be left in position for prolonged periods prior to skidding or yarding. These periods may be as long as 12 months and when sloped terrain exists the logs could begin to roll at any time.

In contrast with the bucking operations with large trees is the bucking at the felling site observed in Southern pulpwood operations. In most instances the land is relatively flat and the tree is cut into approximately five-foot lengths. In these operations it was often observed that the axe is used in the limbing task (Plate F-34) and that bucking often preceded limbing (Plate F-35).

This type of small tree bucking appears to be inherently less hazardous than is evident in Western operations.

Bucking and Limbing at the Landing Area

The use of large capacity skidding equipment allows for tree length skidding with the attendant need for additional limbing and bucking procedures at the landing prior to loading on trucks. These activities are shown in Plates F-36 through F-41 which demonstrate some of the hazards associated with bucking at the landing.

Generally the buckler is competing for space with the other landing activities and being on foot is liable to be struck by moving vehicles or logs. However, the landing area is usually flat-surfaced and the logs are less subject to rolling spontaneously.

In Plate F-37, the end of the log is being bucked by a chaser. His location is at the edge of a slope and the end of the log being cut will drop over the side. The logger is also tenuously located and a side-step could have resulted in his falling as well.

In Plates F-38, F-40 and F-41, the buckers are located in hazardous positions where log roll could have resulted in crushing injuries. In Plate F-38, the truck backing up could have initiated log movement. In comparing Plates F-40 and F-41, log movement did occur as a result of the bucking cut and a further hazard exists due to the loader operation being close coupled with the bucking operation.

Miscellaneous Bucking Activities

An unplanned bucking operation is shown in Plates F-42 and F-43. This task involved cutting off the log ends after they had been loaded on a railway car; this trimming was required because of an error the originally bucked lengths which exceeded right-of-way clearance requirements.

As shown, the laborer is cutting with the saw often being held over his head. There appears to be a high probability for snagging the chain on logs not being cut and as the logs are cut the pieces could hit the laborer or he could stumble over them.

Plates F-44 and F-45 show another type of bucking with the logs floating in water. This operation involved cutting logs into lengths suitable for use in a plywood mill.

CHAIN SAW OPERATIONS

The chain saw has become the primary hand tool used in logging operations. It has replaced the axe and other saws almost completely throughout the logging industry; the latter tools are now used almost exclusively for utility purposes and for special jobs.

A large number of chain saws are marketed which vary primarily in size, weight and power; however, two basic configurations are shown in Plates F-13 and F-14. The bow saw shown in Plate F-14, appears to be limited in use to the Southern pulpwood operations with the standard saw of Plate F-13 being most prevalent in other geographical areas. The bow saw uses an elliptical, hollow chain saw cutter bow and is considered adequate for felling and bucking small timber.

The trend within the logging industry is to replace heavier chain saws with lighter saws; some logging companies are now using saws weighing 15-18 pounds, even in Western logging operations where larger tree diameters are prevalent. It is of note, however, that one large company suspects an increase in the number of saw related injuries to their employees since introducing a new, lighter weight saw. Their observation was related to both an apparent increase in non disabling injuries and disabling injuries. The implication of the light-weight saw as possibly being responsible for this increased injury rate had not been confirmed at the time of the anecdotal report; however, company safety personnel also reported that sawyers were claiming an increased incidence of kickback with the new saw.

The major jobs involving the use of chain saws include tree felling and bucking (limbing) at the felling site and at the landing prior to loading on log transportation vehicles. These uses are discussed in the appropriate sections on each operation. The remainder of this section will discuss general procedures and requirements which are not logging operation/task specific.

TRANSPORTABILITY

A highly cited relationship to saw injuries are accidents occurring while carrying the saw. By implication of state logging codes, ANSI Standard O3.1-1970 and of written and/or stated company operating practices the greatest hazard is present when the saw is carried while the engine is still operating. Even though the saw is carried at idling speed with the chain not moving it is intuitive that injuries would be more severe, as well as more frequent. Although the statistical data on injuries which were reviewed did not reveal this implied relationship, the following types of occurrences are likely contributors to increasing the frequency and severity of injuries resulting from carrying operating saws:

1. Any loss of balance by the worker would tend to increase his probability of grasping the throttle control thereby engaging the clutch and putting the chain in motion.
2. Walking with an operating chain saw, the logger tends to hold the saw with both hands maintaining the chain and bar across his

body (Plate F-48).

3. Falling with an active saw could result in trigger contact with branches or other protrusions on the ground resulting in clutch engagement.

By virtue of its basic configuration the chain saw is a hazard any time it is moved. For general transportation of the saw, one manufacturer recommends that a specially fitted sleeve be used to cover the bar and chain. This appears to be an excellent recommendation but does not substitute for the state codes requirement that saws (and other tools) be restrained during carriage in crew vehicles (or the typical requirement that tools not be carried in crew compartments). It also does not solve the problem of short distance portation such as between trees or logs.

The basic problems associated with saw carriage are personnel falls and a high probability for the chain and bar to snag on the ground, undergrowth or even trees. In both instances the logical approach is to ensure that the saw is carried in a manner which reduces the probability of falling on top of it or of having an external force (eg. snag) drive it toward the body.

Plates F-29 and F-46 demonstrate the commonly accepted method for saw portation with the chain and blade pointed to the rear and the saw's mass hanging close to the ground. This method of portation is contrasted with the apparently more hazardous methods shown in Plates F-47 and F-48.

As would be expected, there are variations among the various standards dealing with saw carrying. These variations include not only the parameters which the standards treat but also inconsistencies in what is stated or implied. These are summarized in the following:

1. Some codes require that the saw engine be stopped only when carrying for distances greater than from tree to tree or when there are hazardous conditions. From field observations, we would tend to consider this practice as being more hazardous than stopping the saw. While some forests involve flat land with few or no obstructions to impede logger movement, tripping and falling is still one of the more frequent causes of injuries. Although there were no data located which related slips and falls to chain saw injuries the implication suggests that it is highly probable.
2. While the majority of standards suggest stopping the saw during movement they also indicate an option of moving to "a safe place" or "to the next cut". The latter suggestion is contra-indicated because of the very high percentage of injuries associated with falling trees and rolling logs. The recommendation would be to always take evasive action employing the escape route concept.
3. One standard (ILO) suggests that the chain saw be carried with the chain pointed forward (Plate F-47) if the saw is running with the chain disengaged. While movement of the logger with the saw operating is not considered to be a good practice, in the event that there is an extenuating circumstance requiring movement, then

the saw should be carried with both hands holding their respective handles. In this manner more effective control of bar (and chain) motion is maintained than with a one-handed carry. We repeat, at this point, the caution that saws carried across the body present the high probability of falls on top of the bar and chain. However, when operating, the saw should be in the user's forward visual field as opposed to the preferred trailing position when not operating.

4. Only one standard (MI) suggests that the saw be carried with the guide bar to the rear. While this is in concurrence with our field observations and conclusions, the majority of standards do not treat orientation of the carried saw. The AR standard suggests only that the blade be upright during carriage (AR standard does not recommend either the forward or trailing orientation). In the MI standard it is implicit that the blade is upright, in the trailing orientation, from the suggestion that saws be carried by the top handle. This upright blade orientation will prevent (or reduce) the possibility of injuries if the sharp chain were pointed toward the body.
5. Three standards suggest that the saw be carried in a manner to prevent contact with the chain and muffler. This is self-explanatory and is certainly recommended as a good practice.

SAW REFUELING

Refueling operations present a number of potentially hazardous conditions. The primary concern of the standards reviewed and of recommendations contained in saw manufacturer's publications is the possibility of fire. Each of the recommendations made by these standards is considered appropriate and would be logical to follow in all operations.

Among the precautions not presented as standards are the following:

1. Prevent spillage of fuels on body parts or on clothing. In addition to the fire hazard these fuels are toxic and can be irritating to the skin. There is a possibility of fuel splashes with droplets (or even massive showers) impacting the eyes. None of our field observations evidenced the use of face shields to protect against splashes. Typical of the situation shown in Plate F-49, there was also a tendency for glove removal during refueling. Should gloves be worn during refueling (not unlikely, especially in cold weather) they would constitute a hazard if they were to be wetted with fuel.
2. The possibility of fuel splash with the consequent saturation of clothing is apparently not a concern of the personnel involved in logging operations. However, in the event of a fuel spill it should be recommended that the wetted clothing be replaced immediately and stored in a non flammable container. A further suggestion is to provide protective clothing for use during refueling operations which can be removed after the operation is completed.

3. While there was considerable evidence of fire extinguishers in many logging operations their locations were not necessarily in close proximity to the refueling areas. This was especially true where refueling was not restricted to a centralized site; loggers tended to carry their own fuel containers to the felling site which required them to move only a short distance when refueling was required.
4. No standards were located which recommended a saw de-fueling operation prior to storage and/or transportation. Since injury data relating to this potential hazard were not located this may be an equivocal requirement. However, it is intuitively a good practice; this procedure would, of course, require special precautions.

SAW STARTING

Chain saws are started using a starter cord. Because of this feature it is necessary that a firm grip be maintained on the saw's top handle to prevent saw twisting. While starting, it is recommended or required by most standards that the saw be placed on a firm surface (preferably the ground; if impractical, then on a stump, log or heavy limb).

A popular method of saw starting is the "jump start" (observed during field observations). This method of starting involves gripping the saw handle in one hand while the holding arm is snapped forward and the other hand pulls back on the starting cord. While injury data have not been found which mediate against this mode of starting, safety personnel within larger organizations have established this as an unacceptable procedure. This procedure is also inconsistent with the above requirement for a firm surface.

Only one standard (IL) dictates that other personnel be at a safe distance during saw starting (ie. beyond two meters). By implication, there is a possibility that the saw might jump, in reaction to the pull on the starter cord, and hit another person. The above described "jump start" appears even more likely to result in injuries from this cause; a safe distance of two meters would not be sufficient for a jump start.

In observations of logging operations involving two men in the felling of a single tree it was concluded that saw starting operations could be hazardous to the second man. For this type of operation, when it becomes impractical for the second man to move to a safe distance it would be recommended that he position himself at the operator's shoulder opposite the hand pulling on the starter cord. (A caution is to be noted: there are several methods and saw orientations practiced in saw starting; consequently, the position of the second man should be defined with respect to each practice).

The owner's manual for at least one chain saw recommends an option of ground starting or push-away (jump) starting. In the recommendation for ground starting, the manufacturer suggests placing the saw on a flat surface with the knee positioned against the handle bar, over the starter housing. While gripping the trigger handle with the left hand, pull the starter cord with the right hand.

The latter use of the knee to stabilize the saw during starting should be

investigated. Because of the close proximity of the knee to the chain it is expected that an increase in the frequency of knee injuries might result.

SAW OPERATION

Use of the chain saw is sensitive to the requirements of the job being performed. Consequently, much of the information on saw usage and safe practices is contained in the sections detailing discrete operations. Discussions of operating considerations not presented in other sections are presented in the following.

Noise and Vibration Generation

No identifications of work injuries related to noise and vibration are evident from the injury statistics information obtained. It is suspected that these kinds of injuries are considerably more prevalent. With respect to noise, field observations revealed that a large number of loggers (but less than half) use ear protection. Although some used the ear-muff type as shown in Plate F-49, a majority used ear plugs in preference. At least one large company make these available to anyone wanting to use them and it was company policy to "suggest they be used".

Vibration effects have been noted with the use of chain saws. However, the domestic literature has not treated this problem extensively. The foreign literature suggests a high correlation of saw vibration to Reynaud's disease.

Eye Protection

At no time were observations made of loggers using eye protection during the use of chain saws. It is claimed that the chips fly away from the eyes and therefore protection is not required. Injury data indicate that a significant number of eye injuries do occur but the data do not reveal the specific causes. In the performance of tasks, such as shown in Plate F-43, it is suspected that the saw user is facially impacted by flying particles.

Saw Guarding

One form of guarding is reported in the use of "safety chain". This type of chain incorporates a wiper blade which is reported to free wood chips from the cut with the result that saw kickback is less frequent.

No evidence that other forms of saw guarding, which would be effective during operation, was obtained. However, the use of personnel protective equipment (reported elsewhere) has been promoted for Eastern operations.

LOG TRANSPORTATION - IN FOREST

The typical practice in logging operations is to skid or yard logs through the forest to a centralized landing. This landing is typically in an area which has been cleared in the forest and serves as the collection point for a number of felling operations and for the trucks used in log transportation from the forest. River driving, which was a significant form of log transportation has almost been completely replaced by truck transportation. In those areas where this mode of transportation still exists, it appears only

as a transient because of environmental considerations and is expected to completely disappear within a very short time; ocean haulage in rafts is still dominant in Western operations.

SKIDDING OPERATIONS (Skidder Vehicle)

Most operations presently use skidding as the method for moving logs to the landing. Basically two forms of skidding were observed: cable type (Plate F-50) and grapple hook type (Plate F-51). Both types of skidding are similar; however, operator proficiency may vary with the type of skidder.

Cable skidding involves the use of chokers (chains or cables) as shown in Plate F-50. The choker setter installs the choker around one end of the log and fastens to it a cable from the skidder. (Variations include the contiguous choker and cable). A number of logs can be handled in this way in a single operation as shown in Plate F-50. Once the chokers and cables are set the skidder operator uses the skidder's winch to draw up the logs which permits dragging the logs without the need for skidding pans.

Cable skidding permits the simultaneous hook-up of several logs but as the logs are winched to the skidder and when the skidder starts its forward motion rather violent motion of the logs will occur. This dictates that an appropriate area around the skidder and logs remain clear of personnel and equipment.

Nominally in the case of skidding, the skidder operator is responsible for fastening his own chokers. However, observations have also been made of operations in which choker setters perform this function with the skidder operator function limited to skidding only. In the latter case, appropriate precautions are necessary to ensure clearance of the choker setters from the area prior to winching-up the logs. The clearance area must be large enough to preclude injury in the event that the logs being skidded set sedentary logs in motion.

Grapple hook skidding can involve the hauling of one or more logs up to tree length, as well. In this form of skidding, the operator remains vehicle mounted at all times, and positions the grapple over the logs to be skidded. He can use vehicle movement to gather each of a number of logs. Generally, the logs are controlled more effectively by this method of skidding but precautions are still required to maintain the area cleared of personnel.

Once the skidder is in control of the logs, it is moved from the felling site to the landing area. Stumps and other obstacles in the path of the skidder may result in inadvertent log motion thus requiring that skidding roads be kept clear of personnel. The forces generated through impacts of the skidder or the skidded logs are said to be sufficient to fracture standing trees, which could impact with the skidder or personnel in the area of skidding road.

Skidding roads could include large cleared areas within the forest but often are rather narrow paths through stands of timber (Plate F-52). Generally, the skid road is cut (Plate F-53) through the forest by selective felling of trees to provide adequate clearance.

In the landing area the skidder operator drags the log load to a pre-determined position, usually paralleling a deck of logs awaiting truck loading (Plate F-54). He unwinds the winch to put slack into the chokers and cable and may either disembark from the vehicle to unfasten the chokers (Plate F-55) or remain in the vehicle until another logger removes the chokers. After the chokers are removed the skidder operator winches in the cables and returns to the felling site for another load.

Grapple-type skidding is accomplished without the need for assistance or for the skidder operator to leave the protection of his vehicle. However, in order to orient and gather a log load, the skidder must be driven to each log; often the skidder is driven over a number of logs strewn on the ground (Plate F-56).

Skidder Vehicle Characteristics

Skidder vehicles may be rubber-tired (Plate F-57) or track type (Plate F-58). The bodies of the vehicle are articulated providing for greater maneuverability. Control of the vehicle is through a steering wheel or through differential speed and directional control of the tracks.

In skidding-out the logs the operator often simultaneously controls vehicle motion and the cable winch. He uses the winch to pull the logs into position often using full winch power to extricate the logs.

For most skidding operations observed, the skidders were equipped with roll-over protective canopies and in many instances the canopies were partially screened to afford some protection against branch penetration into the cab. However, the use of protective canopies was not universal and the extent to which screening is used does not appear to provide sufficient protection.

A unique feature for skidders (observed at only one company) is the incorporation of a rotatable control station. The skidder was equipped with a control permitting the operator to rotate his seat in accordance with the direction he is travelling (he could also position himself to face laterally). This type of skidder appears to promise increased safety because it ensures a better field of view relative to direction of travel.

Vibration and buffeting exposures of the skidder operator can be quite severe. While measurements of force magnitude were not taken it is suspected that these parameters do constitute a hazard. The hazard is related more to the quality of the ground surface than to the basic vehicle design.

The operator of the vehicle does not usually use a seat belt; even in those vehicles which are equipped with them. It is commonly stated that the operator fears not being able to jump clear of the vehicle if it should start to roll over or fall down an incline. Though not stated, it is suspected that use of a seat belt is rejected, as well, because it prevents the operator from moving his body in order to gain visibility. As shown in Plate F-59, taken from operator normal eye position, visibility of the forward ground is quite obscured. Similar problems are noted for rearward vision where the arch also obscures vision (Plate F-57).

Skidder Vehicle Alternative Uses

The skidder is used as a work horse for a multitude of tasks. Some of these jobs are listed, as follows:

1. Snow plow (Plate F-60).
2. Road grading (Plate F-53).
3. Clean up of debris.
4. Pushing other equipment which is stalled, stuck in mud or cannot get traction on ice or snow (F-5).
5. Pulling down or knocking down lodged trees.
6. Forming log stacks (or decks) at landings.

Injury Potential

The basic reasons for injuries resulting from skidder vehicle operation are not well defined. In general, the vehicle operator is protected reasonably well; the major cause of injury to the operator appears to result from vehicle overturn due to ground disintegration under the vehicle's weight or due to inadequate operator control on slopes. A number of injuries have also occurred due to winching operations where logs have been "pulled into the cab" or cable flailing after breaking under tension. On a relative scale, however, the skidder operator does not appear to be as vulnerable as are other occupations.

The point at which the greatest number of skidding related injuries occur is with personnel working within the vehicle's right-of-way. Logs being winched and/or skidded often do not travel in a straight line; they tend to make massive flailing movements in response to forces induced by contacts with ground obstructions. In addition to the injuries due to log drags, secondary causes are the result of trees knocked down by skidder or log drag impacts and due to personnel being struck by the vehicle itself.

YARDING OPERATIONS

These operations are typically identified as a Western operation and involve the use of long length cables or chains for moving logs to the landing area. Typically this operation is performed by high lead skidding or sky line hauling; however, a simplified form of long cable skidding is also used in Southern pulpwood forests. This simplest form of cable rigging is discussed first.

Southern Cable Skidding

In this form of cable operation a truck-mounted winch is used to gather bucked logs at the felling/bucking site. The cable is manually pulled from the truck to the logs and fastened around one or more logs as shown in Plate F-34. The logs are approximately five feet in length and the cable is fastened at about mid-length. At a signal from the cable setter the truck winch operator powers in the logs; truck loading is accomplished at the same time.

Cable Yarding

This is the most complex form of log transportation from the felling site to the landing site. It is used extensively in Western logging operations but was not observed elsewhere. Performance of this operation requires the support of loggers who specialize in each of a number of tasks and who must be well coordinated in the interest of personnel safety.

Three forms of cable yarding (with variations) are performed: high lead, sky line and balloon. The high lead system skids logs along the ground without providing any lift; the sky line employs an elevated cable which provides lift (often the logs leave the ground completely;) the balloon method involves use of a helium-filled balloon which provides lift to the logs while cables control the movement and elevation of the balloon. Balloon logging operations were not observed during the program because of poor weather conditions during the scheduled tour.

Little real difference is noted between high lead rigging and sky line rigging in terms of impact on logger safety.

Cable Rigging Installation

The central point within the high lead yarding system is a high powered engine (donkey engine) which powers the movement of a semi-permanently installed set of cables as shown in Plate F-61. The engine is used consecutively to winch the main haulage cable, with its log load attached, to the engine site and then to return the cable to the log site.

The donkey engine and spar installation are located at a landing and are generally the central or focal point for all activities at the landing. In recent times, almost all spars are portable, steel poles anchored and stabilized by a series of guy cables, as shown in Plates F-61, F-62 and F-63. However, the use of a spar tree is still evident in some locations. An alternative approach, still in use, is the A-frame (Plates F-64 and F-65).

The use of an adequate number of guy cables which are well anchored (Plate F-66) is essential for supporting the loads which develop. Additional support is provided through the use of hydraulic load levelers attached to the spar vehicle which are emplaced as shown in Plate F-67.

Once the spar and engine are installed the rigging can be relocated to facilitate the removal of logs located anywhere around the spar and from a linear distance of about 1,000 feet. Cable is strung from the winch/spar to a location in the forest. This cable consists of a main hauling cable and a return cable. A tail spar, as shown in Plate F-64, and/or tree stumps installed with pulleys complete the system. (A large number of variations in the cable system prevail; however, detailed description of these is not considered necessary for this report).

In operation, the donkey engineer, responding to appropriate signals, uses the haulback or straw line to pull the main cable to the location of the logs. On a second signal, he winches in the main cable to which the logs are attached. Further discussion of these operations is presented in the following paragraphs.

CHOKER SETTING OPERATIONS

In using the high lead yarding system it is typical to employ a crew of choker setters under the direct supervision of the head rigger. Choker setting involves the installation of chokers around each log to be skidded and connection of the choker to the main haulage cable. The number of logs attached to the cable for haulage may vary depending upon the size and weight and capability of the engine/spar system. Movement of the cable is dependent on a series of signals between the whistle punk and the donkey engine operator.

The choker setting crew can be of varying size but in general is under the direct supervision of the head rigger who works with the crew. The following tasks are performed by this crew:

1. Whistle punk: one member of the crew is designated to communicate with the donkey engineer. He is usually equipped with a transmitting device which is used to actuate a horn. He signals when to start log haul, stop hauling, move hauling cable forward or aft, drop skyline hook, etc. These horn signals can be heard throughout the area and serve as warning to all personnel who might be within the bight.
2. Head rigger: while it is the whistle punk's responsibility to operate the horn communication system it is not his responsibility to determine what signals to transmit. (An exception to this rule permits the whistle punk to determine, on his own recognizance, when to call for the engineer to stop cable movement in the event of an impending accident). This is the responsibility of the head rigger who directs all of the choker setting activities and is responsible for safety of the crew.
3. Gopherman: although in most instances where cable skidding is practiced the ground is sufficiently rugged to provide clearance for the emplacement of chokers around the end of the log, there are many instances where a hole must be dug to permit this operation. While many companies have generally eliminated the use of explosives for this purpose because of the injuries which occurred, other companies still use this procedure.

Plates F-68 through F-71 show choker setters in action. In this sequence the ground was relatively flat; however, in many instances of Western logging, choker setting involves working on slopes. In such cases the crew members must avoid working on the down hill side of any logs. As seen in Plate F-31, logs are often stacked one on top of another; this is another major cause of injuries due to log shifting.

When the chokers have been set and hooked to the cable the crew moves away from the area and the donkey engineer is signalled to winch in the turn of logs. Clearance of personnel from the bight is necessary whenever the cable is in motion. In addition to the swinging logs and choker cables it is not infrequent that a branch becomes snagged in the cable and can be propelled with considerable force for relatively great distances.

The need for rapid movement of the choker setters introduces the hazard of slips and falls. This appears to be a greater hazard on sloped ground and especially where large amounts of slash are evident. It is expected that snow covering obscures stumps and other obstacles which increase the probability of accidents.

LOG HAULAGE

The donkey engineer, upon receiving a signal from the head rigger (via the whistle punk) starts the engine and winches up on the main haulage line, simultaneously letting up on the straw line. Often the operator does not have visibility of the logs being dragged along the ground until they are within a short distance of the spar. Consequently, he must be able to receive signals from the rigging crew in the event of any emergency situation. This poor visibility is shown in Plate F-72, taken from the donkey engine cab.

Plates F-73, F-74 and F-75 show a sequence of bring the logs to the landing by both high lead and skyline cable methods. As shown in Plate F-75, at the landing, the chaser signals by hand, instructions for the engineer in order to place the logs properly on the ground. When the logs have achieved a stable position the chaser unhooks the cables (plate F-76) and when, clear again signals the engineer to return the mainline to the choker setting site when indicated by the head rigger.

OTHER CABLE YARDING METHODS

The movement of the logs by cable can also be a staging process as shown in Plates F-77 and F-78. In the example shown, an A-frame has been constructed on a raft (Plate F-78) as is being used to bring logs into the water. Cable control is via a tail spar (Plate F-79) around which logs from the surrounding clear cut area have been decked.

Not shown in these plates is that the tail spar was originally used as a main spar to collect the logs from the felling site.

Shown in Plate F-80, is a smaller type of cable yarding machine which is used for yarding of smaller trees and from shorter distances.

ADDITIONAL CONSIDERATIONS IN LOG HAULAGE

All operations are not as automated as described in the above. A number of observations were made in which manual power (Plates F-81 and F-82) was used to transport logs to the landing area.

Plate F-83 shows a log tong used for pulling and lifting of logs. This device is infrequently used and one logger indicated that its use is primarily to extricate logs when chokers or other methods cannot be used.

The use of horses for skidding logs was not observed but it is understood that they are still in limited use. One reporter indicated that they are used in watershed areas where a small number of trees are felled. They are preferred over other skidding methods which tend to be more destructive.

LANDING OPERATIONS

The landing area is centralized in location with respect to the felling sites. For large operations which diversify between skidding and yarding methods of log transportation it is most likely that the respective landing operations would not be combined; however, the forms of activity at each operation are similar.

Safety requirements should dictate the layout of landing areas; this is especially true since it is at the landing where a large variety of equipment and occupational specialties are integrated and the most prevalent hazards are predictable and controllable through effective planning.

LANDING AREA DESCRIPTION

Typical landing areas can generally be characterized as a large flat clearing layed-out primarily for vehicle traffic control. Logs are skidded or yarded into the area, processed and/or decked for truck loading, and transported to a log dump.

Development of the landing area requires the clear cutting of trees and grading to produce a hard flat surface having effective water drainage. The ground surface and understructure is ideally quite stable and resistant to damage from tires of trucks, skidders, etc. In one operation observed, a specially equipped truck skidder (Plate F-7) was used for grinding down of tree stumps to ground level. Skidders and bull-dozers are used for grading.

Leading in and out of the landing is at least one road suitable for repetitive use by heavily laden trucks. In some Western logging operations these roads may be used for loads up to 80,000 pounds (including truck weight).

Skidding roads leading to and from the landing are typical of that shown in Plates F-52 and F-53. Similar to typical logging road operations, the same skidding road can be used for both incoming and outgoing vehicles.

OPERATIONS WITH VEHICLE SKIDDING TECHNIQUES

It appears that the majority of logging operations are supported by vehicle skidding. In many operations, the landing is required to service only a single skidder and a single truck. However, as the size of the logging operations grows, so does the number of skidders and trucks.

In the simplest operation the skidder, a log loader (Plates F-84 and F-85) and the logging truck (Plate F-86) are brought together in a side-by-side arrangement. As the skidder delivers its load along side the log loader a bucker begins to remove any previously overlooked branches and cuts the tree length log (Plate F-36) into a size compatible with the truck. The log loader operator transfers the bucked and limbed logs to the adjacent truck; usually the operator transfers more than one log at a time. As the process continues the skidder will also be used for maintaining the areas relatively free of debris using the blade on the skidders front end to push cut branches and short logs out of the way. A "deck" of short logs of merchantable quality is shown in Plate F-87 for a Southern pulpwood landing area. Nominally

this clean-up work is performed with the same skidder used to transport the logs.

As the volume of effort performed at the landing increases there is a spatial as well as sequential shift (or time displacement) in landing operations with each operation being carried on somewhat independently. Each operation may be duplicated at several sites in the landing area and are summarized in the following:

1. Logs are skidded-in and the chokers released. The skidder operator may break the stack of logs he has brought in if necessary to ensure exposure for further limbing and bucking. The skidder then leaves to collect another load of logs.
2. A bucker limbs the delivered logs and may perform additional log cutting when required for ensuring that log lengths meet truck load specifications. In operations involving saw log production the bucker uses a tape measure for determining lengths; the objective is to maximize the value in terms of maximum lengths (and standardization). For pulpwood logging, lengths are not as critical and cutting points are determined by visual approximation. The bucking of saw logs at the landing includes judgements of wood quality; thus the bucker will also be responsible for the removal of dead wood sections from the log. The bucker may also move limbed branches manually from the bucking area and generally maintain the area clear of debris. Plate F-36 shows the development of a slash pile adjacent to the bucking area.
3. The above procedures are repetitive with the bucked and limbed logs being temporarily stored in a deck as shown in Plate F-88. This deck is formed and grows continuously for later loading on a truck. Formation of the deck is accomplished by the skidder operator or the log loader operator, depending on log size. With every load he brings in he pushes or places the previously limbed and bucked logs up on top of the deck. Often this procedure involves driving the skidder over logs and partway up the side of the log deck.

Once the log deck is completed (ie. reaches truck-load size) the skidders and buckers initiate development of a new log deck. The new log deck is built elsewhere on the landing; it should be remote from other decks which are actively being loaded on trucks.

LOG LOADING

Three approaches are generally followed in truck loading operations. These are manual loading, grapple loading, and fork loading. Each approach involves a somewhat different hazard potential.

Manual Loading

This technique is somewhat antiquated but still prevalent in Southern pulpwood logging. As shown in Plate F-89, logs are gathered and carried to the truck by all members of the logging crew. In this type of operation the truck is centrally located and tree falling and bucking is performed at a short radius from the truck.

Initially the crew collects logs closest to the truck and of the smallest diameters from a distance. These are placed on the truck bed, until the log height exceeds manual lift heights; they are left on the ground adjacent to the truck.

In this operation, logs which are too heavy for carriage to the truck are cable skidded to the truck (as previously described). The winch (shown in Plate F-90) is used to lift logs as the truck load grows. This winch is powered and provides a swivel motion to assist in locating and placing of the log (Plate F-91). The swivel motion is manually controlled and the loader operator stands on the log load (Plate F-92).

Grapple Loading

In this technique, the grapple loader may be a separate vehicle located alongside of the truck being loaded or the grapple loader may be an integral part of the truck being loaded. The grapple operation is similar in both cases.

Grapple loaders (Plates F-93 through F-95) can vary in size and capacity with the operator seated on an open (exposed) seat or protected within a completely enclosed cab. Controls used by the operator include the following:

- a) Rotation of the basic assembly to the right and left.
- b) Elevation of the grapple arm.
- c) Extension of grapple arm.
- d) Rotation of the grapple hook.
- e) Opening and closure of the grapple hook.
- f) Speed control for each of the above operations.

The grapple loader uses a hook (Plates F-96 and F-97) for grasping the log. In the operation shown by Plate F-93, the grapple hook is used in conjunction with a heel boom to control and orient the log for loading on the truck. In this type of operation the truck driver moves the truck backward and forward in response to arm signals from the signal man (Plate F-99) and the grapple loader operator lays the log onto the truck bunk (F-100).

In operations involving grapple loaders (knuckle type), such as shown in Plates F-95 and F-96, the truck remains stationary and the loader operator moves the log into position.

Fork Loading

In fork loader types of operation the loader operator maneuvers the vehicle around the landing and picks up logs from decks (Plate F-101) and can selectively load a truck. In this type of loading the truck remains stationary while the loader "drops" logs into the bunk (Plate F-36).

Truck Loading Requirements

The basic requirement in loading logs on trucks is to ensure a stable load which does not exceed weight limitations established for any of the rights of way used. The trucks used vary according to type of logging operation. In Western operations the trailer-type, shown in Plate F-102, is typical for the transporting of large logs. Plates F-5 and F-96 show other types used in Eastern operations.

With the trailer-type truck shown in Plate F-102 the unloaded truck travels while carrying the trailer. Just prior to the loading operation the loader operator lifts the trailer from the truck bed. The truck driver moves forward and the trailer is lowered into position and fastened in place.

The bunk stakes, shown on the truck are used primarily for lateral load stabilization and log loading is accomplished such that the logs interact to support most of the forces which develop. Bunk chains beneath the logs place inboard tension on the stakes. As shown in Plates F-104 and F-103, the logs are often loaded well above the height of these stakes. Further load stabilization is effected with binder cables or chains which are used to encircle the log load.

The binder is usually set by the truck driver who throws the cable over the load (Plate F-103) and fastens them (Plate F-105) using a tensioning bar. Plate F-106 shows the chain fastener configuration.

In this load binding operation the driver has often been observed walking under the load while fastening the binders. Alternatively, the driver receives assistance from a second loader who passes the end of the cable under the truck.

It has been stated that a good work practice is to stabilize the load with the loader while the binders are being attached. This practice was seldom practiced during observations; it is claimed that if logs are loaded properly they will remain stable until the binders are emplaced. Additionally, a hazard develops, with the throwing of the binder over the load, to anyone located on the opposite side of the truck.

During observation of at least one landing operation, trucks were moved a short distance, after loading, to a new location where the binders were emplaced. This creates a hazard to both personnel and equipment should the load shift.

However, most operations involved emplacing of binders before truck movement, followed by the routine tightening of the binders after driving about a thousand feet. This routine permitted the load to settle. Tightening of the binders involved loosening of one binder at a time, leaving the load somewhat stabilized. It is to be noted though, that at least one fatality resulted from the driver loosening all of the binders simultaneously during this tightening operation. No reason for this unsafe procedure is known.

In Eastern operations, truck configurations were observed which completely contained the log load and apparently did not require the use of binders.

LANDING OPERATIONS HAZARDS

The major hazards which develop at the landing are associated with log and vehicle movements. In the injury data analysis it was shown that, for Western operations, the second loader is especially susceptible to fatal injuries. The log truck driver is not much safer when out of his cab.

A major recommendation for good work practices in landing operations is to ensure adequate clearance for personnel and between operations, with adequate vehicle operation driving pattern controls. Vehicle collisions with other vehicles and with foot traffic occur with a high frequency, as is also noted with log movement. Section I indicates constraints which result in small landing sizes.

Other types of injuries also occur; many associated with equipment repair and with the encroachment of other logging operations into the landing area.

LOG TRANSPORTATION OPERATIONS

Major transportation of logs to the mill can be accomplished by truck, railroad car or water. Often these methods are combined with water transportation being almost entirely limited to rafting procedures. River driving still exists but because of environmental considerations has become or is becoming a thing of the past.

Generally, logs are initially transported from the forest, by truck to a log dump for log storage and sorting. From the dump the logs can be sent into the mill or prepared for further transportation.

TRUCKING ROUTE

Logging roads of varying quality along with high quality highways comprise the routes used by logging trucks. Often the logging roads are quite narrow and require spaced turn-outs to permit passage of traffic in both directions. Especially in Western logging operations, these roads can wind through mountainous terrain and forward visibility of the road ahead is often obstructed by outcroppings of rock and uncut trees. Sometimes these roads are not restricted and tourists can create additional hazards.

Among the observations made during travel on logging roads was the continuing road maintenance activity; including repair and resurfacing with gravel. Weather conditions, including fog, ice, rain and snow are not uncommon. Road surface watering as a means for dust control is frequent.

The various logging codes stress both road design and maintenance and the design of logging trucks. Braking systems are obviously the most important consideration.

Although seat belts are provided in most trucks observed it was frequently stated that these are not used in the mountains. One company representative indicated that most of his drivers stopped at a point where the road slope had flattened to put on seat belts but would not use them in the mountains. Most drivers believe that if the truck becomes a runaway that they can jump clear if not restrained.

It is also reported that seat belts are used by crew bus occupants in the same way.

LOG DUMP OPERATIONS

Unloading of log trucks is typically accomplished with a fork-type log loader. Plates F-107 through F-109 show the sequence of this operation. The first step is to completely envelop the log load with the fork while the load is still retained by the binders. The truck driver removes the binders and the fork loader operator lifts the load and transports it to a log deck in the dump as shown in Plates F-110 through F-112.

The major considerations for personnel safety in this operation involve the restriction of foot traffic (including the log truck driver) and the maintenance of vehicle traffic control. With respect to the truck driver, he is vulnerable to both logs falling from the truck and to being struck by vehicles or logs dropped from the fork loader. While it is a good practice to support the log load with the fork loader while the binders are removed, an alternative approach was also observed (Plate F-113).

In this approach the log truck was driven alongside a barrier. The truck driver got out of the truck and from the protected side of the barrier reached into the binder chains, unfastened them and pulled them free. In this way, if the logs fall from the truck the driver is protected.

While, in principle, this latter approach appears effective there were two observations which suggest it is not fool-proof. The first was an observation of a truck driver not pulling close enough to the barrier and, in order to remove the binders, he placed himself between the truck and the barrier. The second observation is that after removal of the binders the truck is driven to another location within the area to be unloaded. While actual observation was not made, it appears likely that the log load could spill at this time. In such cases it would be recommended that the driver not leave the truck cab during the unloading operation and that foot traffic not be permitted in the area for any reason, as specified by many of the current codes.

The need for strict traffic control is also evident. Small vehicles offer little protection against the forces which could be generated by log rolls or by collision with the large vehicles. The continuous stream of trucks entering the dump combined with the rapid movement of log loaders between trucks and decks dictates the need for well defined routes for the trucks. The loaders move to various decks depending on the type of logs being unloaded. This move can be in a rearward direction just as frequently as in the forward direction and it appears that, with the larger vehicles and loads, operator visibility is greatly restricted. One type of loader was observed where the operators console rotated so that the operator could face the direction of travel. Often, with this type of vehicle, the operator faced to the side where he could look forward and aft with only head movements.

Once the truck has been unloaded it is driven to a hoist (Plate F-114) where the driver removes the trailer and places it on the rear of the truck. The trailer is fastened and the truck is driven back to the landing in the forest.

Log Sorting

Separation of logs on the basis of wood type, log size, wood quality, etc., is effected in the sorting yard (part of the log dump). Two methods were observed. In the first, a fork loader was used to break stacks (or decks) and

selectively move logs to new decks. In the second, logs were dumped by a log loader onto a moving chain (Plate F-115). This latter procedure is described in the following.

In the chain sorting procedure a number of logging specialties and equipment are brought together. As the logs are laid on the moving chain at one end a log loader is used to remove graded logs at the other end of the chain. A chain operator controls chain movement and must watch the progress of each operation; premature movement of the conveyor chain could result in either injuries or equipment damage.

The chain is stopped to permit log scalers to measure and grade each log. Logs are then interchanged on the chain to group common types. This is accomplished with a heel-boom grapple (Plates F-116 and F-117).

Log Scaling and Marking

Log scaling is performed at several points of logging operation. Scaling is a procedure for estimating the number of board feet of lumber which each log will provide. This procedure is necessary for determining payments as well as for inventory control. Payment considerations include wages for loggers who work for incentivized wages (eg. fellers, truck drivers, etc.) and for determining purchase price from independent loggers.

In operations where logging companies use the facilities of an independently operated log dump the logs are tagged (Figure F-118) to identify the owner.

The log scaler can be a company employee or an employee of an independent Scaling Bureau. He measures the logs (Figure F-119) and estimates the wood quality (Plate F-120). Appropriate markings are placed at the end of the log (using a can of spray paint) and a record sheet identifying each log is maintained.

While the injury data do not indicate that the log scaler is particularly vulnerable to injury it is expected that he would be subject to slips and falls and to log movement. In addition, when working at the felling site or in landings he would be vulnerable to the same hazards as the other personnel in these areas. As shown by the injury data, scalers have been hit by falling trees, killed by explosives and hit by vehicles.

Preparation of Logs for Further Transportation

The log dump is generally used as a log storage yard for subsequent transportation. Dumps nominally used for mill operations require only that the logs be moved from decks to the point of entry to the mill. Ponds (Plates F-121 and F-122) are typically used to float the logs to conveyors; however, use of a log loader to place logs on the conveyor is not unusual.

Rafting

Water transportation (except river driving) usually involves the building of a log raft (Plate F-123). This involves dumping logs into the waterway, aligning them and containing them in position with a series of brow logs chained together in series. Individual logs or a number of logs bound together (Plate

F-124) are used for the raft.

The logs are oriented by loggers who walk on the logs using poles to push the logs into position (Plate F-122) or use a small boat (Plate F-121) for pushing. Once the raft is formed it is towed by a tug boat to its new destination. The towing distance can be considerable (distances of over 60 miles were cited) and may include traversing coastal waters.

A general requirement for loggers working over or near water is the use of flotation vests. A number of drownings are cited in the injury data. However, there is considerable reluctance, among some loggers, in wearing these vests. Although the logger may be a good swimmer there is a high probability of head impacts with logs which can contribute to the injury. While loggers usually wear helmets these are inadequately retained and a fall into the water will most likely dislodge it. A recommendation is made for a helmet designed for this use which will not create an additional hazard to the logger who finds himself in the water, and will be retained on the head. Such a helmet is used by many surfing enthusiasts.

Train Transport

The loading of trains is effected in much the same way as are trucks. Plates F-125 and F-126 show an operation involving the loading of pulpwood. In this example, a number of hazards are evident. During loading, the logs are unstable and a laborer is usually assigned to orient the logs as they are placed aboard. Falls from the car or log rolls or accidental penetration of the foot by the pickaroon are frequent occurrences.

MISCELLANEOUS OPERATIONS

Separation between logging and mill operations is often not clearly differentiated. In some operations, logging operations are considered to be ended at the point of log delivery in the sorting yard. However, in some logging operations, milling operations were observed in the forest. For example, Plate F-127 shows a portable chipping machine used in the forest. Plate F-128 shows the same type of operation in a log dump. In these operations debarking and chip production were performed before the major transportation phase.

Plates F-129 and F-130 show two types of crew buses used in logging. The various logging coded cover the use and design of these vehicles.

APPENDIX B

LOGGING SAFETY STANDARDS SUMMARY (Complete Summary is in Volume II)

<u>TOPIC</u>	<u>PAGE</u>
GENERAL EMPLOYEE SUPPORT REQUIREMENTS	B-7
OPERATIONAL SAFETY	B-7
CAMP CONSTRUCTION AND MAINTENANCE	B-11
Camp Sanitation	B-14
Water Supplies	B-19
Facilities	B-21
PERSONNEL	B-24
INJURY MANAGEMENT REQUIREMENTS	B-25
PROTECTIVE CLOTHING AND EQUIPMENT	B-27
PERSONNEL TRANSPORTATION REQUIREMENTS	B-30
PERSONNEL TRANSPORTATION	B-30
Crew Vehicle Types	B-30
Vehicle Operation and Inspection	B-31
Personnel Accommodation and Seating	B-33
Safety Provisions	B-35
First-Aid and Fire Protection	B-37
Equipment and Explosives Transport	B-38
Vehicle Design	B-39
VEHICLE OPERATOR PROTECTION	B-42
Canopies and ROPS	B-42
SELECTION, USE AND MAINTENANCE OF HAND TOOLS	B-59
FELLING OPERATIONS	B-63
PLANNING	B-63
SUPERVISION	B-64
FELLING CREW SIZE	B-67
ESCAPE ROUTE CLEARANCE	B-68
FELLING DIRECTION	B-69
UNDERCUTTING	B-71
BACKCUTTING	B-73
WEDGING PROCEDURES	B-73
SNAG FELLING	B-74
LODGED TREES	B-75
WARNINGS AND SIGNALS	B-76
SPRINGBOARDS AND CHOPPING PLATFORMS	B-77

<u>TOPIC</u>	<u>PAGE</u>
BUCKING OPERATIONS	B-79
SUPERVISION	B-79
ENVIRONMENTAL CONSTRAINTS	B-79
WARNING AND SIGNALS	B-80
BUCKING LOCATION	B-81
PRE-BUCKING OPERATIONS	B-81
LIMBING	B-82
BUCKING PROCEDURES	B-83
SAW OPERATIONS	B-84
REFUELING	B-84
STARTING	B-84
OPERATION	B-85
CARRYING	B-86
DESIGN REQUIREMENTS	B-88
INSPECTION, MAINTENANCE, ADJUSTMENT	B-90
MISCELLANEOUS	B-91
SKIDDING OPERATIONS	B-92
SKIDDER DESIGN REQUIREMENTS	B-92
SKIDDER MAINTENANCE AND REPAIR	B-99
VEHICLE OPERATIONAL REQUIREMENTS	B-100
SKIDDING ROAD CONDITION	B-103
SKIDDING PROCEDURES	B-104
SKIDDING WITH ANIMAL POWER	B-109
SIGNALLING REQUIREMENTS	B-111
PERSONNEL PRECAUTIONS	B-111
YARDING AND SKIDDING OPERATIONS	B-114
PERSONNEL REGULATIONS	B-114
SIGNALLING AND WARNING REQUIREMENTS	B-117
YARDING OPERATIONS	B-128
YARDING PROCEDURES	B-128
LANDING DESIGN	B-134
CHOKER SETTING	B-134
CHASERS	B-136
WHISTLEPUNK	B-137

<u>TOPIC</u>	<u>PAGE</u>
INSTALLATION OF RIGGING	B-138
SPAR TREE REQUIREMENTS	B-138
GUYING OF SPARS	B-140
RIGGING PROCEDURES	B-150
RIGGING INSPECTIONS AND MAINTENANCE	B-160
RIGGING SPAR TREES	B-163
RIGGING REQUIREMENTS - GENERAL	B-167
A-FRAMES AND BOOMS	B-168
PORTABLE METAL SPARS	B-170
METAL SPAR INSTALLATION	B-172
CABLES AND ROPES	B-178
SPLICES, CLIPS, CLAMPS	B-180
GUYLINES AND INSTALLATION	B-184
SHACKLES AND BLOCKS AND SHEAVES	B-188
BLOCKS	B-195
STRAPS	B-201
LINES	B-203
LINES AND LEADS	B-206
LOADING AND UNLOADING OPERATIONS	B-216
AREA MAINTENANCE	B-216
SIGNALS	B-217
LOADER OPERATOR EXPERIENCE	B-218
EQUIPMENT INSPECTION	B-219
STACKING AND LOADING OPERATION	B-221
TRUCK LOADING REQUIREMENTS	B-222
PERSONNEL LOCATION	B-226
PROCEDURES AND OPERATIONS	B-230
EQUIPMENT DESIGN REQUIREMENTS	B-234
EQUIPMENT USE--PRECAUTIONS	B-241
MISCELLANEOUS	B-244
TRANSPORTATION OPERATIONS	B-245
TRUCK DESIGN	B-245
DESIGN OF BINDERS, CABLES, CHAINS	B-257
VEHICLE OPERATIONS	B-271
ROAD CONSTRUCTION	B-285
DESIGN REQUIREMENTS	B-285
BUILDING OF ROADS	B-288
TRAFFIC CONTROL	B-290
INSPECTION AND MAINTENANCE	B-291

<u>TOPIC</u>	<u>PAGE</u>
BLASTING OPERATIONS	B-293
PERSONNEL REQUIREMENTS	B-293
HANDLING OF EXPLOSIVES	B-296
STORAGE OF EXPLOSIVES	B-300
TRANSPORTATION OF EXPLOSIVES	B-303
PREPARATION AND BLASTING	B-304
LOADING	B-311
FIRING THE SHOT	B-314
MISFIRES	B-316
MISCELLANEOUS REGULATIONS	B-319
GENERAL OPERATIONAL REQUIREMENTS	B-319
AREA MAINTENANCE	B-321
PERSONNEL PRECAUTIONS	B-322
EQUIPMENT OPERATION REQUIREMENTS	B-324
EQUIPMENT SAFETY REQUIREMENTS	B-327
Visibility	B-327
Seating	B-328
Guarding	B-329
Flammables	B-332
Electrical	B-334

APPENDIX C

FATALITY REPORTS REVIEW

Reports summarizing each fatality within the logging industry were obtained from the states of Washington and California. These reports included:

1. Washington - total fatalities 91, occurring during the period of 1968 and 1970 through Oct. 1972.
2. California - total fatalities 93, occurring during the years of 1968 and 1971.

These reports are further summarized in this appendix; these summaries were the basis for analyzing the cause & effect relationships presented in Section II of this report.

Additional data on fatalities were acquired from Oregon for the period of 1966 through 1971 (total of 212 fatalities). However, this data was not accompanied by sufficient descriptive data to enable the presentation of summaries in similar form.

A number of fatality descriptions were also obtained for the Eastern pulpwood area. These were highly selective and did not lend themselves to any form of analysis. Consequently, the descriptions have been presented along with selected injury descriptions in Appendix D.

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Falling tree glanced off a stump causing smaller tree to fall. Victim accidentally knocked off his hard hat, small tree struck him on bare head.	Helmet retention; poor control of felling direction.	Head impact by tree struck by felled tree.	Faller
Victim walked away after falling a snag while partner finished felling the tree. Deadwood crumbled in direction victim was walking.	Lack of evasive action	Impact by snag being felled	Faller
In felling a snag it was necessary to place a second undercut. Undercut was made with too great a depth & snag fell uphill rolling back onto the victim.		Impact by snag felled.	Faller
Victim hit by log while standing beside a truck being loaded. Crane hook slipped while operator was attempting to make log more secure on load.	Lack of safety zone.	Impact by log dropped during loading.	Faller
While cutting the last of six sprouts from an old stump, victim was unable to perform a back-cut properly. Sprout fell backward hitting victim.		Impact by falling sprout.	Faller
While taking a short-cut to the landing over wet and damp rock, victim slipped & slid down rock face and over the edge of a bluff.		Total body impact with ground surface.	Faller
Two broken snags leaning on tree being felled. Leaners fell on victim unexpectedly.	Leaners were not removed prior to working in area.	Impact by snag supported by tree being felled.	Faller

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
After felling a tree it lodged in crook of tree. Victim initiated bucking near lodged tree. The support tree gave way and victim was struck by uprooted butt.	Working around lodged trees.	Struck by uprooted tree.	Faller
Heart attack.		Cardiovascular	Faller
Crushed by trees felled by others.	Inadequate work separation distance between fellers.	Crushed by tree	Faller(2)
Crushed by trees which broke loose when trees or logs supporting them broke loose.	Working around lodged trees.		Faller(2)
Victim placed undercut from wrong side resulting in tree falling into a leaner. Butt of falling tree kicked-back striking victim who fell to ground & was crushed when butt came to rest on his head.	Working around lodged trees & improper control of tree falling direction.	Head impact due to kickback by tree	Faller
Small limb struck victim on head. Victim was wearing hard hat improperly.	Poor discipline in use of protective equipment.	Head impact by limb	Faller
Victim was felling a tree supporting a leaner. Smaller tree broke off at the top; tree top fell on victim.	Working under lodged trees.	Body crushed by falling timber	Faller
Falling tree struck another tree causing the top to break off. Broken tree top flew through the air striking a woods boss who was observing a second falling operation.	Inadequate distance between personnel in felling areas; inadequate warning to fellers by observer entering area.	Impact by flying timber.	Woods boss (Observer)

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>Victim initiated but did not complete the felling of a tree. Victim then initiated the felling of a larger tree downhill of the first tree. Larger tree vibration caused first tree to fall.</p>	<p>Working downhill of tree on which cutting has been initiated; no special precautions taken when leaving partially cut tree.</p>	<p>Impact of falling tree</p>	<p>Faller-bucker</p>
<p>After bucking a tree, victim climbed up on top of log to use it as a walkway. Log rolled pitching him off & rolled over him.</p>	<p>Inadequate blocking of logs which may roll; working on top of logs.</p>	<p>Body crush by rolling log</p>	<p>Faller-bucker</p>
<p>Log was dislodged by a turn being skidded Log rolled crushing victim who should not have been in skidding area.</p>	<p>Entering hazardous area without alerting working personnel.</p>	<p>Body crush by rolling log.</p>	<p>Faller</p>
<p>Victim fell tree into intertwined limbs from other trees. Impacted trees were pulled to ground under weight of lodged tree. One of trees impacted fell backwards hitting victim.</p>	<p>Inadequate control of tree falling direction.</p>	<p>Impact by tree knocked down falling tree (self inflicted)</p>	<p>Faller</p>
<p>Two brothers falling trees. While one was falling the other had his back turned. Falling tree hit another tree which struck inactive victim in back of head.</p>	<p></p>	<p>Head impact by tree. Knocked down by falling tree (inflicted by another faller).</p>	<p>Faller</p>
<p>Wind caused tree to sway during undercutting operation. Victim left tree standing with seven inches of holding wood at hinge joint. Victim proceeded uphill to buck a log and tree fell uphill.</p>	<p>Leaving a partially felled tree.</p>	<p>Impact by partially cut tree left standing.</p>	<p>Faller</p>

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim felled tree into standing timber. As tree fell it brushed a snag which whiplashed & struck victim.	Falling tree into standing timber.	Impact by snag hit by falling tree	Faller
Victim felled tree to dislodge another tree. When tree failed to dislodge he proceeded to buck a third tree. While standing on the butt the first tree started to slide. Although victim used escape route he stopped too soon & was struck.	Continuing to work in area of lodged tree.	Impact by lodged tree which moved.	Faller
Victim accidentally touched chain saw blade to a log while clutch was engaged. Saw kicked back slicing victim's neck.	Inadequate control of chain saw while engine running possibly failure to stop engine while not cutting.	Neck cut due to chain saw kickback.	Faller
Victim cut by chain saw when he fell off landing while engine was running.		Chain saw cut.	Faller
Victims struck by limbs dropping from trees during felling operation.		Struck by widow-maker	Faller (4)
Falling trees impacted with other objects (snags, stumps, smaller trees) which acted as fulcrums. Tree kicked back.	Failure to use escape route effectively	Struck by tree during kickback	Faller(10)
Falling trees caused breakage of other tree tops. Tree tops fell on victims.	Felling into standing trees.	Struck by flying timber.	Faller (4)
Victim walked between two fallers without giving them a warning. Tree fell on victim.	Failure to announce entry into falling area & waiting for response.	Struck by felled tree.	Scaler

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING		
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS
Rolling log		Crushed leg; refused blood transfusion.
Victim partially bucked a windfall using a short blade. Renewed bucking operation with a longer blade.	Inadequate blocking of log to prevent downhill roll.	Bucker
Falling tree broke off limb of second tree which struck victim.	Inadequate separation distance between felling & bucking areas.	Bucker
Struck by trees felled on hill above them. Fallers could not see buckers.	Working downhill of felling operation; possible lack of warning or poor operations planning.	Bucker (2)
Victim worked under a leaning sidewinder previously loosened.	Working under leaners	Bucker
Victim caught between two logs. Second log rolled downhill.	Working downhill of logs without proper blocking of uphill logs.	Bucker
Log flipped causing saw to strike victims face. Log came to rest on victim crushing him against second log.		Bucker

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim did not leave when other workers departed for day. Headed in wrong direction & was drowned.	Supervision failure to monitor crew member whereabouts.	Drowning	Bucker
Victim was behind feller checking tree being felled. Tree unexpectedly fell uphill.		Struck by tree falling in un-planned direction.	Bucker
Tree uprooted & fell on victim while he was bucking off the top of a tree he had just felled.		Struck by spontaneously up-rooted tree.	Faller-bucker
Victim felled a tree which lodged in two smaller trees. Victim felled one of the two supporting trees & first tree fell on him.	Working near lodged tree. Attempting to use felling procedure to dislodge tree.	Struck by lodged tree	Faller-Bucker
Victim felled a snag which landed on the end of a log supported by a second log. Log served as arm to catapult the victim		Struck by log catapulting body through the air.	Faller-bucker
Victim used sapling for support in climbing on top of log. Sapling was holding log in position & its displacement caused log to roll.	Climbing on log inadequately blocked to prevent rolling.	Crushed by rolling log.	Faller-bucker
Victim felled trees in proposed direction. Trees struck other trees which fell on the victims.	Felling into standing trees; possible poor planning of escape route.	Struck by secondary tree falls.	Cutter (3)

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>Victim felled snag which was completely rotten except for a pitch seam. Tree remained standing & victim initiated felling of tree uphill of snag. Snag fell uphill.</p>	<p>Working near a cut tree; probable attempt to knock down snag with another tree.</p>	<p>Struck by snag falling uphill.</p>	<p>Cutter</p>
<p>Victim felled tree which hit snag causing it to kickback.</p>	<p>Inadequate control of falling direction; failure to fell snag to remove hazard.</p>	<p>Struck by tree during kickback</p>	<p>Cutter</p>
<p>Victim felled tree which was supporting a slab. During tree fall slab was released crushing victim against a log.</p>	<p>Failure to clear adequate safety zone prior to felling.</p>	<p>Struck by slab & crushed against log.</p>	<p>Cutter</p>
<p>Victim started to fell tree which needed wedging. Since he didn't have the wood available for a wedge, started to cut another tree. First tree fell backward knocking victim into his running saw.</p>	<p>Working near a partially felled tree; equipment unavailability.</p>	<p>Decapitation by chain saw due to being struck by falling tree.</p>	<p>Cutter</p>
<p>Victim felled a tree (in a very rocky area) into a snag. Chain reaction caused rock or log to roll over victim.</p>	<p>Felling tree into a snag; failure to fell snag to remove hazard.</p>	<p>Crushed by rolling rock or log.</p>	<p>Cutter</p>
<p>Victim felled a tree which balanced momentarily on a snag. Tree slid or kicked back.</p>	<p>Inadequate control of falling direction; failure to fell snag to remove hazard.</p>	<p>Struck by tree during kickback caused by snag.</p>	<p>Cutter</p>
<p>Victim left no holding wood during cutting of a snag. Snag slid off stump with the butt hitting the ground causing the snag to fall uphill. Top of the snag broke off and hit the victim.</p>	<p>Inadequate control of falling direction; unaccepted felling technique.</p>	<p>Struck by top of snag broken off during fall.</p>	<p>Cutter</p>

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim was standing on side opposite cut. Tree barber-chaired & slabbed. Slab jill poked into ground, buckled & broke in half striking victim.		Struck by slab caused by barber barberchair.	Cutter
Victim placed initial cut in snag. Snag crumpled crushing him against stump.		Struck & crushed by parts of snag being felled.	Cutter
Victim cut five trees in succession none of which fell. He then walked in front of tree row at time trees fell. Tops of trees struck victim.	Working around partially felled trees.	Struck by falling trees.	Cutter
Victim cut two trees which were hung up in one another. While victim was standing adjacent to a windfall the trees started to fall brushing against another tree. Limb was broken off which struck victim.	Failure to pull down lodged tree prior to felling adjacent trees.	Struck by flying limb.	Cutter
Victim tried to set choker from downhill side of log. Line was slackened to lower the rigging and caused log to roll.	Working on down hillside of log.	Crushed by log roll downhill.	Rigger
Partner bucked log which rolled into rock pile on which victim was standing causing a rock slide.	Working on down hillside of log.	Rock slide started by rolling log.	Rigger
While checking logs being hauled victim was struck by a sapling as the turn of logs proceeded along the line.	Working in the bight of haulage system.	Struck by sapling	Rigger

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim struck by a choked log which upended when it hung up on a stump & swung sideways.	Working in bight of haulage system.	Struck by log being hauled by cable.	Handy Rigging Man
Victim was looking for a choker hole in a pile of logs. One log hung up on a stump coming to rest on some limbs under which he was standing.		Struck.	Rigging
Victim was walking 50 feet to side of a turn of logs. One log hung up on a stump causing it to pivot.	Walking to side of turn rather than following it.	Head struck by log swinging from cable.	Rigging Slinger
Victim was logging a new road about 300 ft. from the landing when a log was knocked loose at the landing. In response to warning victim ran for protection of cliff's 3 foot overhang but didn't travel fast enough.	Working downhill of landing area.	Struck by falling log.	Rigging Slinger
Victim was setting rigging on a root wad. As rigging line was slackened it caused root wad to tip and roll.		Crushed by rolling root wad	Rigging Slinger
Log struck a stump, up-ended and struck victim.	Inadequate distance from distance from bight.	Struck by log.	Choker Setter
Dead tree fell striking victim.	Failure to fell snags	Struck by falling snag.	Choker Setter

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim was standing by a small tree bent by two felled trees resting on it. He was struck by tree when it was released after cat caused felled trees to move.	Failure to mark potential hazard; working too close to leaners	Struck by spring-back of small tree released from tension.	Choker Setter
Victim hit by a tree that fell almost (sic) by itself.		Struck by falling tree.	Choker Setter
Chunk dislodged by turn being yarded. Chunk slid downhill, hit a stump, flew in air striking victim 50 feet from stump.		Struck by flying chunk set in motion by turn.	Choker Setter
Victim was located on hillside adjacent to root wood. Two parallel logs were uphill and two were downhill of the victim. Uphill logs rolled crushing victim against the down hill logs.	Working downhill of logs.	Crushed by rolling log.	Choker Setter
Victim fell over cliff landing on rocks.		Fall from cliff.	Choker Setter
Victim suffered heart attack.		Heart attack.	Choker Setter
Heavy limb slid down haul back line striking victim.	Working in bight of cable.	Struck by limb falling from cable.	Choker Setter
Victim set choker on log in loose pile. When he walked under pile a log slipped pinning him to the ground.	Working under lodged logs.	Crushed by moving log.	Choker Setter
Tree fell on victim when catskiner winched log off root wad.	Working in bight of tractor winch	Crushed by falling tree	Choker Setter

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>While winching a log which was longer than than expected, it shot downhill tightening the line which pulled a small tree down.</p>		<p>Struck by tree felled by winching cable.</p>	<p>Choker Setter</p>
<p>Victim was assisting a powderman working in an area where two fellers were also working. Fellers were unaware of victim's presence.</p>	<p>Working in wrong area (sic). Failure to announce entry into felling area.</p>	<p>Struck by felled tree.</p>	<p>Choker Setter</p>
<p>Victim was hooking onto a log when a skid was dragged against a green fir tree (a distance of 50 feet away). Although the tree appeared to be well rooted it fell.</p>		<p>Struck by tree knocked down by skidder.</p>	<p>Choker Setter</p>
<p>Choker setter started a log roll downhill when he pushed choker around log. Victim was struck on chest.</p>	<p>Working downhill of logs.</p>	<p>Struck in chest by log rolling downhill.</p>	<p>Choker Setter</p>
<p>Turn of logs hooked windfall chunk. Chunk hit a stump which caused log to pivot & set two supported logs to roll downhill.</p>	<p>Working downhill of logs.</p>	<p>Struck by logs rolling downhill.</p>	<p>Choker Setter</p>
<p>Victim set a choker on a turn & gave go-ahead signal. Turn moved forward about 10 feet when it hung up on 3 stumps. When turn was dislodged the top of a fir swung around. A warning call was given & although crew hit the ground the victim was struck.</p>	<p>Working too close to bight.</p>	<p>Struck by swinging turn of logs.</p>	<p>Choker Setter</p>

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim was riding on a sling made of a choker attached to the slack line carriage. The line whipped dropping the victim to the ground.	Working in bight; riding on cable system not designed for worker transportation.	Fall to ground from a yarding cable.	Choker Setter
Victims were crushed by tractors when gears were accidentally engaged.	Working around vehicles which have not been stopped.	Crushed by moving vehicles.	Choker Setter(2)
Victims were hooking or unhooking logs when tractors backed up.	Failure to stop engine and brake vehicle during choker setter operation	Crushed between tractor and logs.	Choker Setter(8)
Victims were working on high lead when accidental slack resulted in line butt rigging or haulback to drop on head.		Head impact due to slack in cable system.	Choker Setter(3)
Working on a high lead, victim was found with a madrone stump on top of him.		Crushed by stump.	Whistle-punk
Collision of vehicles on a landing.	Poor visibility & unheard warnings.	Vehicle collision	Grapple Operator (2)
Victim was electrocuted when crane boom drifted into 7200 volt wires above the crane.	Working in area of electrical lines.	Electrocution	Crane Operator
Victim was sleeping in a tent struck by a snag.	Failure to remove hazardous snag.	Crushed by falling snag.	Crane Operator
Victims were operating loading machine when loss of control resulted in roll over.		Struck during vehicle roll over.	Loader (2)

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Mainline jumped the sheave and was cut off on a steel tower machine. End of cable snapped striking victim.		Struck by broken end of flailing cable.	Loader
Victim was adjusting chains on loaded truck when log shifted causing stake to break. Log fell from truck.	Failure to support load during placement of binders.	Struck by log falling from truck.	Hooker-loader
Heel boom under which victim was working suddenly dropped.		Struck by dropping heel boom.	Hooker-loader
While loading a truck, tong let loose on log. Second tong held momentarily then slabbed out causing log to roll off load.	Working around truck during loading; failure to maintain safety zone.	Crushed by log falling from truck.	Second loader
Victim fell off chain deck while truck was moving & was run over.		Struck by moving truck after falling.	Second loader
During yarding operation a line sawed into a 20-inch cedar stump. While victim was working to free the line a log rolled downhill.	Working downhill of logs.	Struck by log rolling downhill.	Hook tender
Victim was loading pads on loading machine. He stepped back to push on pad & was caught between truck & swinging grapple machine.	Failure to stop machines in vicinity of maintenance operation.	Crushed between two vehicles on landing area.	Hook tender
Victims lost control during skidding operations (one on slope & one on road) which rolled over, throwing operators out of cab.	Poor control of vehicle; improper road maintenance; failure to use seat belts.	Thrown from vehicle which rolled over.	Catskinner (2)

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>Victim backed skidder into a 150 foot canyon.</p>	<p>Loss of vehicle control; lack of good visibility during backing up.</p>	<p>Vehicle dropped over cliff.</p>	<p>Catskinner</p>
<p>Victim was operating one of two skidders being used to tow a loader which had run out of fuel. Chokers used as tow lines broke. The loader had brake failure & ran into the front skidder.</p>	<p>Cable failure; defective brakes towing load downhill.</p>	<p>Collision by vehicle which had defective brakes.</p>	<p>Catskinner</p>
<p>Victim was tractor yarding up a grade when rear end slipped sideways. Tractor rolled over downhill. Victim fell out.</p>	<p>Poor vehicle control; non use of seat belt.</p>	<p>Crushed during tractor roll over.</p>	<p>Cat driver</p>
<p>Victim, while pulling a turn of 3 logs, tried to winch them over a knoll. The top log shot down hill piercing the cab and pinned victim.</p>		<p>Crushed by log winched into cab of vehicle</p>	<p>Skidder operator</p>
<p>Final log was being loaded on truck when it slipped from the grapple.</p>	<p>Working in area of truck loading; failure to maintain a safety zone.</p>	<p>Struck by falling log during truck loading.</p>	<p>Chaser</p>
<p>Mainline parted between the turn & the tower. The line coiled itself around the tower & while flailing, hit the victim who was trying to protect himself. Victim was thrown against the base of the tower.</p>		<p>Head impact with solid structure</p>	<p>Chaser</p>
<p>Line broke causing tower to snap back breaking a weld. Tower catapulted victim into the air.</p>		<p>Impact with ground after being catapulted.</p>	<p>Chaser</p>

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim had unhooked one choker and while releasing second choker was struck by first choker which was swinging in an arc.	Inadequate head coverage by helmet.	Head impact (temple) by swinging choker	Chaser
Victim was crushed against log he was working on, by a turn being yarded into landing. Operator did not or could not see the victim.	Working in bight of yarding cable.	Crushed by turn logs.	Chaser
Victim was bucking logs when he was struck by logs swinging from a tong.	Failure to maintain safety zone.	Struck by swinging logs in yarding area.	Chaser
Log truck was used to push another truck. Force was exerted against a log which penetrated radiator. Driver backed truck and not hearing warning signal; crushed victim against loader.	Poor traffic control at landing; misuse of truck.	Crushed between vehicles at landing.	Chaser
Yarder backed up at landing to deliver a load. Victim was struck by tool box on back end of yarder.	Poor traffic control at landing.	Struck by vehicle	Chaser
Victim was leaning on a log supported by a second log. A third log slipped from the tongs striking the first log which catapulted victim over an embankment.		Catapulted by log struck by falling log.	Knot bumper
Victim was trimming logs in a deck when crane deposited more logs. One log was dislodged and caught victim between two logs causing power saw to cut his groin.		Groin cut by power saw.	Laborer

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim was helping truck driver to remove binders because of a pin which would not release. When release was effected log rolled off truck.	Load was not supported during removal of binders.	Struck by log rolling off truck.	Unloader
Victim was using fork lift to pick up small logs. He backed up over a log & when he looked to see what he had hit. He accidentally hit a lever & was caught in a sheering action between the arm & frame.	Inadvertent control operation	Crushed by vehicle.	Fork Lift Operator
Victim was assisting another driver with a load. Load shifted & log fell.	Load not supported.	Struck by log rolling off truck.	Truck driver
Victim was working with load when a tree fell on the truck.		Struck by falling tree	Truck driver
Victim suffered heart attack.		Heart attack.	Truck driver
Loader operator put vehicle in reverse instead of forward and caused trailer to roll on cab.	Error in vehicle control.	Struck by another vehicle.	Truck driver
Loss of brakes resulted in victim attempting to jump from cab. He was run over.	Loss of brakes	Runover by runaway truck.	Truck driver
Brakes failed on truck. Victim was run over when he ran to catch the runaway vehicle.	Loss of brakes	Runover by runaway truck.	Truck driver

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Truck hit by freight train.		Struck by another vehicle.	Truck driver
Truck found in creek bed.			Truck driver
Truck found off the road, crushed		Crushed in vehicle	Truck driver
Victim was greasing line of dump truck when he tripped the line & truck body dropped.		Struck by movement of dump truck body.	Truck driver
Accidents with other vehicles		Vehicle accident.	Truck driver(2)
Victims loading, unloading or standing near the truck trailers were struck by logs rolling off.	Failure to maintain a safety zone; probable failure to support loads during loading operations.	Struck by logs rolling off.	Truck driver(5)
Victims rolled over a bank and rolled trucks.	Inadequate control of vehicle.	Truck roll-over	Truck driver(2)
Loader was adjusting a log before placing it on trailer. Log rolled off the fork and crushed victim against the truck wheel.	Working in hazardous area during loading.	Crushed by log roll.	Truck driver
Trying to negotiate a turn or dealing with icy roads victims drove off road. Victims were crushed by load, or were thrown or jumped from vehicle.	Inability to control vehicle under adverse conditions.	Vehicle accident	Truck driver(5)

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim was riding in the last car of a log train when a wing log fell & jill poked causing log to pivot on it's stake.	Inadequate load retention.	Crushed by moving log.	Tail-end brakeman
Victim was operating a travellall which went off the road. Vehicle rolled on 1:1 slope throwing victim out of vehicle.	Loss of vehicle control.	Thrown from rolling vehicle	Fire watchman
Victim was blowing stumps under adverse weather conditions. He was within 25 feet of the stump. The blast blew him & a piece of stump where he was found.	Inadequate distance from blasting area.	Powder blast	Powderman
Victim was removing tags from a bundle of logs. He placed his head between two logs in order to reach a tag when the top log shifted.	Working on unsupported log deck.	Head crushed between shifting logs.	Tag & tally man.
Victim ran off the road while operating a road grader.	Loss of vehicle control.		Grader Operator
Victim was operating a road grader which ran over an embankment. Vehicle rolled over pinning him in the cab.	Loss of vehicle control.	Vehicle roll over	Grader man
Victim was operating a bulldozer which broke it's track while backing down a slope. The vehicle lurched & while the victim tried to leave the vehicle it reversed direction & he was thrown back into the seat & the vehicle rolled.	Failure of equipment.	Crushed by vehicle roll over	Equipment operator

REVIEW OF ACCIDENTS RESULTING IN FATALITIES - WESTERN LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim was driving a traxcavator which had no canopy. He was crushed by a felled tree.	Absence of canopy; operating a vehicle in felling area.	Crushed by felled tree.	Hauling Engineer

Appendix D

SELECTED INFORMATION FROM PREVIOUS LOGGING STUDIES

In 1955, the Department of Labor performed a study of disabling work injuries (DWI) within the logging industry (Ref. 1 and 2). This study covered 1482 logging establishments distributed among the Southern, Northern and Western regions of the United States. Table D-1 is a summary of the DWI frequency and severity rates reported by this study. Also indicated is the distribution of the survey respondents by geographic area and according to type of operation (saw log vs pulpwood).

With reference to severity rates reported by this study and to those reported annually (Ref. 3) by the DOL (as part of the typical annual survey of all industries) it becomes doubtful whether the two survey methods are dealing with the same population. The annual survey of severity rate (see Section III) indicates a 1955 severity rate of 6500 compared with 12,445, as shown in Table D-1. Assuming that the annual survey technique is a good representation of the total logging population then it must be assumed that the respondents to the special survey were not truly representative.

Although this inconsistency is noted, the data presented by references 1 and 2 are still quite useful in identifying a number of relationships to injuries. They have been used, elsewhere in this report, for comparisons with more recently developed information, but the inferences as to injury trends may not be totally valid for the present time period.

Figures D-1 through D-7 and Table D-2 present injury data for a number of relationships. In reviewing these data it must be recognized that logging operations have been changing markedly and it is hypothesized that the types of injuries, their causes and other relationships have also changed. Sufficient information are available to substantiate this hypothesis; however, data are presented elsewhere to suggest that there is a trend toward different injury causes on the basis of frequency distribution. If nothing else, there is good information to indicate that both frequency and severity rates have steadily declined since the 1955 time period.

Table D-1. WORK-INJURY RATES IN LOGGING ESTABLISHMENTS, 1955
(Bureau of Labor Statistics News Release)

Lumber region and product	Number of establish- ments	Frequency rate ^{1/}	Severity	
			Average number of days lost or charged per disabling injury	Severity rate ^{2/}
Total ^{3/}	1,482	80.1	153	12,445
Saw logs	1,085	82.5	189	15,596
Pulpwood	216	76.2	71	5,429
Southern region: ^{4/} Total ^{3/}	358	70.2	154	11,090
Saw logs	281	71.4	159	11,347
Pulpwood	53	75.8	101	7,646
Northern region: ^{5/} Total ^{3/}	351	72.7	86	6,317
Saw logs	177	61.2	165	10,073
Pulpwood	145	75.3	67	5,018
Western regions: Total ^{3/} .	773	88.5	198	18,408
Saw logs	627	91.3	203	18,515
Douglas fir region: ^{6/}				
Total ^{3/}	453	95.0	197	20,680
Saw logs	342	104.7	199	20,804
Western pine region: ^{7/}				
Total ^{3/}	257	82.4	204	16,947
Saw logs	233	82.2	210	17,257
California redwood region: ^{8/} Total ^{3/} . .	61	86.4	167	16,258
Saw logs	51	93.5	185	17,263

^{1/} The frequency rate is the average number of disabling injuries per million hours worked. A disabling injury is one that results in death, in permanent disability, or an inability to work for at least one full day after the day of injury.

^{2/} The severity rate is the average number of days lost or charged per million hours worked.

^{3/} Total includes figures not shown separately because of insufficient data to compute representative rates.

^{4/} Southern region includes Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

^{5/} Northern region includes Connecticut, Maine, Massachusetts, Michigan, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, and Wisconsin.

^{6/} Douglas fir region includes all softwoods and hardwoods in Washington and Oregon west of the Cascades, and in Jackson and Josephine counties in Oregon.

^{7/} Western pine region includes all softwoods and hardwoods in Washington and Oregon east of the Cascades; all softwoods and hardwoods in California (except the counties listed in the redwood region), and in Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, South Dakota, Utah, and Wyoming.

^{8/} California redwood region includes all softwoods and hardwoods in the following 12 counties of California: Alameda, Contra Costa, Del Norte, Humboldt, Marin, Mendocino, Monterey, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Sonoma.

BLS59-0475 - Labor D. O.



Figure D-1. Frequency Rates in Logging by Size of Operation

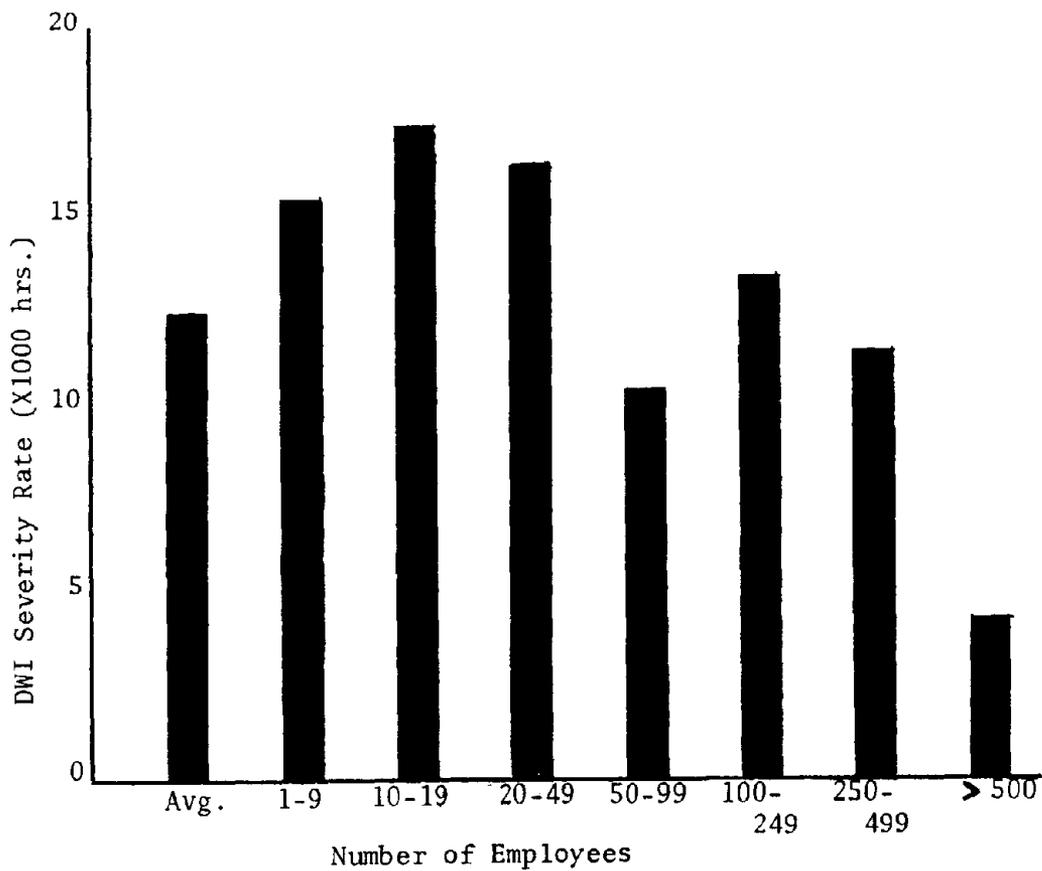


Figure D-2. Severity Rates in Logging by Size of Operation

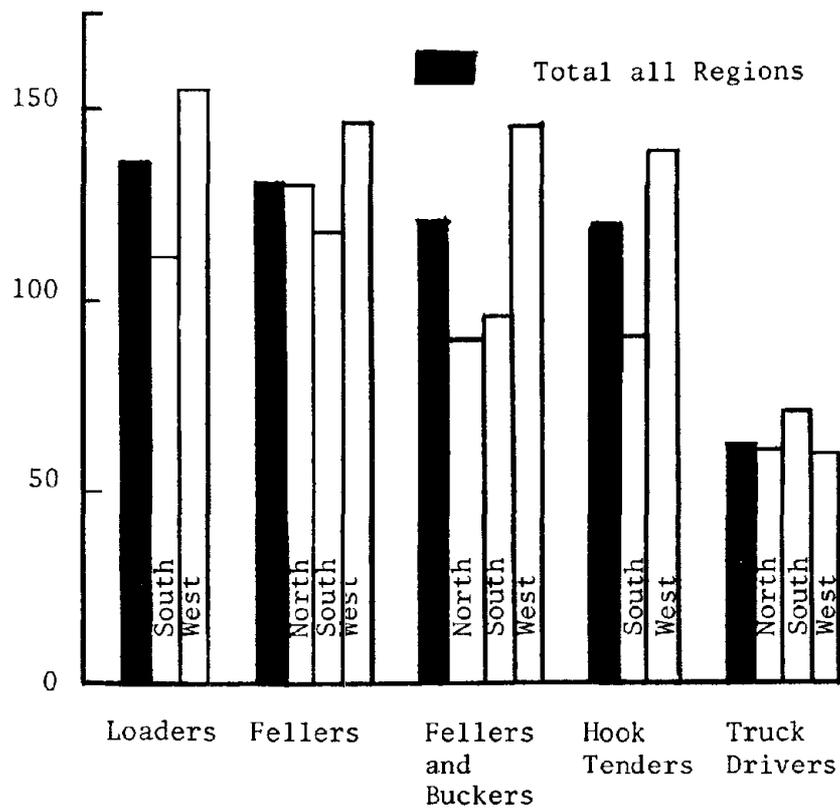


Figure D-3. Logging Frequency Rates by Region and Occupation

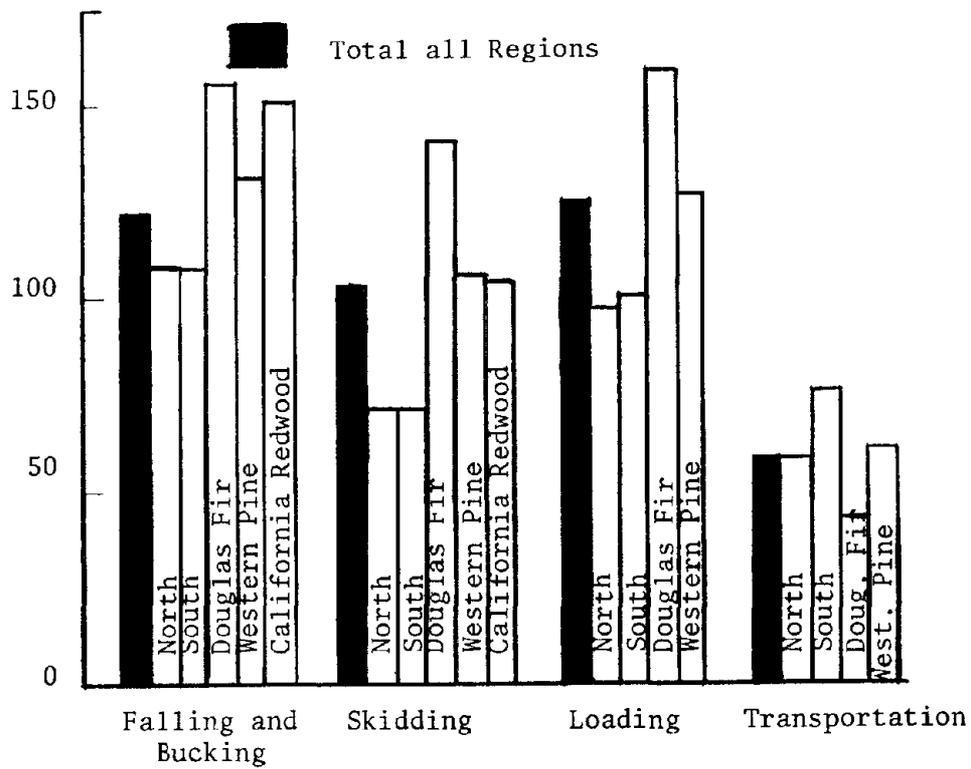
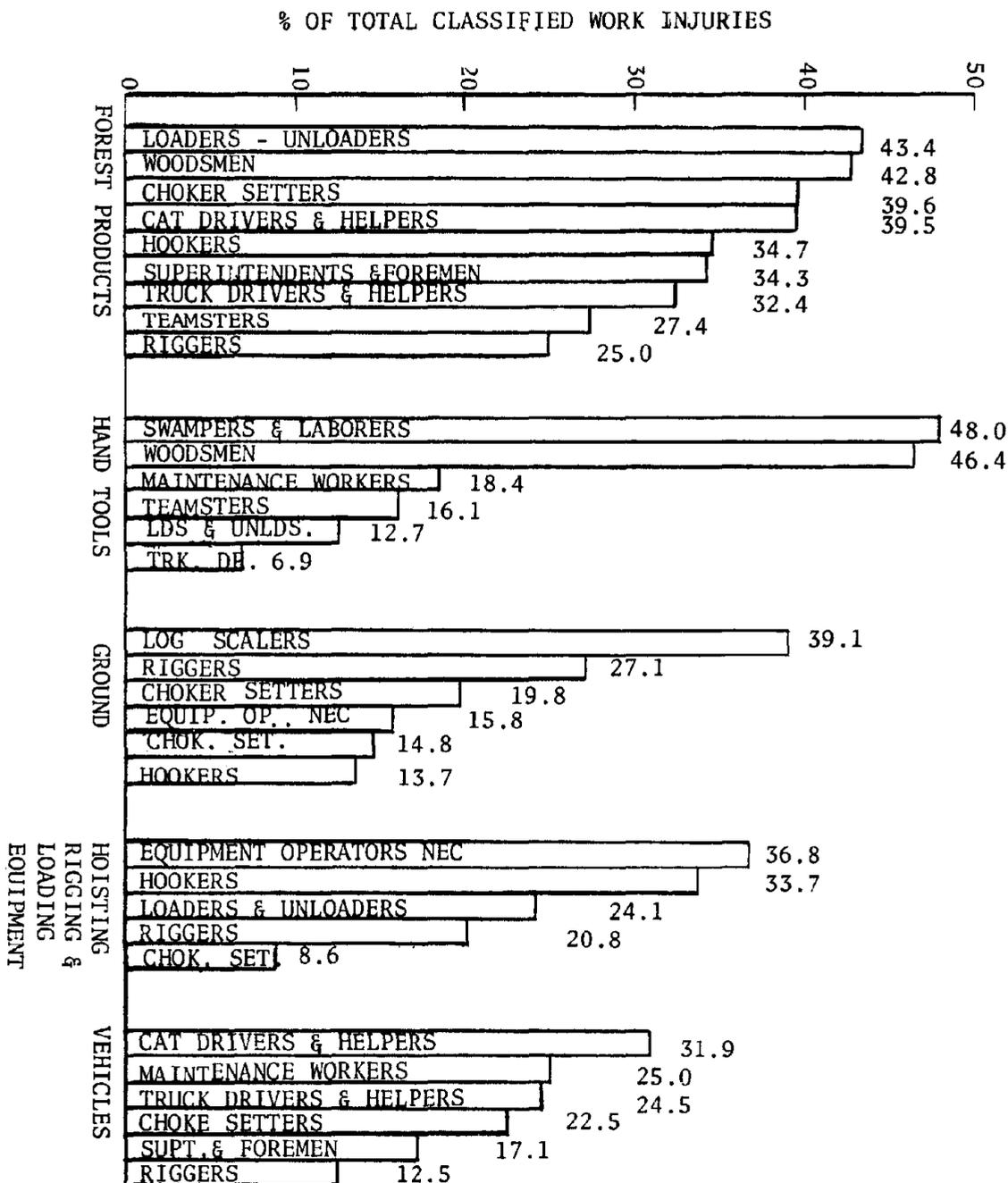


Figure D-4. Logging Frequency Rates by Region and Operation (DOL 1955)

Figure D-5. Logging Work Injuries by Source and Occupation (DOL 1955)



% OF TOTAL CLASSIFIED WORK INJURIES

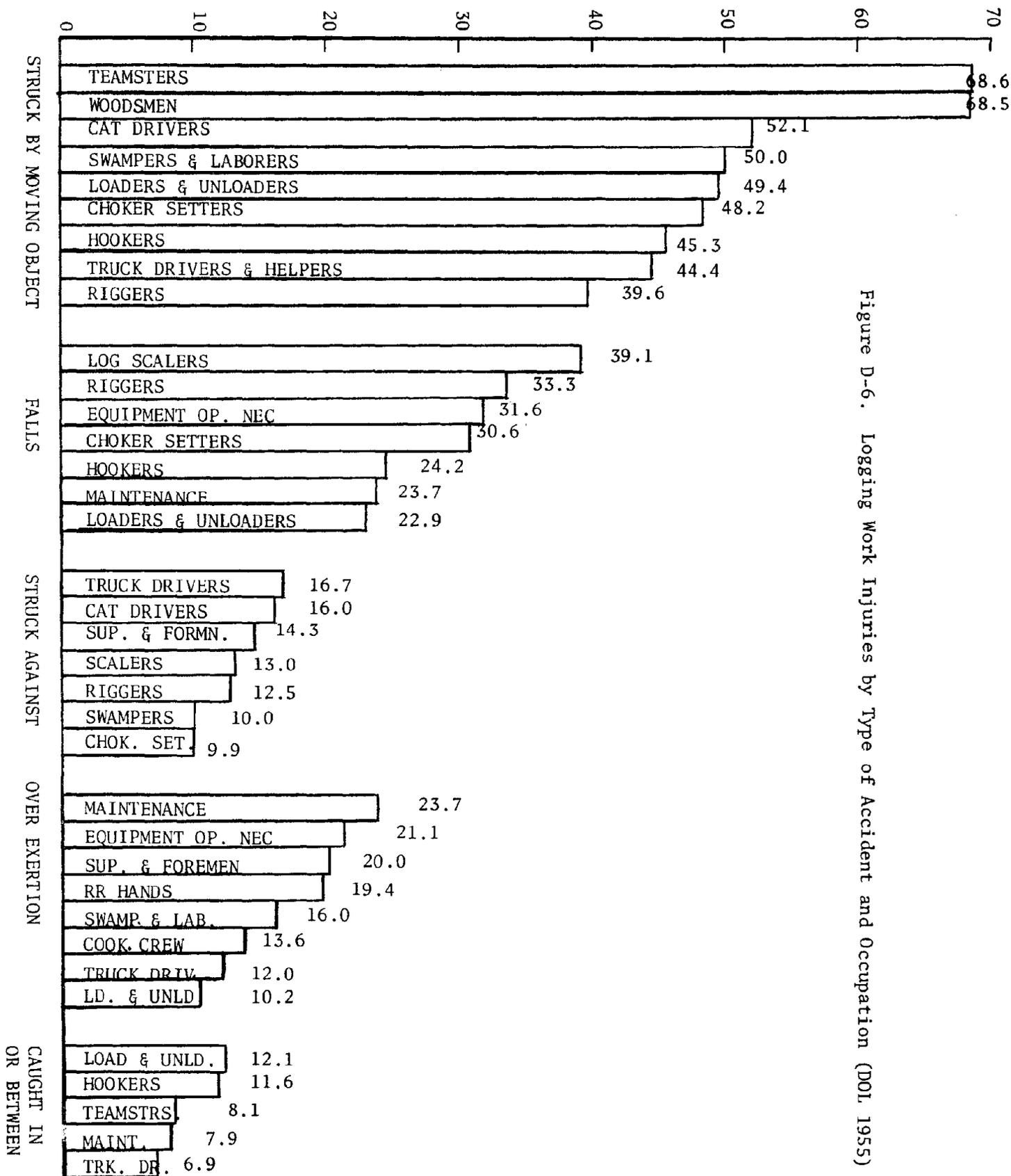


Figure D-6. Logging Work Injuries by Type of Accident and Occupation (DOL 1955)

CLASSIFIED DISABLING WORK INJURIES (% OF TOTAL)

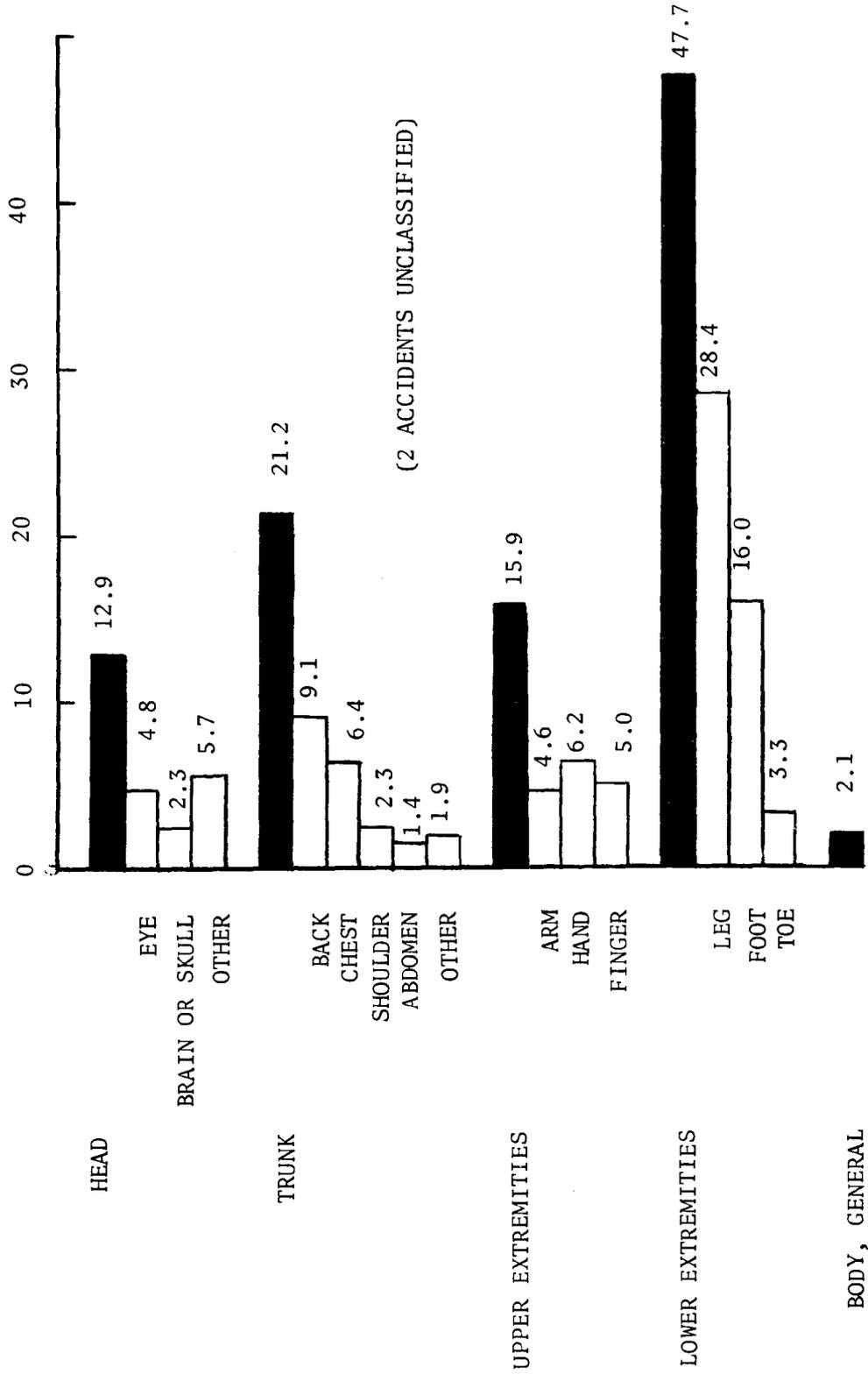


Figure D-7. Felling and Bucking Injuries by Body Part

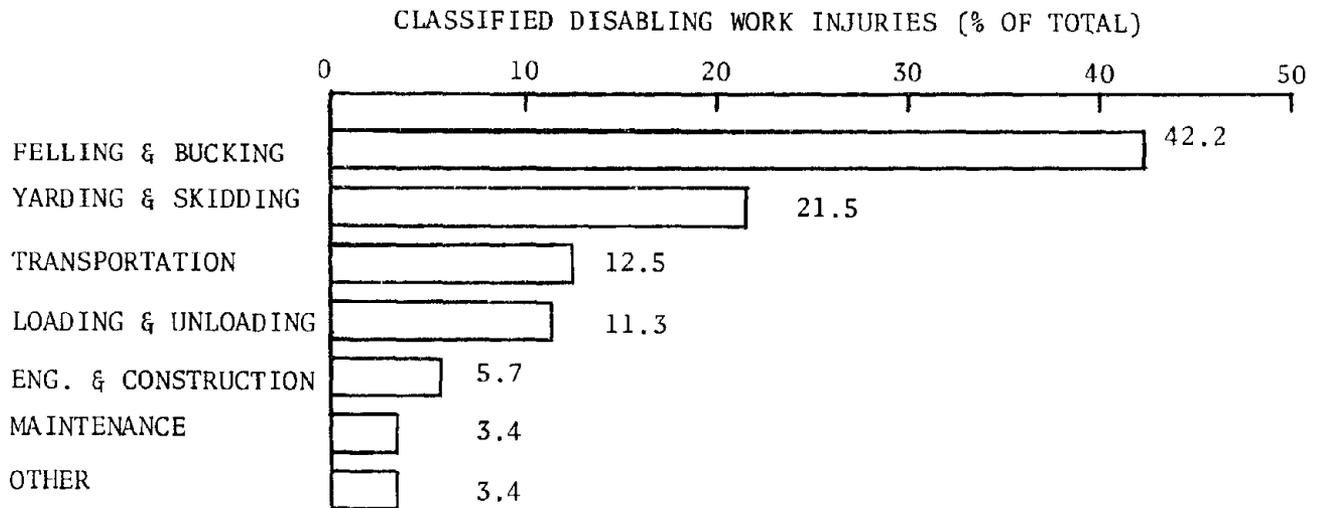


Figure D-8. Disabling Work Injuries in Logging for the Major Types of Operation.

INJURY REPORT SUMMARY

The American Pulpwood Association distributes a safety alert bulletin to each of the member organizations. These bulletins include descriptions of accidents resulting in injuries (including fatalities). A number of these bulletins were reviewed in order to provide some insight as to cause and effect relationships. Since the data are highly selective these bulletins did not lend themselves to the establishment of quantitative relationships. However, the bulletins were summarized and the results are presented in the following pages.

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING

ACCIDENT DESCRIPTION		PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>On previous day victim cut two trees at the butt & left them hung up. On day of injury these trees were dislodged by the wind.</p>		<p>Working in area of lodged trees; failure to dislodge hung up trees.</p>	<p>Fracture of leg & severing of large nerve in neck; struck by lodged tree.</p>	<p>Feller</p>
<p>Victim was attempting to complete the felling of a hung tree that had split up the stem. Saw pinched in splinters. When victim tried to see what was still holding, the tree broke, shot backward & pinned him to the ground.</p>		<p>Not wearing a safety helmet</p>	<p>Death due to crushed skull; struck during attempt to cut down lodged tree.</p>	<p>Feller</p>
<p>Victim cut a tree & left it in lodged position. While cutting a second tree about 30 yards from lodged tree the wind dislodged the first tree.</p>		<p>Working in area of lodged trees; failure to dislodge hung up tree.</p>	<p>Double leg fracture, back fracture & kidney damage; struck by lodged tree.</p>	<p>Feller</p>
<p>Victim attached a wire rope to a leaning tree to prevent its falling across a line fence. The other end of the rope was fastened to an already felled tree. Before victim had completed cutting the leaning tree it broke & was dragged across his foot.</p>			<p>Injury to lower leg & foot requiring amputation; struck by falling tree.</p>	<p>Feller</p>
<p>Victim notched & severed a tree which became lodged. While waiting for assistance he felled & was limbing two smaller trees. Wind dislodged first tree.</p>		<p>Working in area of lodged tree.</p>	<p>Death due to being struck by lodged tree.</p>	<p>Feller</p>

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING		PROBABLE DEFICIENCY		BODY PART/CLASS		OCCUPATION	
ACCIDENT DESCRIPTION							
<p>After felling and limbing a tree the victim began clearing brush on a skid trail. A crawler tractor was skidding out the tree just felled when it was caught by two stumps. Operator released winch line letting the butt of the tree snap back. Tree hit victim in the chest knocking him to the ground some 20 feet away.</p>	<p>Working in skidding area.</p>	<p>Fractured breast bone & bruised muscles around heart; struck by skidded tree.</p>	<p>Feller</p>				
<p>Victim took a break after placing an undercut. He returned to tree & before he started his saw, a limb from a previously felled tree dropped on him from about 40 feet.</p>	<p>Failure to wear hard hat.</p>	<p>Death due to crushed skull; struck by limb falling from felled tree.</p>	<p>Feller</p>				
<p>Victim was limbing a tree while standing on it. The saw kicked back cutting off his little toe.</p>	<p>Standing on tree during limbing; possible failure to use safety boots.</p>	<p>Loss of toe & foot lacerations; cut by saw kickback.</p>	<p>Feller</p>				
<p>Victim was felling a tree which struck the top of another tree. Falling tree kicked back pushing the chain saw into victims leg.</p>	<p>Failure to use escape route during tree fall; felling into standing tree.</p>	<p>Severe cut to calf with extensive blood loss. Death due to refusal of transfusion. Saw cut.</p>	<p>Cutter</p>				
<p>While limbing a felled tree with a chain saw victim was struck in eye by a dry knot thrown by the saw.</p>	<p>Failure to use eye protection.</p>	<p>Slight cut in eye developed into cataract requiring surgery. 70-80% loss of sight & 6 months lost time; Struck by flying chip.</p>	<p>Cutter</p>				

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>Victim was cutting stubs. While limbing he was struck by a stub uprooted by high winds.</p>	<p>Continuation of work under high wind conditions.</p>	<p>Broken jaw & ribs, face laceration, punctured lung and dislocated hip; struck by wind uprooted tree.</p>	<p>Cutter</p>
<p>Victim did not have firm grip on power saw handlebar. Bar was smooth. Saw kicked back.</p>	<p>Poor gripping surface on saw handle.</p>	<p>Laceration of 2 fingers on left hand; cut by saw kickback</p>	<p>Cutter</p>
<p>Victim cut tree which lodged in smaller trees Victim cut smaller trees believing he could escape from lodged tree.</p>	<p>Failure to wear hard hat; deep snow impeded escape; working around lodged trees.</p>	<p>Fractured skull; broken neck; bleeding from ears, eyes, nose & mouth; paralysis; struck by lodged tree.</p>	<p>Cutter</p>
<p>Victim was sawing a hung tree when it rolled & slid back pinning him to the ground.</p>	<p>Sawing a hung tree to dislodge it.</p>	<p>Broken knee joint & torn ligaments; struck by hung tree</p>	<p>Cutter</p>
<p>Victims felled an oak into standing trees. As the tree fell it bent a small tree over which catapulted a 9 foot branch a distance of 40 feet hitting both victims.</p>	<p>Falling into standing trees.</p>	<p>One victim hit on hard hat suffered a fractured skull; second victim suffered bruised shoulder; struck by flying timber.</p>	<p>Sawyers (2)</p>

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>Victim was watching sawyer fell a tree. As it fell one of it's branches caught a near-by snag causing it to fall.</p>	<p>Failure to wear hard hat; felling tree into snag</p>	<p>Death by fractured skull; struck by snag hit by falling tree.</p>	<p>Sawyer</p>
<p>Victim was working in tree length logging operation when he was hit on the head by a falling snag. Snag was knocked down during skidding operation.</p>	<p>Failure to wear a hard hat; inadequate separation between felling & skidding operations; failure to fell snag.</p>	<p>Death due to concussion; face laceration & minor chest injury; struck by snag knocked down.</p>	<p>Sawyer</p>
<p>While removing an unguarded chain saw from a pickup, victim assumed an unsafe position slipped & fell on saw.</p>	<p>Failure to use guard on saw during transportation.</p>	<p>Severe cut of hand; falling on top of saw.</p>	<p>Sawyer</p>
<p>Victim was limbing a pine which protruded over an unseen 5-foot ledge. He was walking on top of the log and pitched forward. In attempting to land safely he threw his saw away but was impaled on a stump of a one-inch sapling that had been cut at a sharp angle. The stump was cut about 4-1/2 feet from the ground.</p>	<p>Limbing while walking on tree trunk; failure to cut sapling close to ground & leaving a hazard.</p>	<p>Penetration from crotch to bowels through scrotum, left groin & abdominal wall; fall on top of sapling stump.</p>	<p>Power saw operator</p>
<p>Victim was limbing when he was hit by a log being skidded.</p>	<p>Inadequate separation between limbing & skidding operations.</p>	<p>Bruised & strained knee; struck by skidded log.</p>	<p>Power saw operator.</p>
<p>While travelling on an abandoned skid trail victim was struck by a partially uprooted fir tree.</p>	<p>Possible absence of protective canopy over skidder.</p>	<p>Death due to broken neck & jaw; struck by fall of uprooted tree.</p>	<p>Skidder operator</p>

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>Leaky hydraulic hose on skidder started a fire in leaves & trash around engine. Victim tried to smother fire but skidder was a total loss.</p>	<p>Inadequate equipment maintenance; absence of proper fire control equipment.</p>	<p>Minor burns due to fire.</p>	<p>Skidder operator</p>
<p>Victim was setting his own chokers while working in blowdown timber. One log was lying atop another with it's butt about 3 feet in the air. When the victim turned his back to set choker on bottom log the top log slipped striking him in the back.</p>	<p>Failure to use seat belt.</p>	<p>Hairline fracture of hip & pelvic bones struck by moving log.</p>	<p>Skidder operator</p>
<p>Victim lost control of machine & fell off as it rolled down hill. He was pinned under vehicle when it came to rest against a tree</p>	<p>Failure to use seat belt.</p>	<p>Blow to head, broken shoulder & foot, severe body lacerations & internal injuries; run over by vehicle.</p>	<p>Skidder operator</p>
<p>While planting a site prepared area an unknown object entered the cab & struck victim on safety hat.</p>	<p>Failure to keep distance from moving vehicle; failure to maintain ground condition.</p>	<p>Temporary unconsciousness; blow to head.</p>	<p>Crawler tractor operator</p>
<p>Victim was helping another operator to refuel. Operator swung tractor to avoid a ground hole & caught victim between tracks & fuel truck.</p>	<p>Failure to use eye protection</p>	<p>Contusions & bruises to both legs; struck by vehicle</p>	<p>Tractor operator</p>
<p>Victim was helping in the loading of a trailer. Co-worker kicked a bolt on the trailer bed to knock it off. Bolt struck victim in eye.</p>	<p>Failure to use eye protection</p>	<p>Ruptured eye; struck by kicked object</p>	<p>Tractor operator</p>

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
While riding on a wheeled skidder a snow laden birch swept victim from the vehicle Rear wheel passed over his head.	Riding on vehicle with no provisions for supernumerary.	Death due to fractured skull; struck by tree & run over by vehicle.	Tractor operator
Victim was straightening frozen logs on top of a truck. While moving a bolt his hook slipped & he fell to the ground 11 feet below.	Safety shoe failure.	Broken back; fall from loader truck.	Loader
Victim was straightening logs on a partly loaded car. A dislodged log rolled onto his foot.	Lack of protective canopy.	Broken toe; rolling log.	Lift truck operator
Victim was loading logs on a truck using a farm tractor equipped with forks. He lifted two logs & when he jerked the forks to release one log the other fell back at him. He raised hands for protection.		Crushed finger & hand lacerations requiring amputation & skin grafts; struck by dropping log.	Loader
Victim was operating a truck in the rain. Truck failed to negotiate a curve; out of control it went through woods about 120 feet knocking down trees.		Minor cuts to elbow & leg; muscle stiffness; loss of vehicle control.	Truck driver
Log truck rear-ended a school bus which was slowing down.	Excessive speed.	No injury.	Truck driver
Victim was leveling logs on a rock car when he tripped over some vines intermingled with the logs. He fell on top of logs.		Bruised right shoulder and right side of chest; fall on stacked logs.	Lumber operator

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Poor footing while levelling logs on a loaded car caused supporting log to roll throwing victim to ground.		Bruised back muscles; fall from loaded car.	Laborer
Victim stabbed his foot while using a tree injector.	Lack of safety shoes.	Cut foot.	Laborer
Victim was helping loader operator adjust wood on loaded rack car. While standing on a platform at end of car a log became dislodged hitting him in chest.		Fractured ribs; struck by dislodged log.	Laborer
Victim was helping feller to dislodge a 12-inch oak. He walked under the leaning tree when the leaner fell. Victim was struck by large limb.	Failure to wear headgear; attempting to manually dislodge a tree	Death due to fractured skull; struck by lodged tree.	Laborer
Victim lifted a bolt of wood too heavy for one man.	Improper lifting procedure	Pulled back muscle; lifting heavy weight.	Laborer
Victim was straightening a load when he lost footing & log he was carrying fell on his leg.		Bruised knee, fall while carrying load	Laborer
Victim jumped onto a planting tractor & seated himself on top of canopy. He was found on ground in front of tractor.	Improper position on moving vehicle.	Chipped shoulder bone; fall from vehicle.	Laborer

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>Victim was straightening load on trailer which was being loaded. Trailer brakes were not functioning properly & safety pin was not in landing gear. Weight of added load caused trailer to move forward causing the gear to collapse. Victim was thrown to ground.</p>	<p>Faulty maintenance</p>	<p>No injury</p>	<p>Laborer</p>
<p>Victim was attaching a fire plow to a tractor. When he had holes in hitch & plow almost aligned he put his finger in hole to see if pin would drop in. The tractor moved.</p>	<p>Failure to set brakes on tractor during maintenance; poor work procedure.</p>	<p>Amputation of finger</p>	<p>Laborer</p>
<p>Victim cut a tree with a feller buncher. The tree became loose & started to lean. In order to regain control the victim moved the machine & it tipped over.</p>	<p>Failure to stop vehicle engine.</p>	<p>Fractured foot; vehicle tip over.</p>	<p>Feller-buncher operator</p>
<p>A crawler tractor was hung up on a stump. The victim attempted to push a log under the tracks to provide traction. As he placed the log the tracks were spinning rapidly and caught his foot.</p>	<p>Failure to remove lodged tree; working in area of lodged tree.</p>	<p>Lacerations & four broken metatarsals; caught by vehicle track.</p>	<p>Logger</p>
<p>Victim was hooking a chain choker. A short distance away there was a hung up tree. Wind blew the tree down.</p>	<p>Failure to remove lodged tree; working in area of lodged tree.</p>	<p>Death due to crushed skull; lodged tree.</p>	<p>Choker setter</p>

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING

ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
<p>While leveling wood on a rail car the victim hooked the log under his feet and fell to the ground.</p>		<p>Dislocated fracture of elbow, fracture of both wrists, contusions of face & chest; fall from rail car.</p>	<p>Woodyard foremen</p>
<p>Victim was using a portable grinder to sharpen the cutting edge of a V-type land clearing blade. The grinding disc disintegrated & a piece came through the guard hitting his knee.</p>		<p>Puncture injury to knee; flying object</p>	<p>Land clearing equipment operator</p>
<p>Victim was working too close to another worker with the result that he was hit in the mouth with the butt of an injector.</p>		<p>Broken teeth</p>	<p>Eradication crewman</p>
<p>Victim was operating a tractor while clearing a fire break. He tried to evade being struck by a sapling which entered the cab between the components of the canopy guard.</p>	<p>Inadequate protection from canopy guard.</p>	<p>Strained chest muscles.</p>	<p>Fire warden</p>
<p>While a tractor operator was pushing a burning snag the tractor blade also pushed a pole on the ground. The pole whipped around hitting the victim's legs & throwing him a distance of 10-12 feet.</p>	<p>Working too close to tractor operation.</p>	<p>Fractured legs & elbow due to being struck by pole moved by tractor.</p>	<p>Fire warden</p>
<p>Victim was using a hydraulic jack to raise a tractor. He had positioned the jack head on a sloping surface; the tractor slipped causing the jack to hit him on the hand.</p>		<p>Amputation of finger; struck by slipping jack.</p>	<p>Mechanic</p>

REVIEW OF ACCIDENTS RESULTING IN INJURIES - PULPWOOD LOGGING			
ACCIDENT DESCRIPTION	PROBABLE DEFICIENCY	BODY PART/CLASS	OCCUPATION
Victim was working in dense underbrush. He saw a snake which he struck at with a stick and a foreign object hit him in the eye.	Failure to wear eye protection.	Cut eyeball; struck flying object.	Forest technician
Victim vaulted from the back of a pickup truck in an attempt to kill a snake.	Poor practice in dismounting from vehicle.	Strained ankle ligament; jumping from truck.	Forest technician

APPENDIX E

GLOSSARY OF TERMS

During the conduct of this program we were confronted with the task of learning the logger's language. A glossary of terms was prepared reflecting historic terms as well as current one. It is expected that this list is far from complete; however, the efforts required to generate a comprehensive listing are beyond the scope of this program.

Many of the codes and standards reviewed in Appendix B also contained a large number of definitions which are recommended for further reference.

In using any glossary of logging terms, it is also to be observed that many terms have also become geographic colloquialisms.

A

ARCH: Rear section of a tractor yarder, generally "U" shaped. Serves as a boom or hoist and raises logs off the ground for hauling through the woods.

AXMAN: Worker who uses ax to cut trees and logs preparatory to making firewood, or who clears ground for construction of log slide, or clears brush for surveying party.

B

BALL-HOOTING: Sliding or rolling logs down hillside by means of log jacks or peavies.

BARBER CHAIR: Instead of breaking to the undercut, a tree splits up from the back cut.

BIGHT: When a line or rope is bent or curved, the bight is the loop or the space within the loop.

BANKER: A laborer who hauls ties or other timber from forest to storage place on bank of river from where ties or timbers are floated.

BARK FITTER: Man who selects tree to be felled for its tanbark. Chops tree limbs off after it is felled by fallers. He prepares for peelers by cutting rings through bark around pole of tree in about four-foot sections and cutting straight line through bark for entire length of tree, with an ax.

BARKER HELPER: Performs duties as described under "Bark Fitter."

BARKER SCALER: Measures the pile of tanbark with a scale rule and computes the volume in cords. Tanbark is piled as cordwood is, before measuring.

BLASTER: Man who removes stumps and obstructions from logging roads or yards with dynamite.

BLAZER: Marks the location of log chutes used to slide logs from forest to point of transportation. This is done by means of blazes made on trees with ax, taking into consideration such factors as topography, grades, and curves when locating proper site of the chute. Blazer may, infrequently, also mark the location of trails, roads, and property lines.

BLOCK GREASER: A laborer who greases blocks (pulleys) and other tackle which are used in skidding operations.

BOATMAN (SAWMILL) POLER: Man who sorts and moves logs about in pond. This is done from flatboat or raft using a pike pole to move logs to foot of chute. May also raise sunken logs by means of hoist attached to boat.

BOAT TENDER: Manipulates starting and steering devices and throttles on gasoline-driven boats which are used to carry supplies and workmen to logging camp, run errands, tow logs, and perform general utility work.

BOLT: A rough, sawed to length, short piece of log or timber. Used to cut laths or shingles.

BOOM: A loading boom refers to the arrangement of poles and lines for loading logs onto the trucks or for decking at landings.

BOOM MAN: Performs duties as described under "Boom Master."

BOOM MASTER: Foreman who supervises, directs and is responsible for rafters and others engaged in construction of log booms or rafts to be towed to mill.

BOOM-STICK BORER: A laborer who drills holes in long spars by means of hand-driven auger or manipulates control valves on auger driven by compressed air. Long spars are used as ribs and sides of boom. With holes, spars may be threaded with chains to secure in position.

BRIDLE MAN: A laborer who walks behind logs sliding down skid road to manipulate clamp on bridle to slow their descent. Bridle is a short piece of rope with two hooks at one end which are driven into first log, and at other end is a clamp that fits over cable running alongside skid road.

BROW LOG: The heavy stationary log at the top, or brow, of a rollway.

BRUSH PILER: A laborer who piles brush and limbs removed from felled trees, to facilitate logging operations and prevent forest fires. Piled, according to set principles, to prevent spread of fire and killing of seedling trees when brush is burned.

BUCK-SKIN: A log, branch, or snag which has had most or all of its bark removed.

BUCK SWAMPER (KING SWAMPER): Foreman who supervises and directs work of a crew of Swampers II.

BUCKER (CROSSCUTTER, LOG MAKER): Saws felled trees into logs of desired length at marks made by Bucker, Head, or Marker II, using manually powered crosscut saw, gasoline-powered saw, or air-driven saw.

BUCKER, CHUNK (CHUNK SAWYER: WINDFALL BUCKER): In advance of cutting operations, saws merchantable trees, blown to the ground by wind, into logs.

BUCKER, HEAD (BULL BUCKER: SAW BOSS: TIMBER FOREMAN for Pacific coast forest): Foreman who supervises and assigns duties to buckers and fallers. Specifies log length and lays off log lengths on felled trees.

BUCKWHEATHER: Colloquial for a novice at lumbering.

BULL BLOCK: A high lead block, 24-42 inches in diameter, which is fastened at the top of a spar tree. Used as a lead for the skyline or main line.

BULL DONKEY: The large engine sometimes used in transporting logs by yarding to landing place.

BULL-OF-THE-WOODS: Colloquial for a foreman.

BULLY: Colloquial for a foreman.

BUNK: Cross supports on which the logs rest on a logging car or truck. Also typical camp bed.

BURL: Tumor-like growth, or knot, on tree trunk.

BUTT CHAIN: A length of chain, butt hooks, swivels and cleavices. Used to connect chokers to main line and haul back.

BUMMER TEAMSTER: Man who uses a bummer (low, two-wheeled cart upon which one end of a log is fastened with chains or tongs when log is skidded out of forest) to haul logs.

BUNCH TEAMSTER (SKIDDER MAN): Worker who drags several logs (bunch) to some convenient place for loading by means of a team of horses or mules.

BUSH MONKEY: A laborer who piles pieces of tanbark by hand in neat, orderly piles (ricks), similar to corded wood, placing the pieces with bark side down to prevent weathering of the tannin contained in the bark.

C

CABLE: A rope of woven wire. A wire rope in logging is termed a "line."

CABLE TENDER: A laborer who tends to cables, such as those on an aerial cableway, which are in more or less continuous and exacting use. He also lubricates cables and bearings of cableway equipment and constantly inspects cables for wear. He performs other duties as assigned, such as connecting or disconnecting logs to cableway carriage.

CAMEL BACK: An iron car re-railer similar in shape to a camel. Also refers to a method of depressing and elevating one side of a roadbed to jar logs off a truck.

CANT: A partially cut log.

CANT HOOK: A stout, hardwood lever terminating in an iron lipped socket used for canting or rolling logs. Similar to a peavey. A movable hook is attached near the end of the stock to grip or hold the log.

CANT-HOOK MAN (CANTER: HOOKMAN): The general term used to designate any worker who uses a cant hook in the handling of logs in any phase of logging operations.

CARRIAGE: Mounted on rollers, this device suspends and pulls logs along a skyline.

CARTER (SLEIGH TEAMSTER): Man who hauls logs on a sled; or may push, pull, or roll logs to load and unload sleds.

CAT: Abbreviation for caterpillar. Used loosely to designate any kind of a tractor with crawler type traction.

CATAMARAN: Equipped with a windlass, this small raft recovers sunken logs. Also called monitor, or pontoon, or sinker boat.

CATCHMAN: One who works, from a low bridge spanning a river, or from boom sticks (logs chained end-to-end, forming a dam to catch or deflect floating logs), to sort floating logs, according to the owner's mark, by deflecting logs with a pike pole as they float past him.

CAT DOCTOR (COLLOQUIAL FOR TRACTOR MECHANIC) TRACTOR REPAIRMAN: TRACTOR SERVICEMAN): One who diagnoses trouble and makes repairs of mechanical defects in tractors, such as adjusting carburetors, regulating timing of motor, and replacing wiring, piston rings, and other worn or damaged parts of tractor's motor or chassis. Uses wrenches, hammers, pliers, screw drivers, and other hand tools to do his work.

CATERPILLAR BOSS: A foreman who supervises the work of a crew of tractor operators, operating crawler-tread tractors, to haul logs and other heavy loads.

CATERPILLAR TENDER: A general term given to a worker who operates a tractor, or whose work is done in connection with the operation of a tractor.

CAT HOSTLER: A laborer who services caterpillar tractors with gasoline and oil, cleans the tractors, and guards tractors during the night or while tractors are idle.

CAT SKINNER (TRACTOR OPERATOR; CAT DRIVER: CATERPILLAR DRIVER:

CATERPILLAR OPERATOR; CAT MAN; CAT SKINNER; TRACTOR DRIVER; TRACTOR MAN): The operator of a gasoline or diesel-powered automotive or crawler-tread tractor; hauls vehicles or implements, (such as dump wagons, graders, plows, rollers, or trailers), pulls out stumps or other objects imbedded in the ground, or pulls the cable of a winch in raising and lowering or loading and unloading heavy equipment or material. He drives by manipulation of throttles, levers, and pedals, and steers the wheel or works levers or pedals which individually control both crawler treads. He may also couple and uncouple loads to and from tractor. He may give the tractor general maintenance and make minor repairs.

CAT'S PAW: The improper way of fastening the end of one full cable, or line, to the eye of another cable.

CAT SWAMPER: One who clears the trails for caterpillar tractors.

CEDAR MAKER: One who makes telephone or telegraph poles from cedar.

CEDAR MAN: One who sorts and inspects cedar poles according to size and length, and grades them according to specified standards. He also acts as crane follower for crane loading of poles on railroad cars.

CHAINMAN (CHAINER): One who maneuvers the log into position for skidding, using a peavey, and fastens chains about log in preparation for skidding.

CHAIN TENDER, SECOND: A laborer who is a subordinate in a skidding crew; assists and works under the direction of the Sled Tender II.

CHASER: A laborer who follows the logs as they are dragged from the forest to the yard and signals the Yarder Engineer to stop the logs if they become fouled on the way. He unhooks the cables or hooks at the yarder tree and is usually a member of the skidding crew.

CHASER II (BLOCK TENDER): A laborer who unhooks the cable used to drag logs from the forest when the logs arrive at the yarder tree; prepares the chokers, blocks, or other necessary equipment to be sent back into the forest. He is usually a member of the yarding crew.

CHIPPER AND NOTCHER: The foreman who supervises the work of two or three buckers and fallers: notches trees for felling (Notcher). Marks felled trees into lengths for cutting into logs (Marker II). He keeps the production record for each man or crew.

CHOCK BLOCK: Iron block, wedge-shaped, used to prevent logs from rolling off bunks. Also, refers to any blocks used to steady logs. (Bunk Block or Cheese Block).

CHOKER: Wire rope, short, used for attaching logs to a main line. Has a sliding hook and ferrule at one or both ends.

CHOKERMAN (CHOCKERMAN; CHOKER; CHOKER-HOOKER; CHOKER SETTER): The laborer who maneuvers logs into skidding position with peavey and fastens choker (noose of wire, rope, cable, or chain) about the logs (by which the log is dragged to the yard). He may level butt end of log with an ax if necessary to make it skid easier (Sniper).

CHOKER, SECOND: A laborer who is a subordinate in a skidding crew and who assists and works under the direction of the Chokerman.

CHOPPER, HEAD (CHOPPING BOSS): A foreman who is in direct charge of felling trees, skidding, and storing the logs. He supervises the Faller; Landing Man; Sled Tender II; Swamper II; and Teamster. He notches trees (Notcher), and marks log lengths on felled trees (Marker II).

CHOPPER, SECOND (FALLER, SECOND): When felling a tree, the logger who works from the lower springboards and less difficult places.

CHUNK: (or chunk out) - The use of motor power to clear ground when the obstructions are too large to move by hand.

CHUNK BUCKER (CHUNK SAWYER; WINDFALL BUCKER): One who saws merchantable trees, blown to the ground by wind, into logs in advance of cutting operations.

CHUNK BUNCHER: When clearing a skid road, one who maneuvers several logs so they may be fastened together with chains or cable for skidding out of the way.

CHUNK-OUT ENGINEER: Logger who operates a donkey engine to skid logs out of the way, when clearing new roads through the forest.

CHUTE BUILDER: One who saws or chops poles and timbers to the desired length and fastens them together with bolts or spikes to build a log chute. Topography, grades, and curves are factors in the construction of various types of chutes.

COLD DECK: Logs piled or decked for storage or handling purposes. A "hot deck" is when logs are taken from the pile before the deck is completed. A cold deck can also refer to a pile of logs which have been cut and skidded, in a certain period above the required amount, and are in reserve for future use.

COMPASS MAN: When making an estimate of timber tract he accompanies the Cruiser and determines for him the correct distances and directions of the boundary or other lines on the tract, using a compass to obtain direction, pacing between points to obtain distances, and consulting blueprints as necessary.

CROSSCUT SAW: A flat hand saw, from 4 to 12 feet long. Drag teeth situated between the cutting teeth. Used by one or two men for cutting timber across the grain.

D

"D": Slang for closed type of socket.

DECK BUILDER: A laborer who builds a log deck (upon which logs are stored to await transportation) by sawing or chopping logs or poles to proper lengths and placing them crib fashion.

DECKER (DECKMAN; TOP LOADER; YARD TENDER): A laborer who stands on top of log piles and guides logs into place, with a cant hook or peavey, as the log is pulled on the log deck by a chain that is attached to a horse, tractor or donkey engine. He also directs the movements of the Teamster or Tractor Operator verbally or by hand signals. When the log is in place on the pile he unfastens the hook.

DECKMAN II: A laborer who uncouples the logs from the main cable as they are pulled to the pullboat, removes the plugs and chains (Hooker, Head; Plug Setter), and hooks the removed plugs and chains to the main cable to be returned to the woods. He poles the logs around to the rear of the pullboat to be made into rafts by the Rafter.

DITCHER-TRIPPER: A laborer who pulls a line to dump the bucket, after each load, by sitting on the boom of an old style steamdriven or gasoline-driven power shovel.

DOGGER (BALANCE-STAFF INSERTER): A laborer who hammers the sharp hook of the dog (a short piece of steel, bent into a pointed hook at one end and with an eye or ring at the other end, to which the cable is attached) into the log to secure the skidding cable, or to fasten logs end to end for making a boom or raft.

DONKEY DOCTOR: A Maintenance Mechanic II repairs donkey engines used for such logging operations as skidding and yarding.

DONKEY WATCHMAN (DONKEY SERVICEMAN): Man who guards logging equipment and services donkey engines at place of operations during shut-down periods. He may also assist Engineer in cleaning and repairing boilers and engines.

E

ENGINEER: The operator of various sizes and types of donkey engines used to load logs onto cars or other vehicles, to pull logs out of forest to a yard, or otherwise move logs during logging operations. He moves hand and foot levers and hand throttle to control the winding and unwinding of cable onto or from drums, the cable actuating loading equipment, or pulling logs from the forest. He observes the bell, whistle, or hand signals in operating the donkey engine to determine when all is clear and safe. He does general maintenance and minor repairs usually designated according to type of engines operated or according to type of work performed.

F

FAIRLEAD: Revolving block or roller or series of blocks and rollers which are contained in a unit and arranged to guide the lines to a spool or drum.

FALLER (CHOPPER; CUTTER; FELLER; LOG CUTTER; LUMBER FALLER); The men, usually working in pairs, who cut down trees with an ax if tree is of small diameter, or with hand crosscut saw if tree is of large diameter. May notch trees, saw felled trees into log lengths (Bucker), and may trim limbs from felled trees (Limber).

FALLER, FIRST: The same as Faller, Head.

FALLER, HEAD (FALLER, FIRST; SAWYER, HEAD). When felling a tree, he may work from the higher springboards and more difficult positions. He usually determines order and direction of felling and may supervise workers who fell trees.

FALLER, SECOND (CHOPPER, SECOND): When felling a tree, he works from the lower springboards and less difficult places.

FLITCH: Thick piece of timber with wane on the edge. A slab.

FROG: The rail crossing point of a switch. A car railer or derailer is known as a frog or "camel back".

G

GOPHERMAN (CHOKER-HOLE DIGGER; GOPHER; SWAMPER): A laborer who digs the earth from beneath a log at a point where skidding chain or choker is to be placed.

GRAB DRIVER (DOUPLE-UP MAN): A laborer who fastens together, end-to-end, several logs, preparatory to skidding, by means of a short chain having at each end a sharp hook that the worker drives into the log with a maul.

GRABHOOKER (HOOKER; HOOK-ON MAN): The worker who hooks skidding or loading chain about a log and fastens it securely by means of a grabhook (a hook with a narrow throat that is adaptable to seizing any link of a chain). He pushes, pulls, and rolls the log with a cant hook or peavey to maneuver it into position for skidding or loading.

GRAB-JACK MAN (JACKSCREW MAN): A laborer who uses a hand-operated jackscrew to lift or move log cars or other heavy objects, sets jackscrew under object to be moved, blocking it with timbers or other objects to prevent movement of jack. Turns screw, by means of a small hand lever, causing object to move.

GRABSETTER: A laborer who fastens grabs (two sharp hooks joined by a chain and having a ring for attaching a cable or chain) to logs preparatory to skidding the logs by means of a two-wheeled, horse-drawn cart.

GROUND LOADER (BOTTOM LOADER; HOOKER; HOOKER-ON; HOOKMAN; LOADER, SECOND; SENDER; SEND-UP MAN; TONGS HOOKER; TONGS PULLER; TONGS SHAKER): A laborer who works on the ground, assisting in loading logs upon railway cars, trucks, or other vehicles, or assisting in rolling logs upon a log deck by maneuvering log into position with peavey; fastens tongs, chains, or other devices about the log by which the log is loaded, or guides log with peavey as the log is pulled up skids and onto log deck, sled, truck, or other vehicle.

GROUND SKIDDER: A truck unit which carries logs without lifting them from the ground and without using a skyline.

GUARD: A protective device around a machine or danger zone.

H

HARDY: Chisel with a square base to hold it upright while cutting material.

HEAD BLOCK: The log which is placed under the front end of the skidway to raise it to the desired height. Also, crosspiece at the front of a donkey sled on which fairlead is attached.

HEAD LOG: Front bottom log on a skidway.

HIGH CLIMBER (CLIMBER; SQUIRREL MAN; TOPPER): A worker who cuts limbs and tops from tall, straight trees selected as spar trees to which skid

rigging is to be attached. Uses climbing spurs and safety belt to climb the tree and may attach rigging to spar (Rigger, High).

HIGH LEAD: A term to denote system of yarding or conveying logs with a donkey, from the cutting area to the landing, by use of cables or lines. A single spar tree is used as a lead for the lines.

HOISTER (HOISTER, LOG POND; SINKER PULLER): The operator of a winch, powered by a donkey engine, located on a pond bank near the foot of chute, to raise sunken logs from the pond bottom and drag them to chute and to separate logs, jammed in pond, which cannot be moved with a pike pole. The logs are moved with a cable that is wound around the winch drum.

HOLDING WOOD: When falling timber this term is used to denote the wood between the corner of the undercut and the corner of the back cut on one side of the tree.

HOOKER, HEAD: The foreman who supervises Plug Setters, Side-Line man, and others engaged in skidding logs with a pullboat. Hooks the logs to rings on the outer end of the main cable, with short chains, and signals Pullboat Engineer to start dragging logs to pullboat.

HOOK TENDER (CHOKER, HEAD; CHOKER-HOOKER, HEAD; LOGGER; SKIDDER HOOKER; YARD BOSS; YARDER BOSS; YARDING HOOK-TENDER): A foreman who plans and supervises the work of the Chokerman, Riggers, and other members of a crew engaged in storing logs in a yard. He indicates roads to be cleared by a Swamper II and designates logs to be skidded and the order in which they are to be skidded. He directs the placing of rigging on spar trees and usually works with his men.

J

JAGGER: Wire sliver which projects out of a wire rope or a wire.

JAMMER: A power-driven derrick mounted on a movable frame, used for loading logs.

JAMMER ENGINEER (HOISTER; JAMMER OPERATOR): A worker who manipulates levers to control cables and boom on a powered loading machine (jammer) used to load logs onto railroad cars.

JERK WIRE (also jerk line) - An open wire that is jerked to transmit whistle signals. (Term used to distinguish it from electric signal systems.)

JILL POKE: The act of punching an uncoupled car, or a log, or other large object, with a log or timber set at an angle, against some powered equipment.

JITNEY: Small power-driven unit used in logging railroads. Can be any small vehicle used to push or drag another vehicle or material. Sometimes has a low platform.

JOBBER (CONTRACTOR): A jobber contracts, supervises and directs crews and keeps time and production records of lumbermen performing one or more phases of logging operations, such as felling trees and cutting them into logs, skidding logs, or loading logs on cars or other vehicles. He usually works with crew if number of employees is small.

K

KICK-IN ENGINEER: A worker who operates a donkey engine to skid logs from the ground into a log chute.

L

LABORER, PILE TRIMMING AND CAPPING (ADZMAN, PILE TRIMMING AND CAPPING; AXMAN, PILE TRIMMING AND CAPPING; PILE CAPPER; PILE TRIMMER): A laborer who uses an ax and adz to trim and point wooden piles and sheeting. He cuts off the butt end of pile to form cap and rolls piles from storage pile to work site with a cant hook.

LANDING: The terms, dump, bank, bank ground or yard, are used interchangeably to indicate a place where logs are hauled, dumped, stored, or piled. Generally the logs are decked on skids. The landing is usually placed alongside a railroad, log road, or on the bank or a river, pond, or harbor.

LANDING MAN (LOG BUNCHER; LOG ROLLER; LOGWAY MAN; PILER; ROLLWAY MAN; SKIDWAY MAN): A laborer who uses a cant hook or peavey to pull, push and roll logs to arrange them in neat, orderly piles on a landing preparatory to loading them for transportation, or rolling them into a chute or flume.

LANDING TREE: Spar tree used at the landing for loading logs. Also for yarding and swinging.

LANDING UNLOADER: A laborer that unloads logs from railroad cars at a landing, using a pile pole or peavey to roll or otherwise maneuver the logs into desired position.

LAY: The direction in which the wire rope is twisted. In "regular lay" rope, the wires in each strand twist in the opposite directions from the strand. In "long lay" rope the wires and the strands twist in the same direction.

LEAD: (or lead block) Guides the cables by which logs are dragged or hoisted. Has a hook or loop for fastening to the tree and anchored with a lead line which has an eye at the one end.

LINEMAN II: A foreman who supervises and directs the work of several Trail Teamsters.

LINES: The wire ropes or cables used in logging. Nicknamed for their various uses as follows:

Boom lines - the "hold up" lines used to support a loading boom.
Buckle lines - used to support, or stiffen, a tree between the top
guy wires and a block or a point that is subjected to unusual strain.
Guy lines - Lines which support or brace the spar trees, booms, etc.
at the top or other points.
Haulback, or trip lines - The large line which pulls or drags the logs
from the cutting area toward the cutting area. (Also trip, pull back,
or back line.) (In skidder system, the receding line.)
Lead line - The one which is used with the lead block.
Main line - The large line which pulls or drags the logs from the cut-
ting area toward the donkey in yarding operations such as the "high
lead" and "North Bend" systems.
Pass line - That section of the straw line used by the high climber.
Running line - Any mobile line as distinguished from guy lines.
Sail guy - Holds up the outer or swinging end of the boom.
Slackline - The sagging or slack skyline in the "slackline system."
Slack puller line or slack puller - This is attached to the skidding
line and carriage to pull in the slack on the tong line.
Skidding line or main line - The line which hauls in the logs by pul-
ling on or through the skyline carriage in the slackline or skidder
system.
Squirrel line - That line which attaches to a loading boom to swing the
boom as needed by means of a counterweight or squirrel.
Straw line (grass line) - A small line which is attached to the donkey
end of the haul back as pilot or guide line. Also used by the
riggers as a pass line.
Tightening line - The fall line to a pair of blocks which tightens or
straightens out the skyline.
Tong line or crotch line - From 20 to 60 feet long, this is the line to
which the tongs are attached at a loading boom. A tong line also is
that part of the skidding line between the slack puller connection
and the chokers.
Transfer line - In skidder or slackline systems the transfer line is
used to change the skyline from one spar to another. It is larger
than the strawline.

LOADER OR BOOM HOIST: The boom or loading boom. A loader is also a workman
who loads the logs on the cars or trucks. A top loader stands on top of the
load and places the logs as they are sent up to him.

LOADER ENGINEER (LOADER LEVERMAN; LOADERMAN; LOADER PUNCHER; SKIDDER LOADER):
Responding to signals given by Loader, he manipulates levers on a donkey
engine to control the movements of cables and boom used to hoist logs from
the ground and load them upon cars.

LOADER, FIRST (LOADER, HEAD): A foreman who supervises and directs the
work of Ground Loader; Top Loader II; and other members of the crew loading
logs onto cars. He selects those logs in the yard that will best fit to-
gether to make one carload and signals Loader Engineer when to pick up the
logs.

LOADING JACK: The platform on which logs are hoisted from the water or ground
prior to loading onto cars or trucks.

LOADING HOOK, LOADING TONGS: A pair of hooks for loading logs. They may either grapple the log at the ends or in the sides. Log tongs differ from the pigs-foot type of log hooks in that the former are of solid metal and similar in design to a pair of scissors or ice tongs.

LOADING TEAMSTER (LOADING DRIVER): By means of a cross haul (a system of blocks (pulleys) and cable or chain by which logs are rolled upon vehicles) he drives a team of horses to load logs on cars, sleds, or trucks. He responds to signals from Top Loader II or other members of loading crew.

LOG-CHAIN FEEDER (CHUTE FEEDER; JACKER; JACKER FEEDER; JACKERMAN; JACK-SLIP FEEDER; LOG SLIPMAN; SLIP FEEDER; SLIPMAN; SLIP TENDER): A worker who hooks logs floating in a pond with a pike pole and guides them with a pole into log chain or other device which carries them up to log deck, while standing on a platform at pond edge beside log chain that runs in a trough beneath surface of water into sawmill.

LOG DRIVER (DRIVER; RIVER DRIVER): By using a peavey or cant hook he assists in floating (driving) logs down a stream to a mill and rolls logs from storage place on river bank into the stream. Working from the river bank or walking on floating logs he guides logs with a pike pole to prevent them from running aground or being stopped by obstacles in the river. If a jam occurs, he works with a pike pole or other handtools to free key logs (logs causing jam) or, if necessary, to dynamite the jam, places dynamite in holes bored in logs or packs mud about dynamite, and sets off charge. He may collect logs in boom for towing to mill or towing across still water (Rafter). He may return up river, after main body of logs has passed, and roll stranded logs into river, or pull sunken logs upon shore to be collected by truck or wagon and transported to mill. May work from boat where water is deep, collecting logs into a boom or floating logs into the river that are imprisoned in backwater. The men on this job are frequently known, according to place of work or degree of expertness, by such colloquial titles as cattyman; head driver; jam cracker; laker; lot watch; river rat; slough pig; white-water man.

LOGGER, HAND: In general terms, a lumberman who is engaged in small logging operations and who uses animals for skidding, instead of gasoline or steam donkey engines.

LOGGING-CAMP TENDER (CAMP TENDER): He guards logging camp equipment to prevent unauthorized removal of property, and during warm weather he uses a hose or bucket to sprinkle water around donkey engines to prevent fires.

LOGGING EQUIPMENT MECHANIC: A Maintenance Mechanic II assembles, sets up, adjusts, and maintains logging equipment, such as steam or diesel skidders, loaders, pumps, generators, and derricks. He may also repair trucks and tractors.

LOGGING-OPERATIONS INSPECTOR (CRUISER, CHIEF; INSPECTOR CRUISER): Inspects operations of the Jobber to insure that activities are being carried out according to contracts and examines subdivision being logged, scales logs, and methods of logging for safety and efficiency. He makes periodic reports to employer on logging activities and progress of operations and may estimate volume and value of marketable timber (Cruiser).

LOGGING WHEELS, KATYDID: (also big wheels, high wheels, timber wheels) - A pair of wheels about 10 feet in diameter mounted on an inverted U-shape axle. The logs are suspended between these wheels and below the axle. The axle is equipped with a tongue for attaching to the motive power.

LOG GRADER: Using an ax and knife he cuts into logs to determine the state of wood and observe shape of each log to estimate board footage and quality of usable lumber it contains.

LOG HANDLER: The general term given to a worker who handles logs in the forest during the process of felling trees, cutting felled trees into log length, loading logs in sleds or wagons, snaking logs to landings, piling logs on landings, or hauling logs to sawmills (Bucker; Chokerman; Faller; Landing Man; Snaker).

LOG-HAUL OPERATOR: A laborer who loads wood on log-haul chain from cars by cutting wires and stakes that bind the load to a car. He breaks jam of logs on car and rolls them one-by-one on log-haul chain and cleans the log haul and car.

LOG INSPECTOR (LOG CULLER): The inspector of logs used in the manufacture of barrel staves, before they are cut into lengths by Stave-Log-Cut-Off-Saw Operator and separates those having defects (knots, crooks, and checks), designating them for use in manufacture of barrel-heading material.

LOG JACK: A mechanical lever operated by hand to roll or lift the logs.

LOG RIDER: Working from floating logs and using a pike pole to select and drive logs to foot of chute, he sorts and shifts logs about in a pond.

LOG SCALER (LUMBER SCALER; PULPWOOD SCALER): Estimates the number of board feet that can be sawed from logs by measuring the diameter of each log with a scale stick (a rule stamped with figures giving the board-foot content of logs of various sizes), records the number of board feet in each log in a record book and totals the number of board feet in each log of logs scaled. He may operate a bull wheel (Bull-Wheel Operator).

LOG TURNER (DECKMAN; LOG DECKMAN; LOG ROLLER; TRIPPER). Rolls logs from the log deck onto the log carriage and turns logs over on the carriage with a cant hook, or wraps a chain around log and operates winch to roll log onto carriage. He turns log into position for sawing, and holds it firmly against carriage knees, using a cant hook as a lever until Dogger has secured log in position. He turns log as directed (logs may be turned by steam nigger operated by saw operator when planks are to be sawed from more than one side) and may help Dogger set dogs when necessary. He may help members of crew to adjust the sawmill equipment.

LOG UNLOADER: A laborer who unloads or assists in unloading logs from rail-way cars into the pond by unhooking or releasing chains from around logs or car. He uses a cant hook or peavey to roll logs from car which do not fall free when chains are loosened and uses an ax to chop side stakes from car to free logs on car, if stakes are used instead of chains.

LOG WASHER: A laborer who directs a high-pressured stream of water from

a hose, on logs being drawn up slip or chute from pond to deck, to remove any loose dirt, gravel, or stones from the bark of log (in many mills this work is accomplished by mechanical sprayers).

LOG-YARD-CRANE MAN: The term applied to a Caterpillar-Crane Operator, a Locomotive-Crane Operator, or a Truck-Crane Operator who lifts and moves logs with a crane in a log storage yard.

LUMBERJACK (LOGGER; TIMBERJACK): The general term given to designate anyone engaged in logging operations in a logging camp.

LUMBERMAN'S JANITOR (LABORER, CARPENTER SHOP; SAWDUST MAN): A laborer who maintains sanitary conditions and reduces fire hazards by sweeping, cleaning, removing debris, and placing tools and materials in orderly arrangement in a lumber and woodworking plant.

M

MAIN LINE ROAD: That part of the logging railroad over which all completed trucks or trains must pass in order to reach the log pond or log dump.

MARK CALLER (LOG SORTER): A laborer who stands at one end of a boom used to sort logs on a river and calls out the different owners' marks, as the logs float past to enable the Catchmen to sort the logs.

MARKER I (BARK MARKER): A laborer that puts an identifying mark on logs that are floated down a river when the logs are owned by different companies by: (1) stamping both ends of a log with characters that are mounted on the head of a hammer; (2) by painting a mark on the ends of log; or (3) by chopping or sawing a mark in the bark at the ends of the log.

MARKER II: A marker of felled trees for cutting into log lengths by Bucker, using a scale or rod of known length and laying off the bole in such a manner as to obtain the maximum of marketable timber consistent with standard log lengths.

MARKER III (LAY-TREE MARKER; TREE MARKER): When selective logging is to be done, he marks trees to be felled by blazing and stamping the trees with a hatchet that has a cutting edge on one end and a mark or stamp on the other end.

MARKING HAMMER: The hammer with a raised stamp to mark the ownership of logs.

MARLIN SPIKE: A slender pointed iron tool for separating the strands in splicing lines.

MINE-TIMBER CHOPPER: A worker in the forest who fells, chops, and saw trees to be used for timbering in mines.

MOLLY HOGAN: A temporary and improper cable splice, made by twisting one strand of wire into numerous circles to form a grommet with which to connect the eyes made in a cable.

MUCKER: A laborer who rakes and shovels bark and other debris from a log landing to facilitate the loading of logs for transportation to the mill.

MULLIGAN CAR: Generally, a truck, or speeder, equipped for and used to transport workmen to and from the camp at meal times. In some sections, the Mulligan wagon is a vehicle used to haul supplies from the city to the camp. In that connection, it is seldom used for transporting workmen.

N

NORTH BEND: A system of yarding or conveying logs, with a donkey, from the cutting area to the landing using a cable suspended between two spar trees.

NOTCHER (CHOPPER; CUTTER; PREPARER; SPOTTER; TIMBER FITTER; UNDERCUTTER): A worker who selects trees and saws or chops a wedge-shaped notch or under-cut on the side of the tree in the direction of fall to guide the fall of the tree and prevent splitting of the bole before it is completely severed. The location and depth of the notch will depend on such factors as the root swell, the lean of the tree, convenience for skidding, and avoidance of other trees in falling. He may mark felled trees for cutting, using a scale or rod to measure lengths and may mark felled trees into log lengths (Marker II).

O

OIL BOY: A laborer who carries kerosene oil to Buckers and Fallers for use on saws to prevent binding.

OVERHEAD SKIDDER: A device which transports logs through the air by means of a skyline with at least one end clear of the ground.

P

PAN: A large metal sheet or pan attached to a cat. Its function is to keep the front of the log from digging into the ground during skidding.

PAY CHEATER: The colloquial word for Timekeeper.

PEAVEY: Similar to the cant hook, it is a handtool used for turning logs. The end terminates in a sharp end, or pike, instead of in a projecting lip.

PEAVEY MAN: The general term given to any worker who uses a peavey pointed lever with movable iron hook near the end) to move logs.

PEELER (BARK PEELER; ROSSER; SPUDDER): A laborer who inserts spud between bark and tree or log and peels the bark from felled trees or logs to obtain bark for tanning purposes, to strip trees or logs for telephone poles, spars, and piles, to prevent the dulling of saw blades in sawmill, and to prepare logs for sawing into barrel staves or for slicing into veneer.

PIECE MAKER (PIECE CUTTER; PULP-WOOD CUTTER): A worker who cuts and piles

pulpwood to be hauled to mill: Fells tree (Faller). He peels bark from tree (Peeler), saws felled tree into suitable log lengths (Bucker), piles logs in orderly stacks or ricks, and clears away underbrush so trucks can be driven from main road to pulpwood piles (Swamper II).

PIGMAN: (Nearly obsolete). A worker who rides in a small boat, called a pig, that is towed behind a log on its way over the skids, and greases the skids to facilitate the skidding of the next log.

PIGS FOOT, or Cup Hook: A hook, or pair of hooks, attached to wire ropes, and held together at the top by a swivel bar. Used to hook into the ends of logs.

PIKE POLE: A long pole terminating in a pike, or sharp point, at the end and sometimes provided with a curved hook to hold and to handle logs in the pond.

PILING SAWYER: A worker who cuts and trims trees to be used as piling in the construction of docks, bridges, and other structures.

PONY: The smallest machine or unit used.

POWER-SAW MAN: A worker who sets up and operates a small gasoline-powered saw used to fell and buck trees (Bucker; Faller). He places saw at cutting point on bole of tree and starts the gasoline engine, and controls the speed of the saw by a hand throttle.

PULP PILER (PULP ROLLER): A laborer who piles pulpwood logs in neat, orderly piles at skidway or landing near logging road or stream, placing logs on pile by hand as high as he can reach, or guiding log upon pile with cant hook as the log is pulled up with a chain dragged by a horse.

R

RAFT DRIFTER: A laborer who rides on a log raft and guides the course of the raft as it drifts down stream to the sawmill by pushing on the bottom of the river with a long pole.

RAFTER (BOOM MAN; RAFFMAN; RAFTSMAN): A worker who walks on floating logs or booms, or works from a boat, assembling logs into proper position and binding them together with chains or other fastening devices to construct a raft to be towed to the mill. He maneuvers the logs into position with a pike and peavey. There are several types of rafts; flat rafts and ocean-going rafts, and the detail method and care in constructing each varies, depending principally on the length of haul, kind of wood to be rafted, and waterway used, such as ocean, bay, lake, or swift river.

RAFTER, BOTTOM MAKER: A worker who places two long poles across several parallel logs, held together loosely by a chain, to build the bottom of a raft upon which other logs are to be loaded. He bores holes in poles and logs with an auger and drives hardwood pins into holes to fasten poles to logs.

RAFTER, PICK-UP MAN: Using a peavey he walks on floating logs, or poles a boat about in the water to collect logs that have broken away from a raft or boom, and maneuvers the logs into position in the boom.

REACH: A rod or beam which connects a trailer to a motorized logging truck.

RIGGER (RIGGER MAN; RIGGING MAKER; RIGGING MAN; RIGGING SLINGER; LINEMAN; LINE SETTER; LOG RIGGER): A worker who installs the system of cables and blocks (pulleys) used in power-skidding operations; performs duties such as fastening blocks to the spar trees with a cable or chains, threading the various cables from the skidding engine through the blocks, and fastening guy wires from the spar trees to stumps or other solid objects on the ground.

RIGGER, HEAD: A foreman who supervises and directs the work of a crew of Riggers, and is usually the Rigger, High.

RIGGER HELPER: A laborer who performs a variety of unskilled duties under the direction of Rigger I, as a member of rigging crew engaged in moving and transporting heavy pieces of equipment such as loading and unloading rigging equipment on trucks, setting up and blocking wooden runways for moving equipment, and sliding and removing skids and rollers under equipment. Lifts heavy equipment.

RIGGER, HIGH (SKIDDER RIGGER): Using a safety belt and climbing spurs, he climbs spar tree and determines position for, and attaches rigging used in skidding logs. He may trim top of tree before attaching rigging (High Climber).

RIGGER, SECOND (GROUNDMAN; RIGGER, EXTRA; RIGGER HELPER): The Riggers assistant in installing cables and blocks used in power skidding, performing duties that can be accomplished on the ground and do not require climbing the spar trees, (such as assembling the cables through the blocks and fastening guy wires to stumps).

RIGGER, THIRD (RIGGER HELPER): A laborer who is a subordinate in a crew of men engaged in installing blocks (pulleys), cables, and other rigging used in skidding logs. He works under the direction of Rigger, Head, performing manual duties requiring little skill, such as carrying blocks and cables to the Rigger, threading cables through blocks, and pulling on guy wires to tighten them.

RIGGING: The wire rope or lines, blocks, sheaves, etc., used at the spar tree, or in skidding systems. The high rigger installs and maintains this equipment. The rigging crew is composed of the riggers, the hooktender, choker men and chasers.

RIGGING SLINGER II: The lead man in a crew of Chokermen. He oversees their work, selects the logs to be skidded into the landing or yard, and gives the signal to skid the logs after the chokers have been fastened and the workmen are in safe positions.

RIGGING-UP ENGINEER: In hoisting new high rigging for skidding operations, he manipulates levers to operate a donkey engine and responds to signals from Rigger, High.

RIVE: To split, a log, instead of to saw, before reducing it to lumber dimensions.

RIVER (FROGMAN; PICKET MAKER; POLE SAWYER; TIMBER SPLITTER): Worker who splits (rives) blocks of wood to make such products as pickets, posts, shakes, and rails by sawing felled trees into suitable lengths, marking blocks so grain will be suited for accurate sizes when split, and splitting block with frog(a splitting tool with a long, narrow cutting blade at right angles to handle).

RIVER, STAVE-BLOCK SPLITTER (STAVE-BOLT MAKER): Using an ax, maul, and wedges, splits stave logs into several bolts (short pieces of wood to be manufactured into barrel staves) for greater convenience in loading and handling at the mill.

ROADMAN (ROAD BUILDER; ROAD MONKEY): A laborer on a crew of men engaged in building logging roads and keeping them in repair. He performs manual duties such as cutting out underbrush, placing logs or poles in holes or swampy places in a road, and excavating dirt, where necessary, to smooth the grade of the road.

ROAD MONKEY II: A laborer who uses an ax, shovel, pick, and other hand tools to keep logging roads in proper condition by filling holes with dirt, leveling rough places, and performing similar duties requiring little skill. During the winter, he places sand in road ruts on hills to control the speed of descent of sleighs.

ROAD POLER (POLER): A laborer who builds corduroy roads, used for skidding logs over swamp or rough areas, by laying poles of small diameter in the road either in zig-zag fashion or at right angles to the road.

ROLLING STOCK: All wheeled vehicles capable of running on railroad car tracks.

ROLLWAY, or Skidway, or Log Dump - Usually the place where logs are rolled or dumped into the pond or at the mill unloading area. Also designates an inclined tramway upon which logs are rolled onto a truck.

ROSSER I (BARKER; LOG FIXER; SCALPER; SLIPPER): A laborer who peels bark from the under side of logs with an ax and smooths slight crooks by cutting off sufficient wood to facilitate dragging the log over the ground.

ROSSER II: To reduce waste of wood that occurs when logs are peeled by machinery at the mill by a laborer who peels bark from the pulpwood logs.

RUB TREE: or Rub Stump, or Oregon lead - A tree or high stump left standing, to deflect the main line in high lead yarding, allowing the logs to follow a natural path, instead of being dragged along a hillside.

RUNNER: A skid log, or timber, under a donkey sled.

RUSSIAN COUPLING: Two logs connected by a section of wood which has not been completely sawed, or chopped off, in bucking.

RUTTER MAN: A worker who drags a form of plow (rutter) over logging roads to cut ruts in the road in which sled runners fit.

S

SAW LOGS: The sections of a tree of suitable character and length for handling in a sawmill, and for use as lumber.

SCAVENGER: A laborer who removes dirt and trash from the streets, outhouses, and other places about a logging camp.

SELECTIVE LOGGING: Picking or selecting trees in a certain area for logging purposes; usually logged with cats.

SHACKLE: A clevis, or "U"-shaped anchor, with a removable pin or bolt screwed, or cotter-pinned, through the "U" ends.

SHANTY BOSS: The colloquial for foreman.

SHEAVE: A grooved wheel, or pulley roller, or pulley block.

SHINGLE-BOLT CUTTER: A worker who cuts and stacks shingle bolts prior to milling, fells trees (Faller). He saws them into suitable log lengths (River) and splits logs into shingle bolts, using an ax, and piles bolts in stacks. He may load bolts onto a truck and haul them to a shingle mill.

SHIP-KNEE MAKER: A worker who fashions ship knees for wooden ships or boats by locating trees in the forest with proper-size roots. He cuts through toe (feeder roots) and heel (tap root) of tree with an ax and crosscut saw to fell tree and bring roots above the ground. Measures with a rule and line from the bottom of heel upward, determining where cut should be made. Cuts upper part of tree from the root to estimated length of knee, using crosscut saw. He shapes and trims knee according to specifications, using a broad-ax and crosscut saw, and measures knee with a chalk line, plumb bob, and square to determine that it meets requirements.

SHOOK, or Box Shook: Any loose, or baled, wood material, ready for use in making boxes.

SHOW: The scene, or location, of a tree falling, bucking, and loading operation.

SIDE: That part of a logging operation, manned by a crew and equipment sufficient to complete the operation to one given point, in readiness for transporting the logs to the mill.

SIDE BOSS: A foreman who supervises and directs the work of a "side,"

which includes Buckers; Chokermen; Fallers; Riggers; and others engaged in falling trees and skidding them to a storage yard or railroad.

SIGNALMAN (FLAGMAN; LOOKOUT; SIGNAL BOY; SIGNAL PUNK; WHISTLE BOY): A laborer who transmits the orders from the Hook Tender to the Yarder Engineer by means of a whistle, bell, or hand signals.

SIGNALMAN, BELLBOY: The transmitter of orders from the Hook Tender to Yarder Engineer by means of the bell system.

SINKER MAN: From a float or raft he secures a chain or cable from a winch over sunken logs and assists Hoister in conveying raised log to chute.

SKID: A log, metal or lumber rail upon which to slide logs. Also the sled or skids upon which the donkey engine and boiler are mounted.

SKIDDER: A system of yarding and conveying logs with a donkey from the cutting area to the landing, using two, or more, cables suspended between two spar trees.

SKIDDER, HAND: A laborer who follows a log as it is dragged over the ground and places short poles under the log to facilitate its movement.

SKIDDER LEVERMAN (DRUM MAN; DRUM TENDER; SKIDDER; SKIDDER MAN; SKIDDER OPERATOR): Skids logs to the yard of skidway by manipulating levers to control power-driven drums that wind up cable to which logs are attached. He also responds to signals given by the Signalman or other member of skidding crew.

SKID ROAD: A trail, or road, to or from the skidway.

SKID-ROAD MAN: The general term given to designate a worker who assists in construction and maintenance of skid roads (rough roads over which logs are dragged from the forest to a storage place to await transportation.

SKID SAWYER: A laborer who saws poles or logs to proper length to make skids over which logs are to be moved.

SKIDWAY: Two skids laid parallel and at right angles to a road. Commonly raised at the end nearest the road. Logs are piled on this as brought from the stump and before loading. The rollway is sometimes called a skidway.

SLAB: The outer circumference, or piece, of a log or tree, to which some or cables about them so they can be uprooted by tractor or horses.

SLACK PULLER: A laborer who, by hand, pulls enough slack in the main skidding cable to enable the Tongs Hooker I to fasten the tongs or chokers (a noose of wire rope) to the logs.

SLACKLINE: A system of yarding and conveying logs with a donkey from the cutting area to the landing on a sagging, or slack, skyline suspended between two spar trees.

SLED TENDER II (CHAIN TENDER; FROGGER TRAILER; ZOOGLER): A laborer who assists in loading and unloading sleds drawn by a tractor. He fastens chains about the load to hold it in position and follows the sled to landing, unfastens chains, and rolls or lifts log from sled or dray.

SMITTER: A laborer who keeps the logs rolling straight on the skids when loading cars, sleds, or trucks, with animal or tractor power, by maneuvering the logs with a cant hook or peavey.

SNAG: A dead standing tree. Also a broken-off tree, or branch of a tree.

SNATCH BLOCK: Any block with a hook or eye which is attached to a fixed object, and which serves only as a guide for a line or cable.

SNIPER: A laborer who rounds off the ends of logs with an ax so they will skid more easily.

SNUBBER ENGINEER: The operator of an engine (snubber) used to pull and lower loaded log cars on grades too steep for operation of locomotives.

SNUBBING: A method of retarding the progress of a machine, or log, by means of lines.

SPAR: Spar Tree or Mast - A tree, which has been trimmed and rigged like a gin pole, for use in loading logs, or in attaching the lines of the various overhead logging systems. The head spar is the main tree nearest the donkey, while the tail spar is the one at the end of the line near the cutting area.

SPEEDER: A small railroad track unit or "jitney". Generally propelled by gasoline.

SPIKE TENDER: A laborer places spikes or goose necks (sharp pointed, L-shaped steel bars) into previously cut holes in the bottom of log slides so that they will dig into and check the speed of descending logs.

SPLITTER: A wedge-shaped piece of metal, or wood, for splitting bolts or shingles. In the latter case, it sometimes has one sharp edge and is called a froe.

SPOOL TENDER (WINCHMAN): A laborer who places several turns or wraps of the logging cable about spool, or capstan, of a donkey engine and guides the cable on the spool when the engine is used to skid logs along the ground or load them on cars.

SPOOLWRIGHT (SPOOL RUNNER): Laborer who hews out a place on stumps or logs along a skid road on which to place a spool for the purpose of guiding the main skidding. He uses a broad-ax or adz to chop the stump or log.

SPRINKLING-TRUCK DRIVER (SPRINKLER MAN; WATER-WAGON MAN): A truck driver who drives a truck equipped with water tank and sprinkler to sprinkle roadways, parking lots, or other areas, to settle dust. He operates hand and foot levers to regulate the flow of water.

SPUD, or Barking Iron, or Peeling Iron - A tool for removing bark from trees or logs.

SPUR: Temporary rail or truck road used in transporting logs from a small area, or a temporary logging site.

SQUIRREL: A counter-weight near a loading boom attached to the squirrel line.

STAKE CUTTER (BLOCK MAKER): A laborer who cuts poles into proper lengths for stakes, and points one end of the stakes with an ax for holding logs on logging cars.

STEERSMAN: A laborer who steers a raft of logs down a swift river to a mill by means of a long oar fastened to a swivel at the rear end of the raft.

STOCK CUTTER: A worker who fells, trims, and bucks trees (Bucker; Faller, Limber).

STRAP: A short length of wire rope with a ferrule, or an eye splice, on each end by which blocks are attached to trees or logs. A "safety strap" is generally connected to a heavy block to carry it down a guy line and prevent the block from striking persons below, in case the regular strap should break.

STUMPER I: A worker who removes stumps from logging roads or yards with dynamite.

STUMPER II: A worker who removes the stumps from logging roads or yards by digging around the stumps to expose their roots and fastening chains bark is usually, though not necessarily, attached. It may be either sawed or split.

SWAMP HOOK: A large single hook, with an eye at one end, attached to a chain. Used for swamping and skidding, and for rolling logs.

SWAMPER I: A laborer who walks behind a horse-drawn truck loaded with logs and manipulates the brakes to slow the descent of the truck down a steep grade.

SWAMPER II (BEAVER; BRUSH CUTTER; BUSH CUTTER; GUTTERMAN; PATH CUTTER; RIGHT-OF-WAY MAN; ROAD CUTTER; RUN CUTTER; SWAMPER, SECOND; TRAIL CUTTER): A laborer who clears the ground of underbrush, fallen trees, and other obstructions before the construction of logging road, skidding trail, yard, or landing. He uses bush hook, ax, saw, and other hand tools and may fasten a chain about large logs to skid them out of the way if a donkey engine or tractor is used for this purpose (Chunk-out Engineer, Tractor Operator).

SWING ENGINEER (SWING-DONKEY PUNCHER): The operator of a donkey engine used to skid logs into a landing by a system of overhead cables, as differentiated from skidding logs along the ground on a skid road (Roader Engineer).

SWINGING: The process of transferring logs from the yarding tree to the place of loading.

SWING TREE: A spar tree used for pulling logs away from a yarding tree. When swung to a landing, it is designated as a landing tree.

T

TAILER-IN (ROLL-DOWN MAN; TAILER-DOWN): A laborer who rolls logs into a position where they can be easily loaded onto cars or stacked in piles with a cant hook or peavey.

TAIL SPAR or Tail Tree: Used in skidder, or other skyline yarding operations, to suspend the outer end of the skyline.

TANK CONDUCTOR: A foreman who supervises the Sprinkler Man and manipulates valves to regulate the flow of water onto logging roads during freezing weather to facilitate the movements of logging sleds.

TEAM BOSS: A foreman who supervises Teamsters engaged in the hauling and skidding of logs. He selects and directs the preparation of skidways and logging roads and determines the most efficient methods and equipment to use.

TELEPHONE-POLE AND PILING CUTTER (PILING AND TELEPHONE-POLE CUTTER): A worker who fells, trims, peels, and saws trees to a proper length to be used as poles for carrying telephone or power lines, or as piling in the construction of bridges, buildings, and similar structures.

TELL TALE: A series of strings suspended over or at the approach to any place or object that is restricted in height; to tell, or warn, people of the danger; a line hung from a squirrel for the same purpose.

THIRD LOADER: A worker who shifts empty logging cars to proper loading position by releasing hand brakes of cars resting on inclines, stopping the cars when they reach the correct position by applying the hand brakes. He also hooks cable from a donkey engine to cars to be pulled up inclines and signals Engineer in moving cars to proper position. He places heavy crossbeams (bunks), on which the logs rest, on the log cars and marks the ends of loaded logs by striking them with a branding hammer (Marker I).

TIMBER TRIMMER (BUTTING SAWYER; BUTTON SAWYER; BUTT-SAW operator; BUTT SAWYER; CUT-OFF MAN; CUT-UP SAWYER): The operator of a power-driven drag-saw located in a mill, on a dock, or on a ramp, used to square the ends of timbers or to cut them into shorter standard lengths.

TOGGLE KNOCKER: A laborer who hits toggle hook with a maul or unfastens it by hand to free the binding chains holding logs in position on a railroad car when the logs are to be unloaded.

TONGS HOOKER I (HOOKER; HOOK-ON MAN; ROPER; RUN BACK; TONGER; TONGSMAN;

TONGS SETTER): A laborer who fastens cables or tongs (similar to ice tongs) securely and safely before skidding or loading, maneuvering the log into position with a peavey. He controls the speed of log during skidding by signals to the Loader Engineer or Skidder Leverman.

TONGS UNHOOKER (LANDING CHASER): A laborer who unhooks the tongs, chokers, or other rigging devices from logs as they are skidded into the landing or yard. He hooks the detached cable to a horse or mule to be returned to woods (Rider) if the cable is not returned to the woods by power from the skidding engine. He may transmit signals from the Tongs Hooker I in the woods to the Skidder Leverman (Signalman).

TOP LOADER II (LOG STOWER; SKY HOOKER): A worker who stands on top of a railroad car, truck, or other vehicle and places logs as they are hoisted into correct position to form an evenly balanced load. He unhooks the cable or other rigging devices when log is placed, and moves log into final position with a peavey.

TOWER SKIDDER: Usually a tall iron framework with hoisting engines and drums mounted on wheels. It serves in the place of the head spar, loading boom and other head equipment in a skidder system of yarding.

TRACTOR: A self-propelled power unit, used for handling logs. Usually designed with a crawling or caterpillar movement and called a "cat".

TRAILER STEERER (LOG-DRIVER HELPER; TRAILER MONKEY; TRAILER-TRUCK-DRIVER HELPER): A worker who steers a trailer attached to a log truck driven by a Log-Truck Driver. He assists in loading and unloading logs and fastening chains around the logs on trucks.

TREE JACK: or Skyline Jack - A block, somewhat triangular in shape, with from one to six steel rollers or sheaves near the bottom. It is usually attached to a tail spar tree as a guide for the skyline.

TREE PLATES: Strips of strap or band iron placed vertically around the sides of a spar tree to prevent the guylines from cutting into the tree.

TREE SHOE: A semi-circular device used to support lines at a head or tail spar tree. Usually constructed with heavy metallic sides and lined with a wooden shoe. Commonly used in several yarding systems.

TRIP LINE BLOCK: or Haulback block - A guiding block for haulback service. Generally fixed near the outer end of a yarding system.

TRUCK DRIVER-LOGGING: A worker who uses a log truck to haul logs (a two-wheeled trailer with a long tongue and regular truck), and aids in loading and unloading logs and fastening chains around logs on a truck.

TURN: One or more logs hauled at one trip by a cat or donkey main line.

TYLER SYSTEM: One in which the logs are yarded and conveyed from the

TWISTER: The colloquial word for Boss.

U

UKELELE HOOK-UP The use of a secondary donkey operated as a slackline unit.

V

VINE MAPLE: A small tree which takes root easily, and forms dense underbrush, with the main stems often lying along the ground.

W

WALKING BOSS: A foreman who travels (walks) between the various groups of workmen in the woods.

WANE: The bark, or place where the bark was formerly attached, on the edge of a piece of lumber.

WATCHMAN, SKIDDER: A logging skidder guard who cleans, and oils machinery parts. He washes the boiler using a hose, and prepares skidder for operating crew by firing boiler and starting gas-driven water pump.

WATER HAULER, TRUCK DRIVER: A driver who hauls water in tanks from source of supply to a logging camp when camp is located at a distance from the supply source.

WOOD BUCKER (FUEL MAN; WOOD BOY; WOOD CHOPPER; WOOD CUTTER; WOOD GETTER; WOODMAN; WOOD SAWYER; WOOD SPLITTER): A laborer who chops, saws, and splits wood with an ax and saw and carries it for use at the camp or in donkey engines.

WOOD CHOPPER II (CORDWOOD CUTTER; PUMPWOOD CUTTER): A worker that prepares marketable firewood in the forest by sawing or chopping down trees with a crosscut saw and ax, saws the tree into suitable log lengths, splits logs with an ax and wedges, and stacks split wood in neat ricks or cords.

WOODSMAN: A foreman who supervises Stock Cutters, Teamsters, and Truck Drivers. He designates trees to be felled and order of skidding. He keeps a record of logs hauled by Truck Drivers.

The general term given to a worker engaged in lumbering or related forest activities, such as blasting, chopping, sawing, pulling, and moving logs and stumps, or gathering resin on a turpentine farm.

Y

YARD BANKER: A laborer who piles logs at a landing, yard, or storage point, rolling and maneuvering the logs into position with a cant hook or peavey.

YARDER: or Yarding Donkey - A donkey engine mounted on a sled and used to haul logs from the cutting area to the landing. The yarder, as such, is used only for short-distance hauling.

YARDER ENGINEER (YARDER PUNCHER): A worker who operates the yarder engine used in skidding logs from the forest to the yard.

YARDING: That part of a logging operation which brings the logs from scattered falling and bucking, or cutting areas, to a common point, or yard, ready to be loaded, or decked.

APPENDIX F

GRAPHIC PRESENTATION OF LOGGING OPERATIONS

This appendix has been prepared to show representative steps within the logging sequence. It has been prepared for use independently from the other portions of this report. However, it has been organized in parallel with the descriptions presented in Appendix A.

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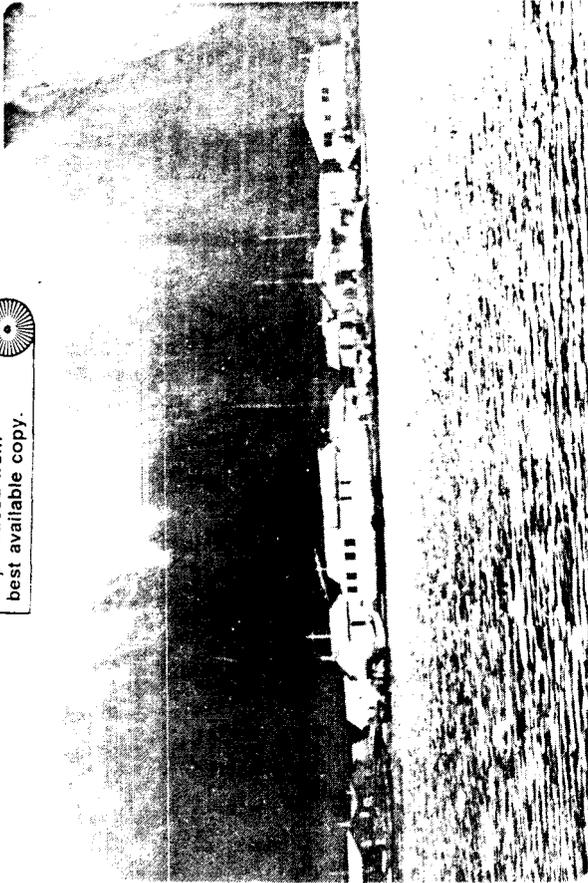


Plate F-1. Logging Camp Constructed on a Log Raft.

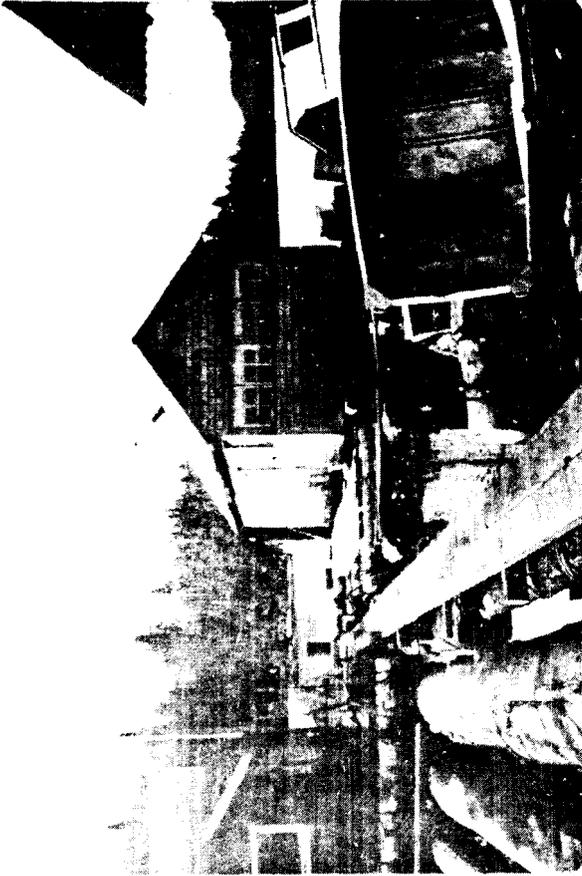


Plate F-2. Structure of Logging Camp Built on a Log Raft.



Plate F-3. Logging Road Through Forest.



Plate F-4. Skidding Road at Logging Site.



Plate F-5. Southern Logging Truck Mired in Mud.

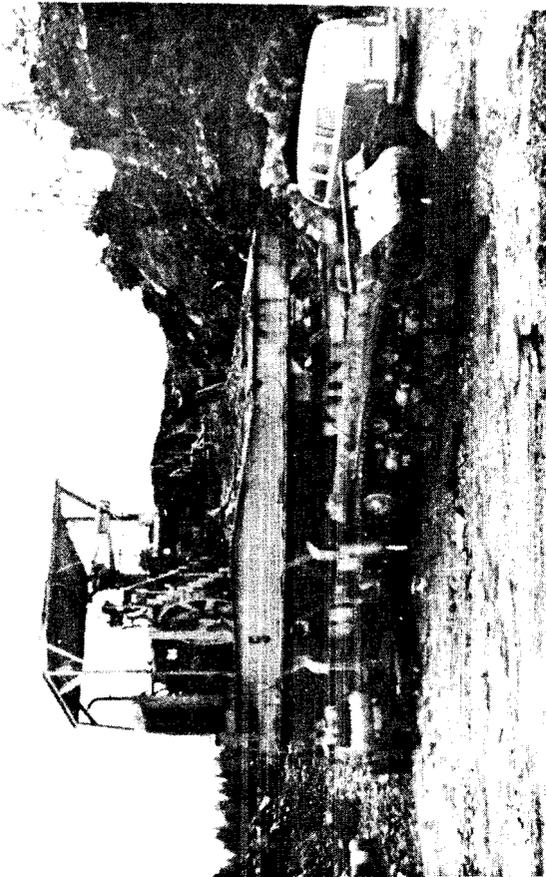


Plate F-6. Rock Crushing Machine for Producing Logging Road Gravel.

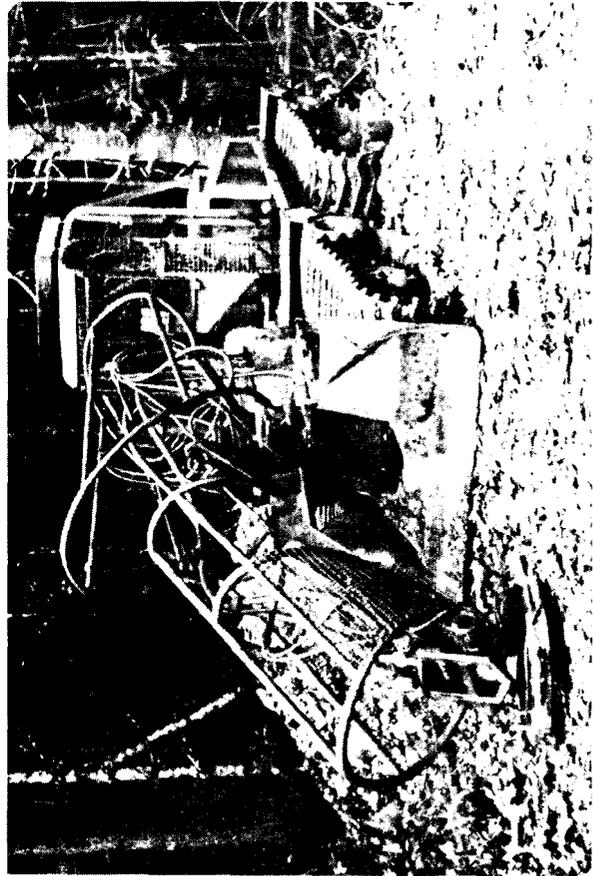


Plate F-7 Stump Grinding Machine.

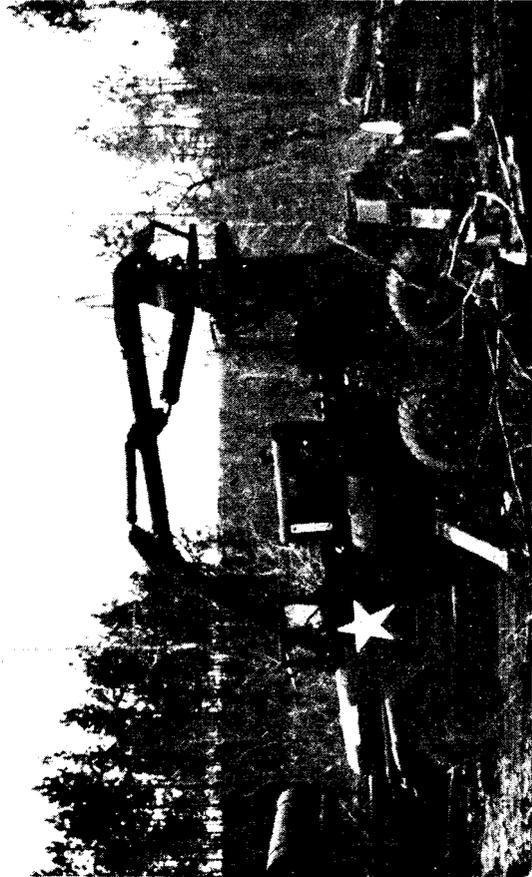


Plate F-8. Equipment Adaptation for Log Loading Operation.

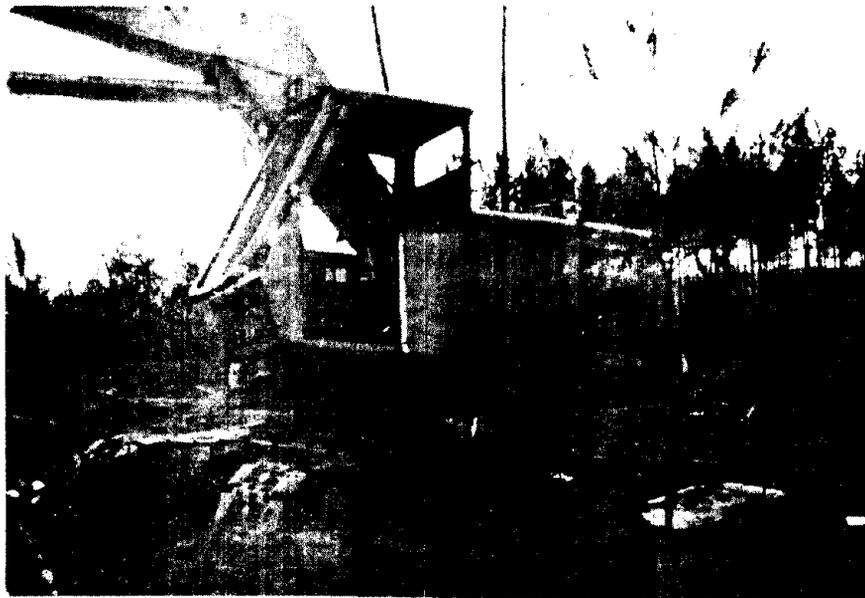


Plate F-9. Tree Harvester Damaged after Over Turning.



Plate F-10. Ladder Fabricated to Meet Intent of OSHA Standard.

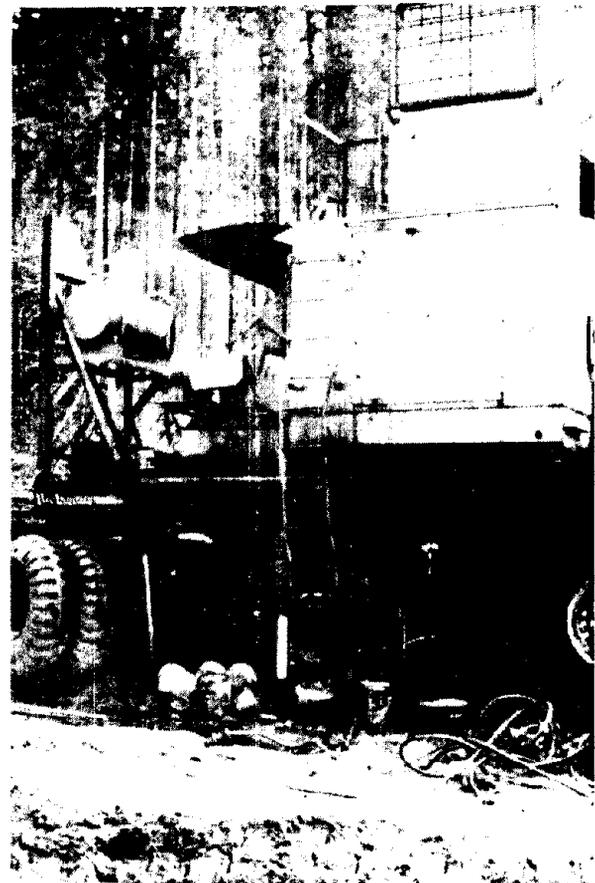


Plate F-11. Machine-Mounted Ladder.



Plate F-12. On-site Repair of Damaged Equipment.

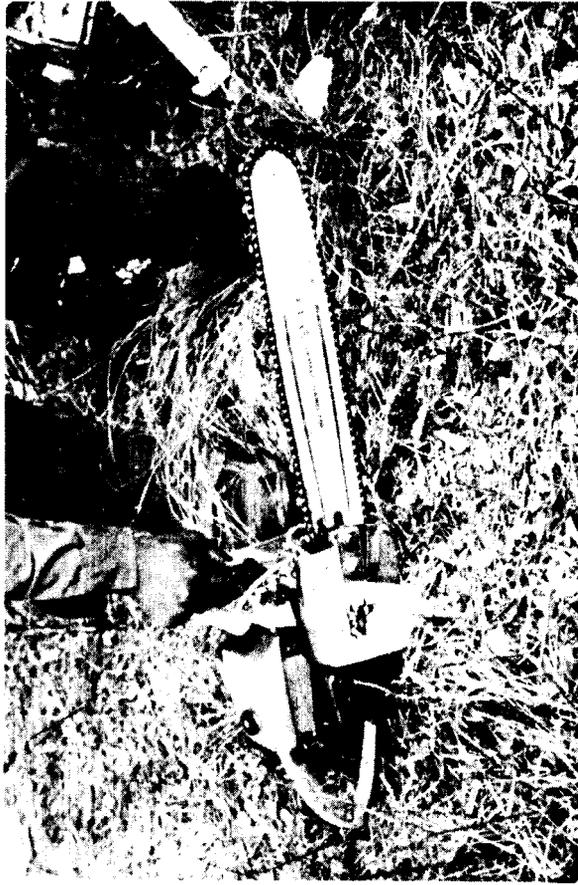


Plate F-13. Typical Configuration of Chain Saw.



Plate F-14. Bow Saw Used Extensively in Southern Forests.



Plate F-15. Felling a Tree Using
Body Leverage to Control
Direction of Fall.



Plate F-17. Feller Endangered by Not
Using Escape Route.



Plate F-16. Feller Endangered by Working Under
Lodged Tree.



Plate F-19. Indication of Trees Being Felled in Several Directions.



Plate F-20. Tree Felling Using a Bow Saw.

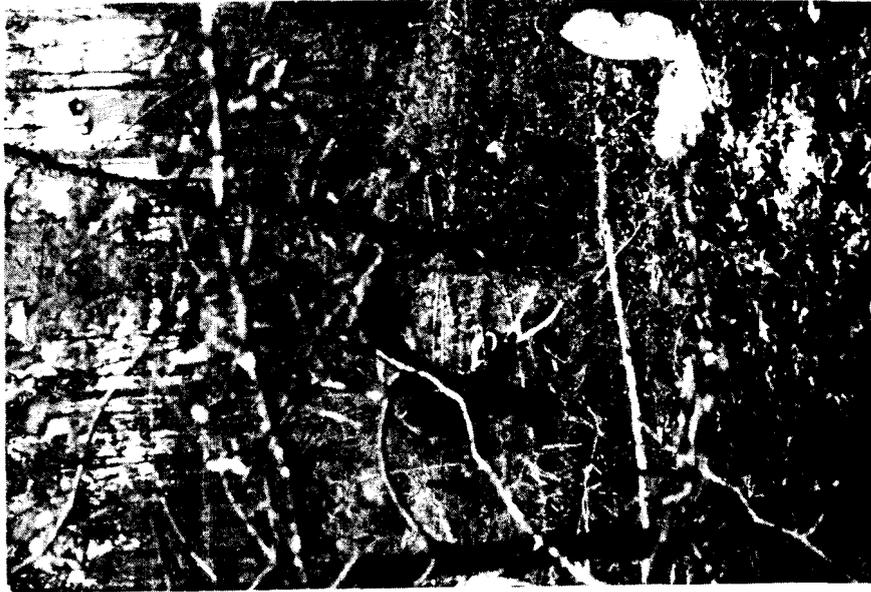


Plate F-18. Tree Stump Showing Evidence of Under-Cutting.



Plate F-21. Cutting Blade of a Harvesting Machine.



Plate F-22. Tree Holding Device for a Harvesting Machine.



Plate F-23. Typical Cut Pattern for a Harvesting Machine.



Plate F-25. Tree Blowdown Showing Unfelled Snags.



Plate F-26. Fellers Examining a Snag Prior to Felling.

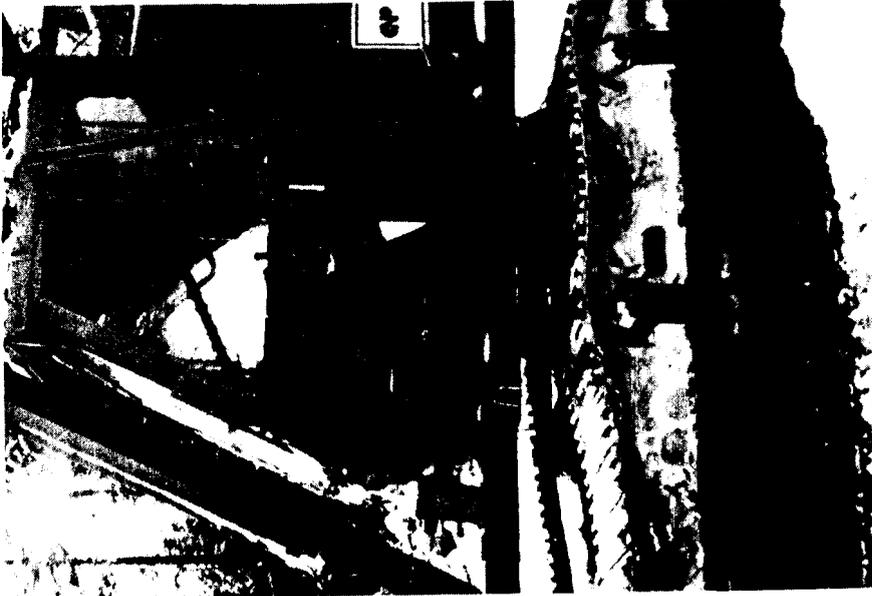


Plate F-24. Harvesting Machine Track and Operator Station.

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Plate F-28. Tree Stump Showing Notches Left by Spring Board Irons.

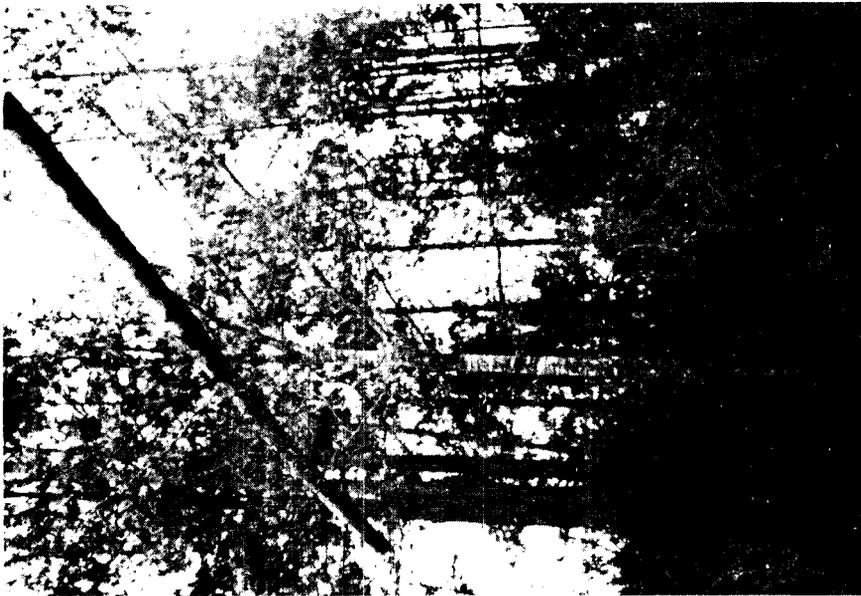


Plate F-27. Broken Tree Segment Suspended from Other Trees.



Plate F-29. Logger Walking Along Top of Felled Tree While Measuring Lengths for Bucking.



Plate F-30. Limbing and Bucking of Felled Tree.



Plate F-31. Limbing of Felled Tree.



Plate F-32. Limbing of Felled Tree.



Plate F-35. Bucking Prior to Limbing.



Plate F-34. Use of Axe in Limbing Task.



Plate F-33. Bucking of Felled Tree.



Plate F-36. Bucking and Limbing at Landing Area.



Plate F-38. Bucking in Loading Area.



Plate F-37. Bucking at Skyline Landing Area.



Plate F-40. Bucking Unstabilized Logs Decked at Landing.



Plate F-41. Simultaneous Bucking and Log Transportation Operation.



Plate F-39. Bucking in Skidder Landing Area.

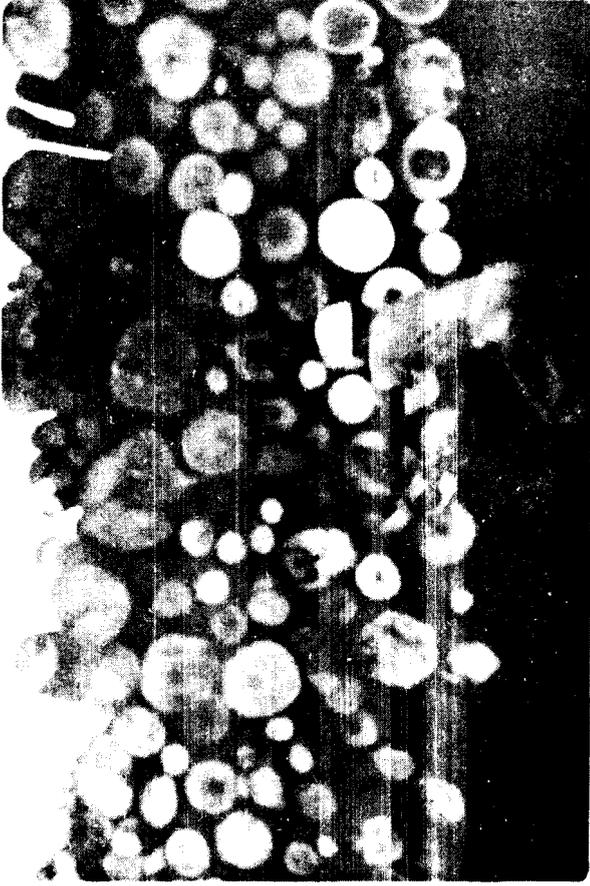


Plate F-43 Bucking Logs Decked on a Train Car.

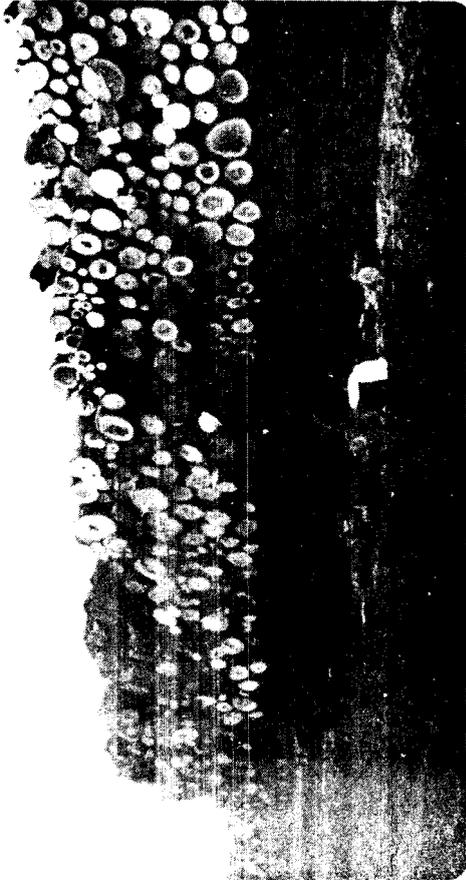


Plate F-42. Bucking Logs Load on a Train Car.

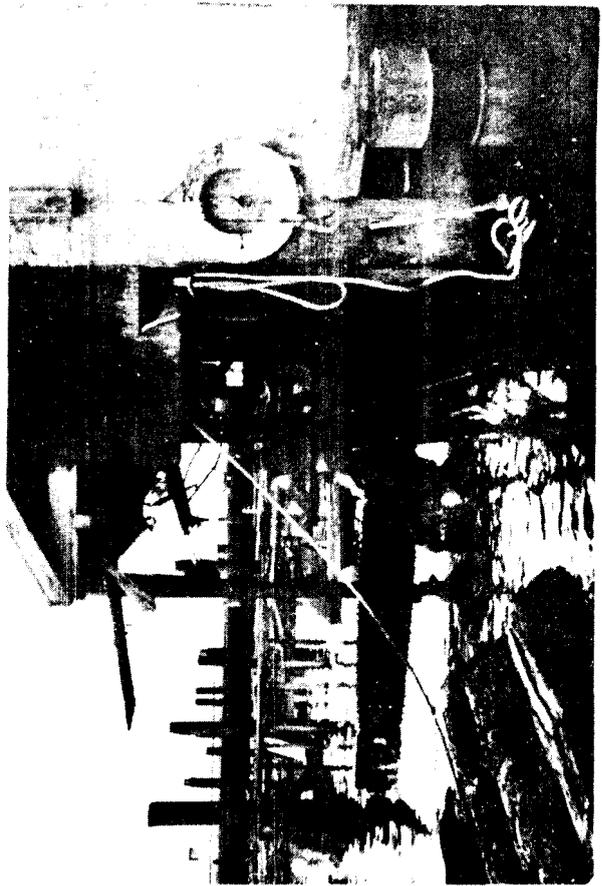


Plate F-45. Bucking Logs in a Mill Pond.

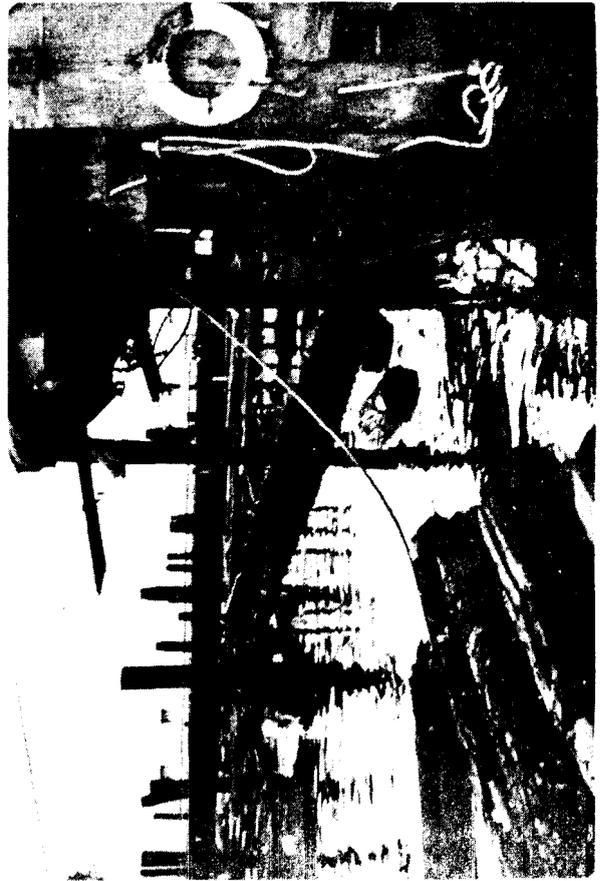


Plate F-44. Bucking Logs in a Mill Pond.

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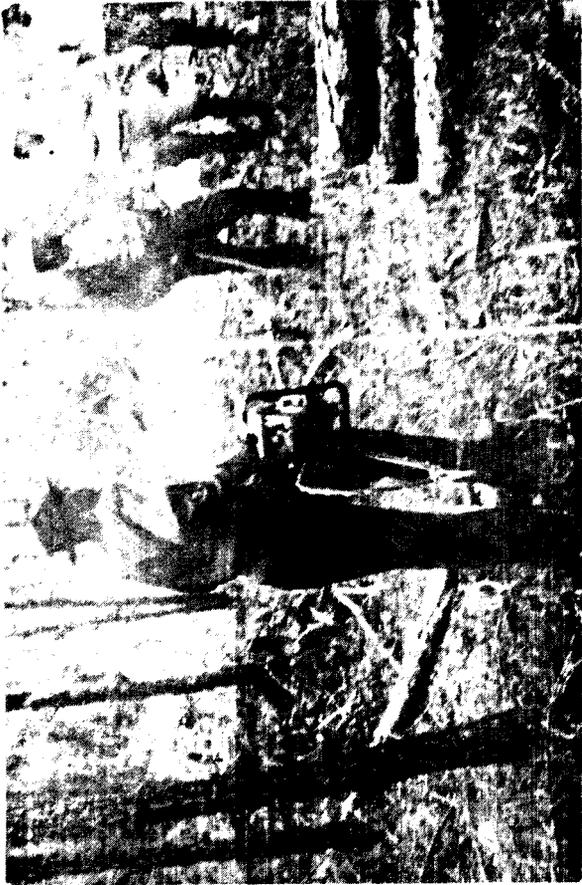


Plate F-46. Saw Orientation for Commonly Accepted Method of Carriage.

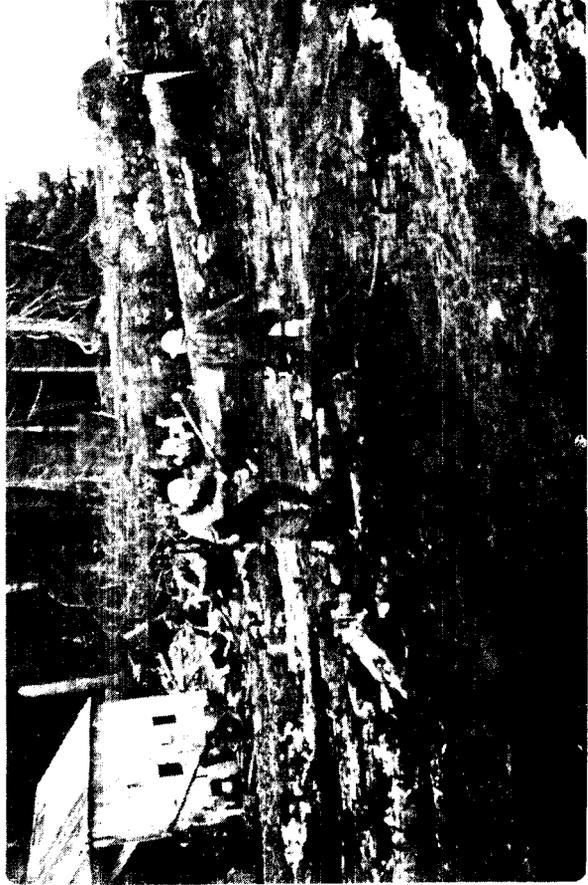


Plate F-47. Alternate Method of Saw Carriage with Chain and Bow Pointed Forward; Marking of Logs.



Plate F-48. Alternate Method of Saw Carriage with Saw Held Across Body.



Plate F-49. Refueling of Chain Saw; Use of Ear Muffs for Ear Protection.



Plate F-51. Grapple Skidder Used for Log Transportation in Forest.



Plate F-50. Log Transportation in Forest with Wheeled Skidder.



Plate F-53. Use of Cat to Clear Skidding Road.



Plate F-54. Delivery of Logs to Deck at Landing.

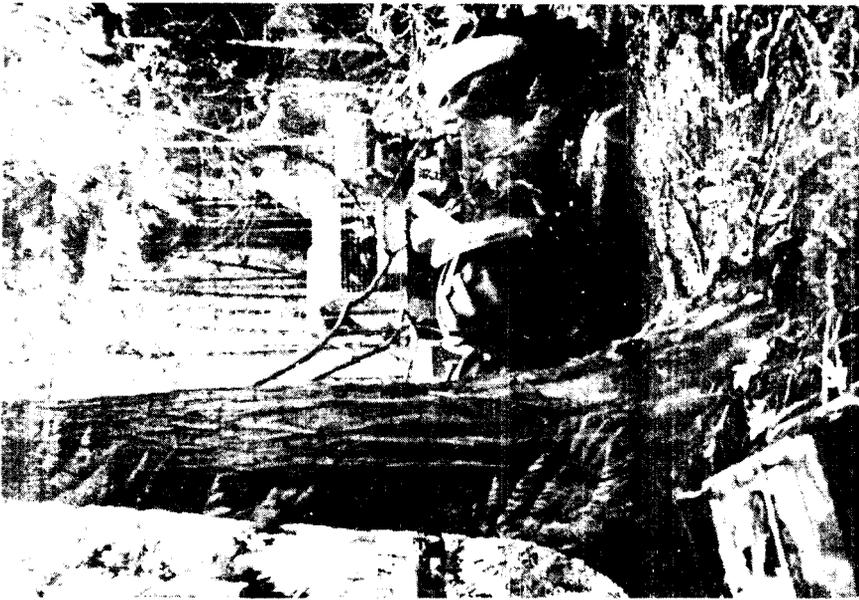


Plate F-52. Wheeled Skidders Operating on Narrow Skidding Road.

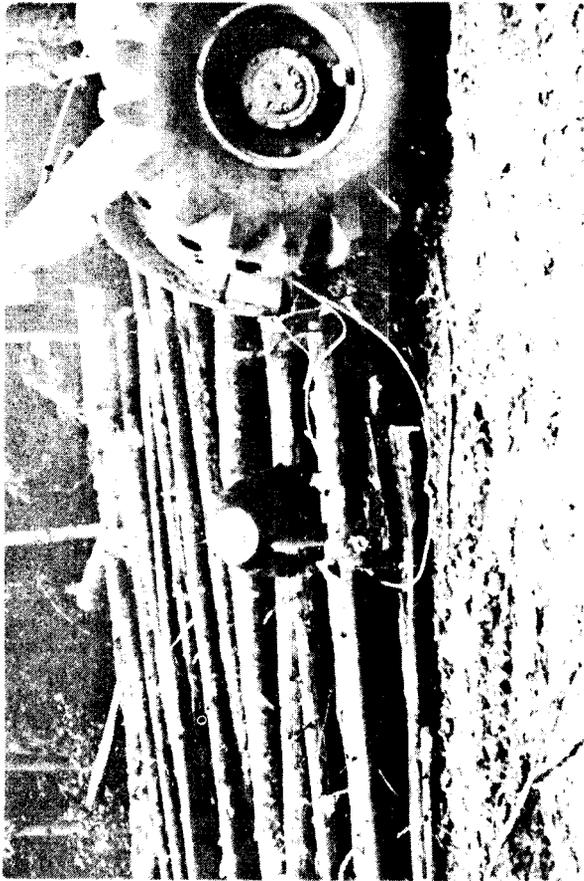


Plate F-55. Removal of Cables from Logs.

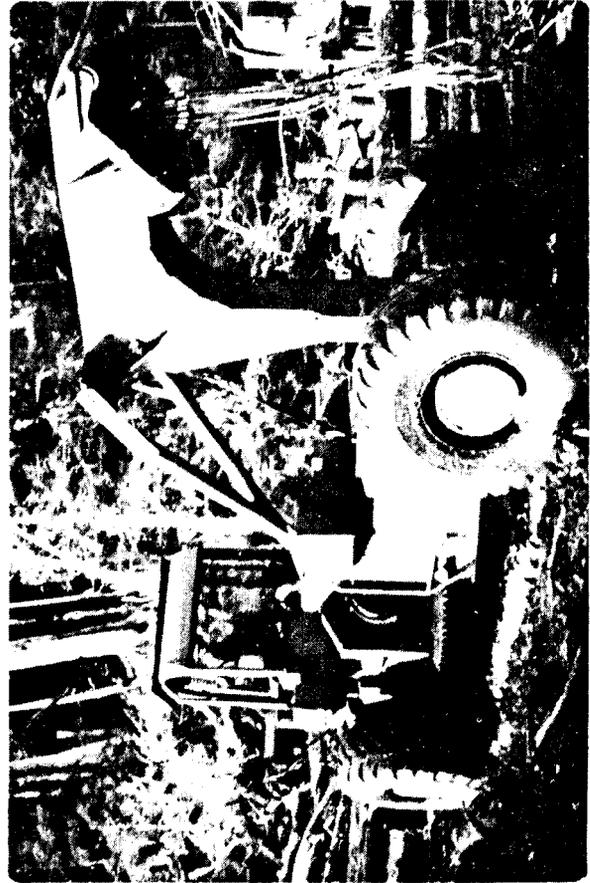


Plate F-57. Rubber-Tired Skidder Showing Choker Cables.

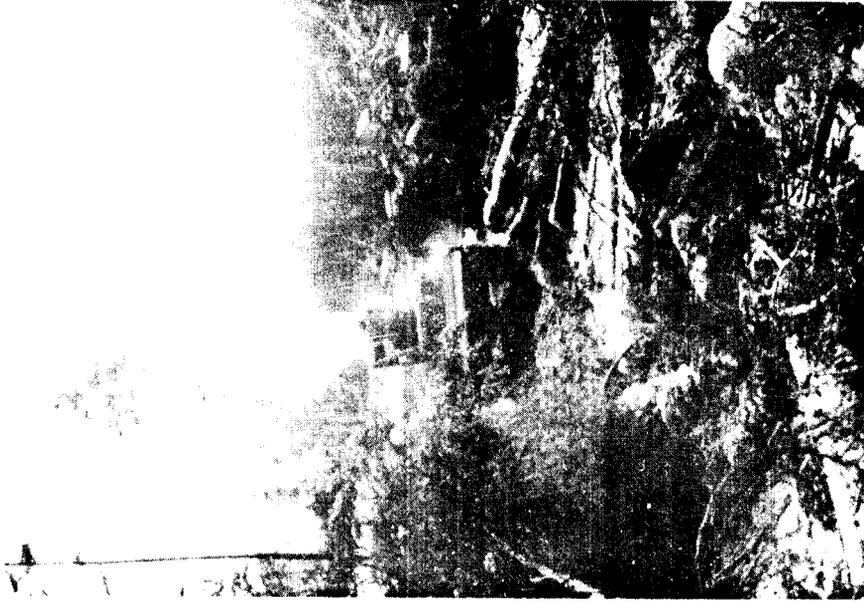


Plate F-56. Operation of Skidder
Over Log Strewn Trail.



Plate F-58. Track-type Skidder Showing Winch and Cable.



Plate F-59. Visibility Afforded to Skidder Operator.

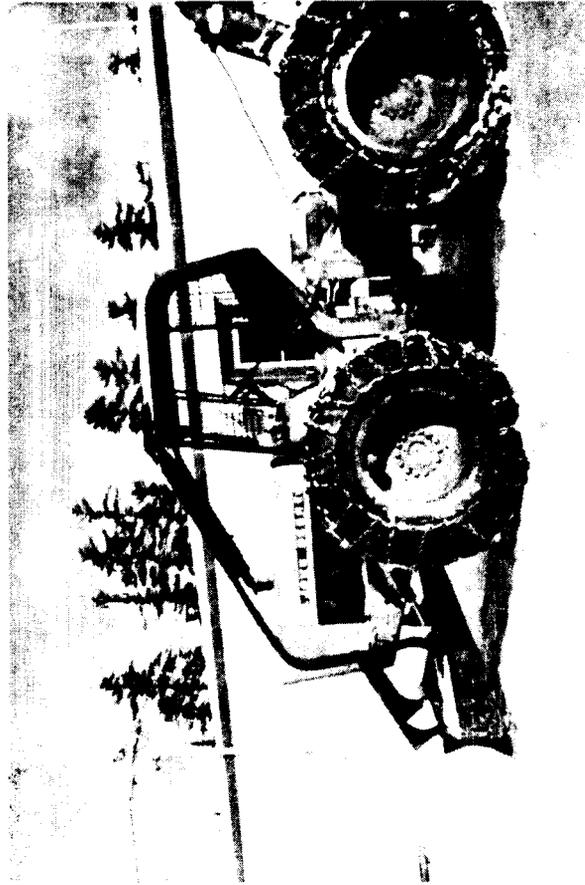


Plate F-60. Skidder Equipped for Alternative Use as Snow Plow.



Plate F-61. Tower (Spar) Installation for Yarding Logs to Landing.



Plate F-62. Cable Rigging Installation. Plate F-63. Tower Rigging Installation.



Plate F-64. A-Frame Installation on Raft; Logs are Yarded into Water.

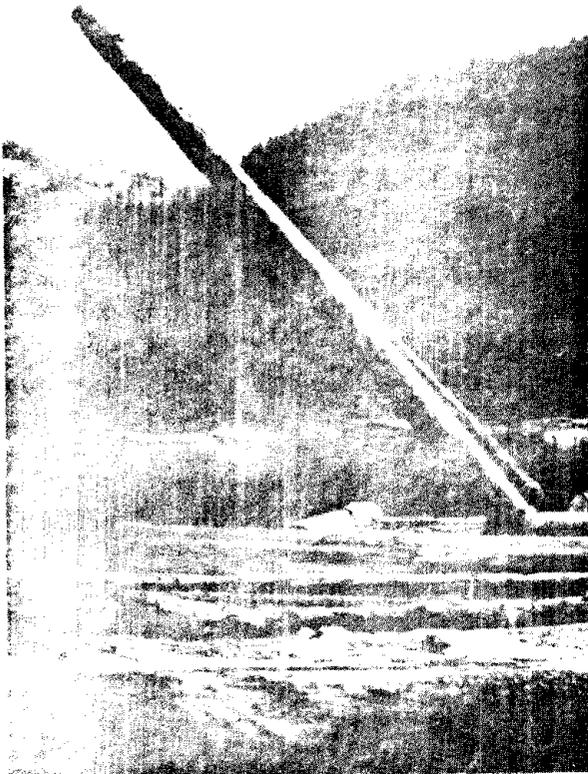


Plate F-65. A-Frame.



Plate F-67. Chaser Running to Release Choker Cables from Turn of Logs. (Note: hydraulically actuated load leveller on donkey engine vehicle.)



Plate F-66. Use of Stump for Cable Installation to Stabilize Spar Tower.



Plate F-69. Choker Setters.

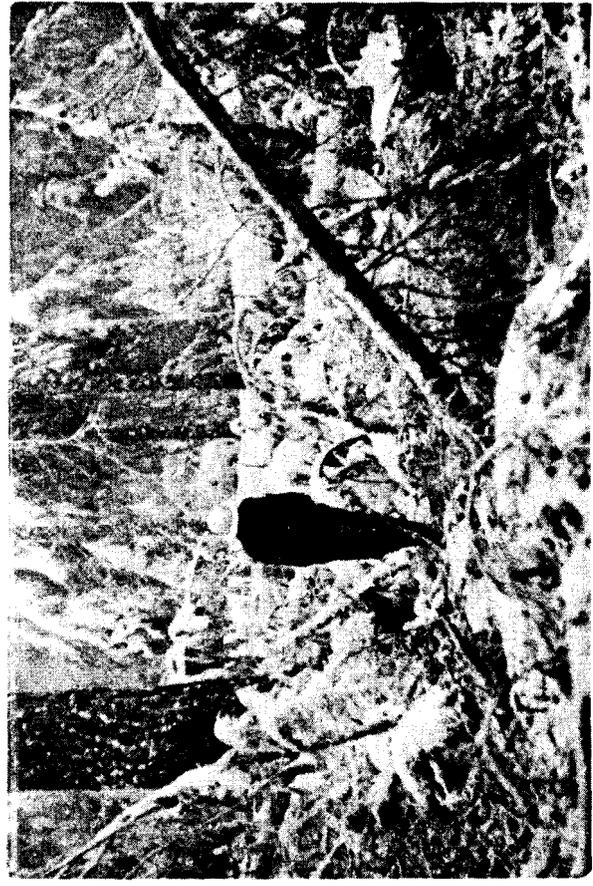


Plate F-71. Choker Setters Working in Snow Storm.



Plate F-68. Choker Setting Operation for High Lead Skidding.



Plate F-70. Choker Setters Working in Snow Storm.

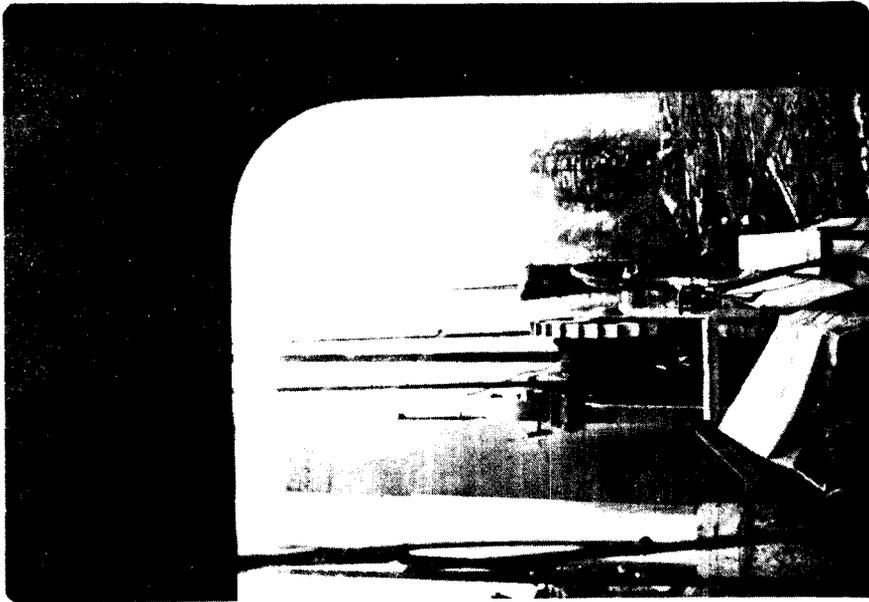


Plate F-72. Visibility Afforded to Donkey Engine Operator.



Plate F-73. Skyline Yarding of Log to Landing.

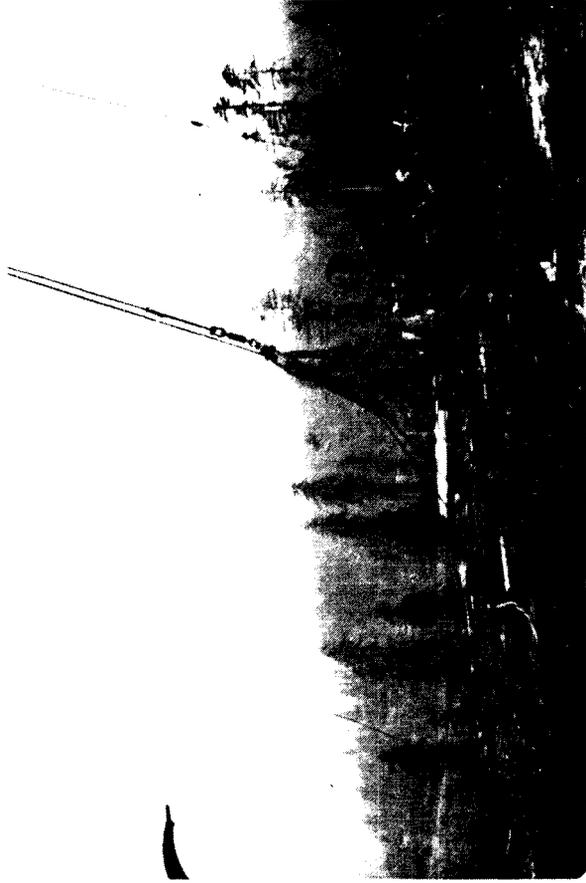


Plate F-74. Log Delivered to Landing.

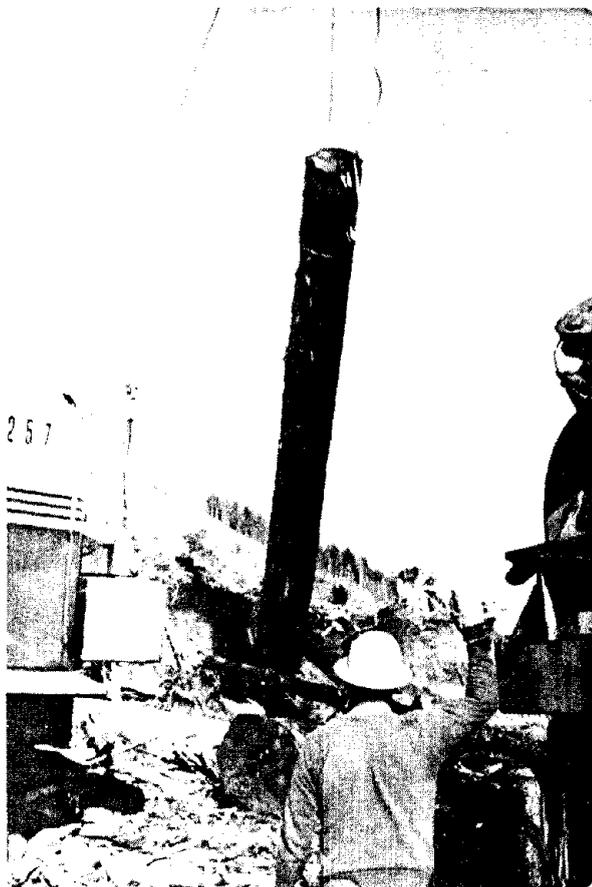


Plate F-75. Placement of Log at Landing (chaser signalling to operator).



Plate F-76. Chaser Unhooking Cable Around Log.

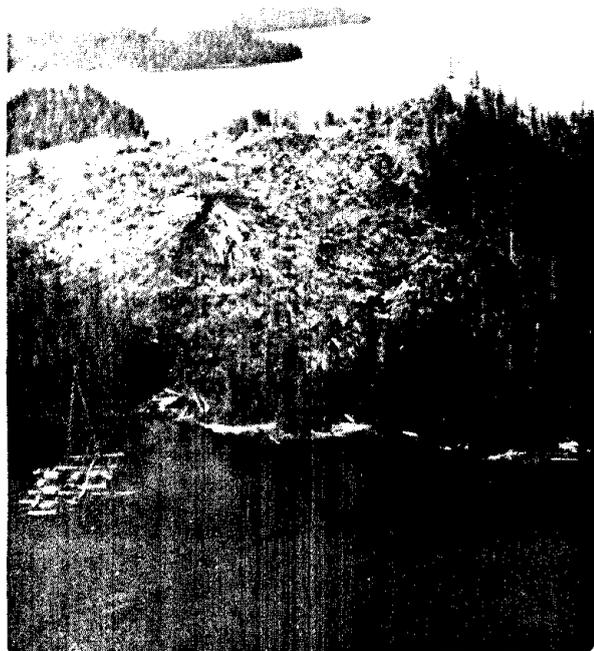


Plate F-77. Staging Process for Long Distance Cable Yarding.

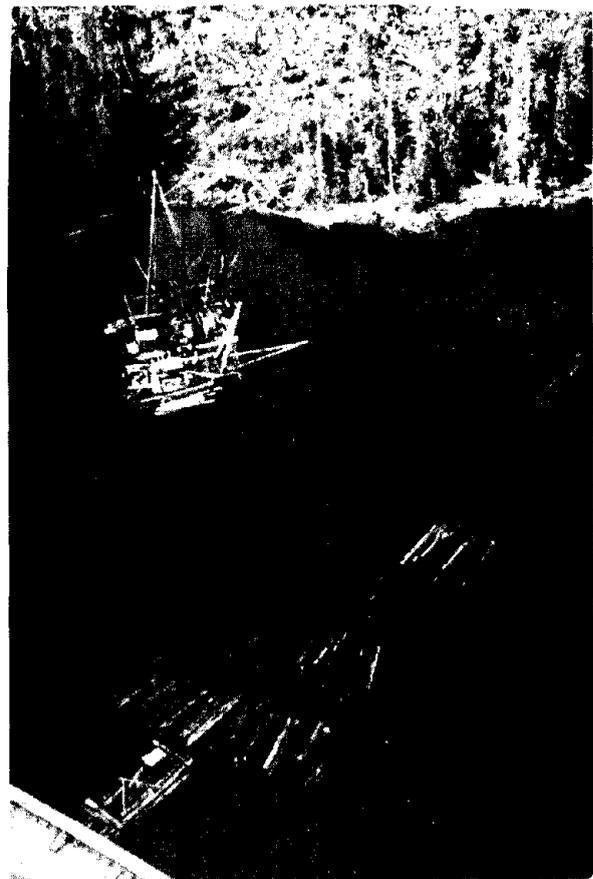


Plate F-78. A-Frame Used at Water Landing Area.



Plate F-79. Spar Tree Converted to Tail Spar Operation.



Plate F-80. Portable Cable Yarding Vehicle.

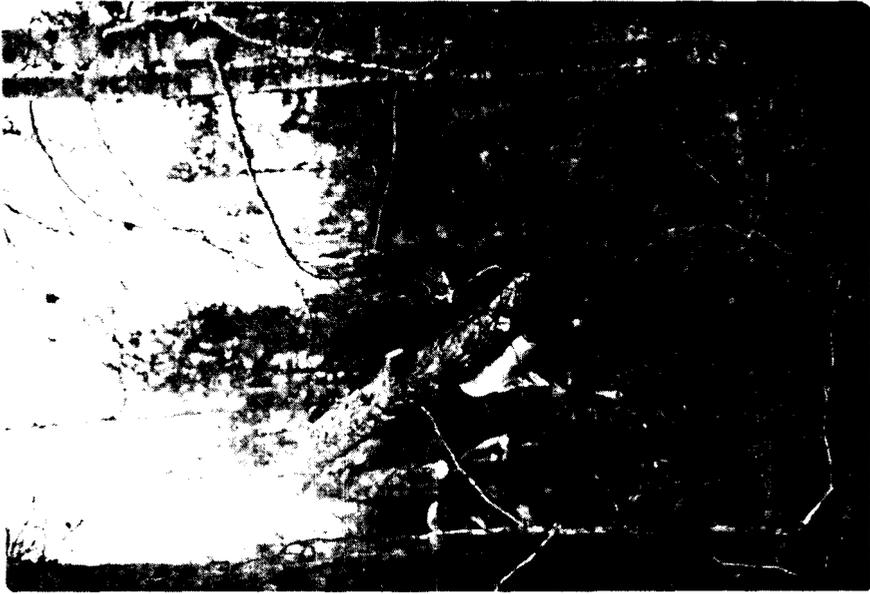


Plate F-81. Manual Transportation of Logs.



Plate F-83. Log Tong Used for Log Hauling.



Plate F-84. Log Fork Loader.



Plate F-82. Manual Transportation of
Logs.

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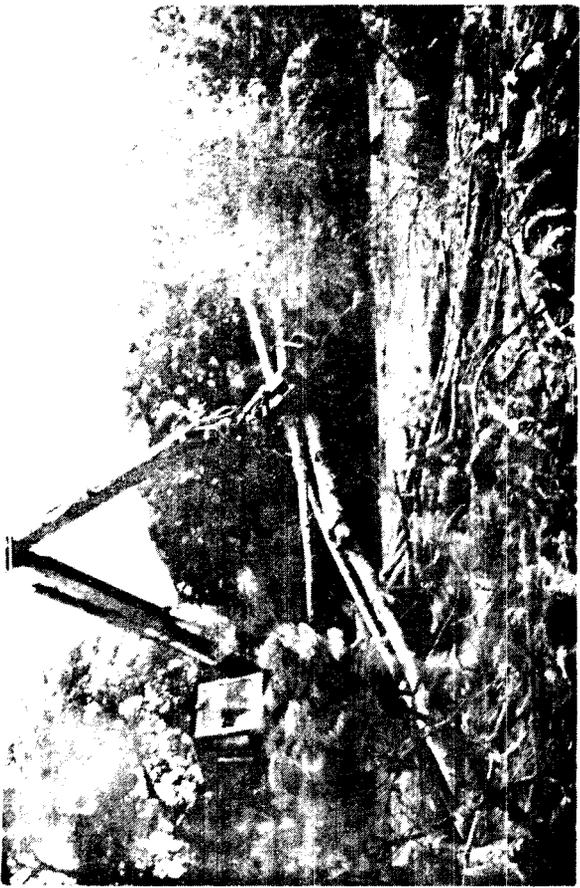


Plate F-85. Grapple Loader.

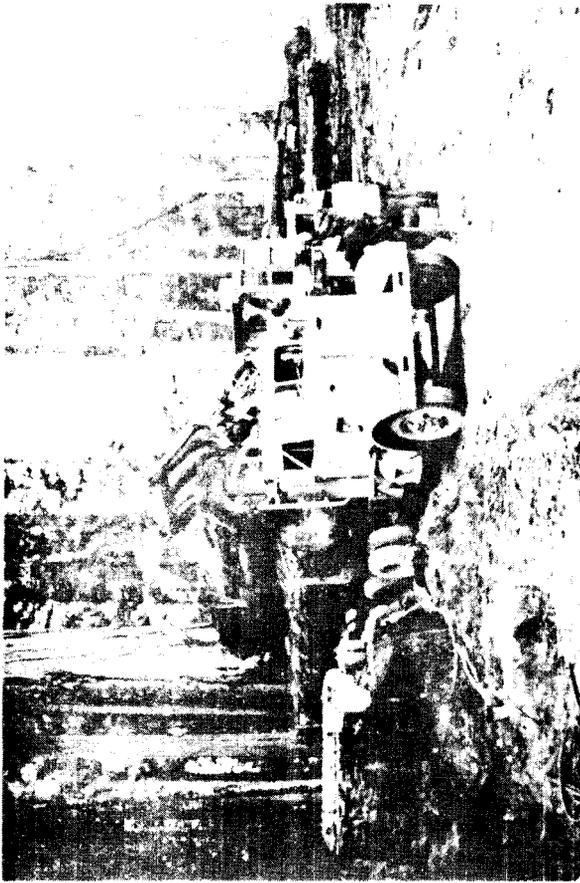


Plate F-86. Loading of Logging Truck.

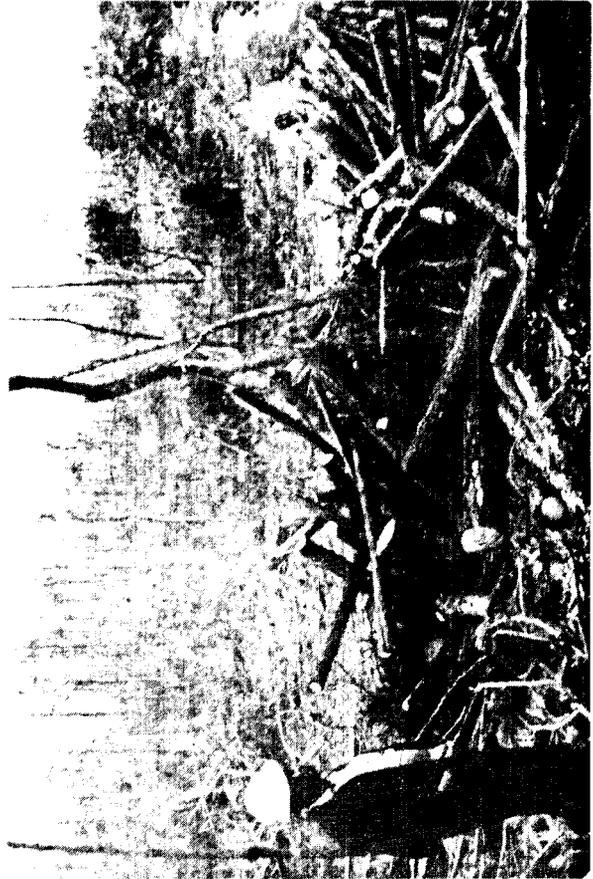


Plate F-87. Pulpwood Log Deck (not typical).



Plate F-88. Log Deck.



Plate F-89. Manual Loading of Pulpwood Logging Truck.



Plate F-91. Manual Positioning of Pulpwood Logs on Train.

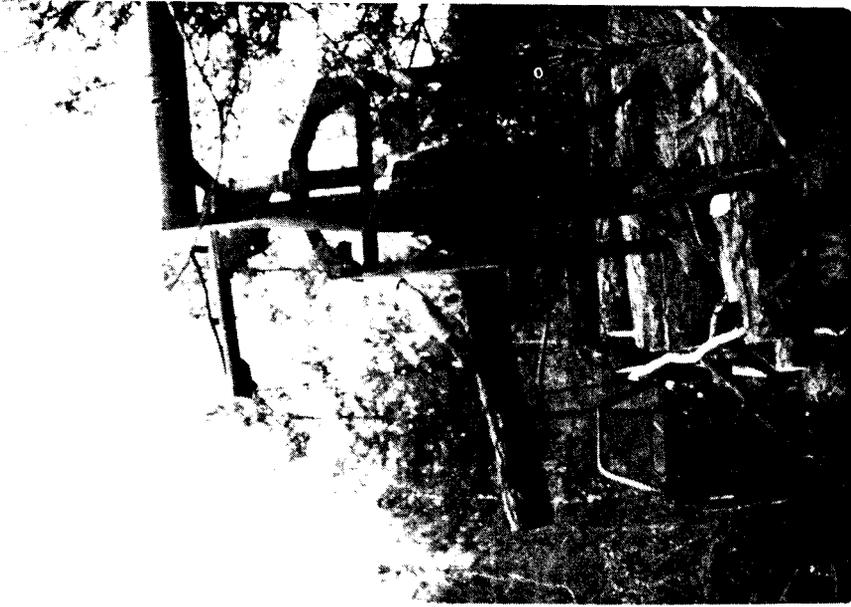


Plate F-90. Winch Used in Loading
Pulpwood Logging Truck.



Plate F-92. Logger Operating Winch From Atop Loaded Truck.

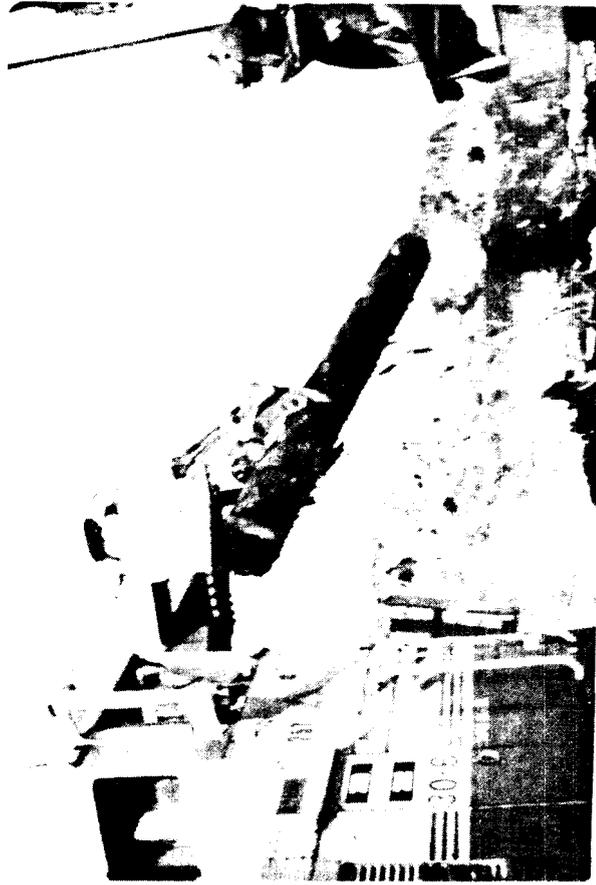


Plate F-93. Boom Loader in Operation at Cable Yarding Landing.



Plate F-94. Grapple Loader Mounted on Truck.



Plate F-95. Grapple Loader Mounted on Truck.



Plate F-96. Grapple Loader in Operation.



Plate F-97. Grapple Loader in Operation.

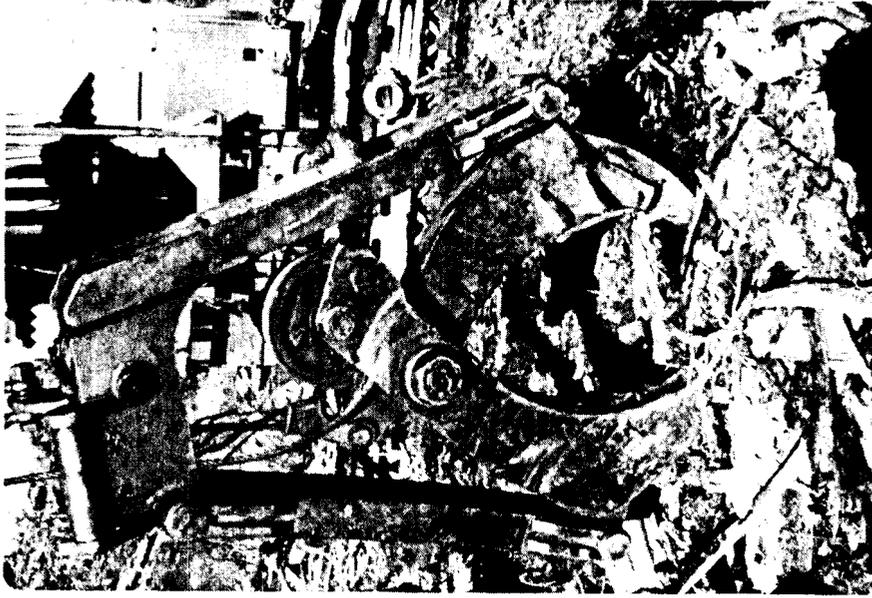


Plate F-98. Grapple Hook Used With Heel Boom Loader.

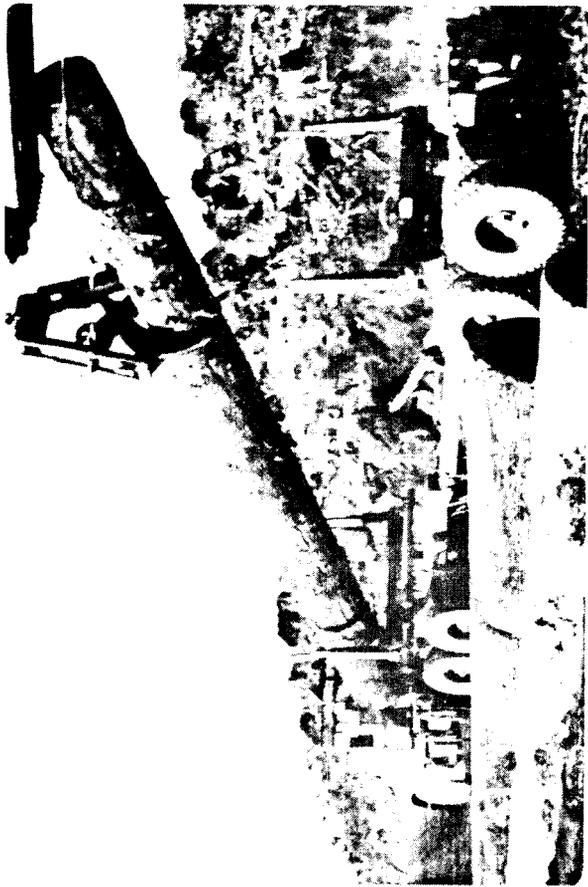


Plate F-100. Laying Log on Truck Bunk with Heel Boom Loader.

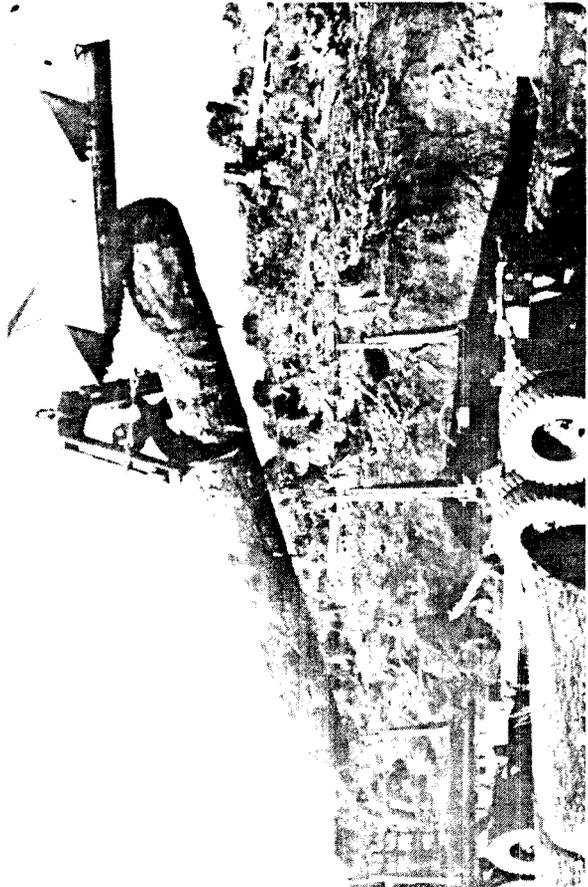


Plate F-99. Loading Truck with Heel Boom Loader.

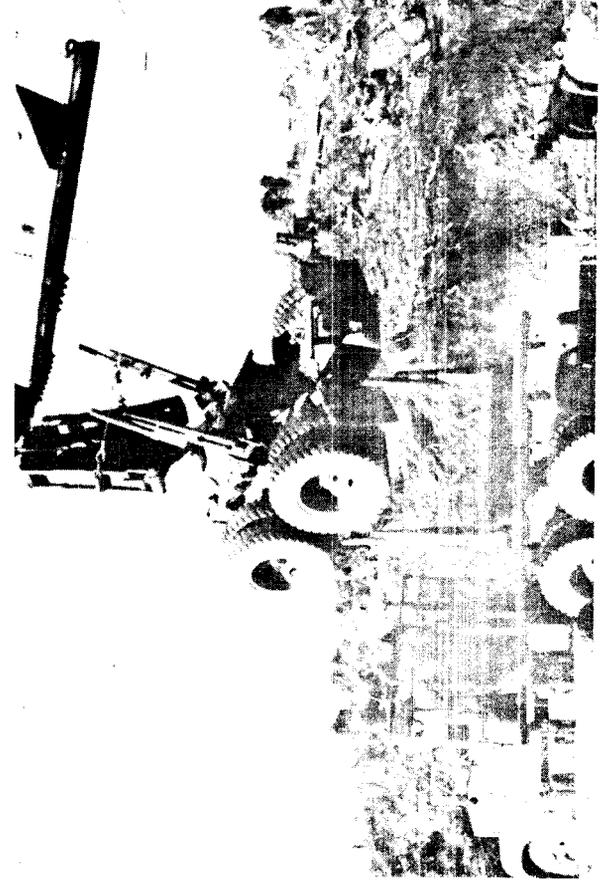


Plate F-102. Unloading Truck Trailer with Log Loader.

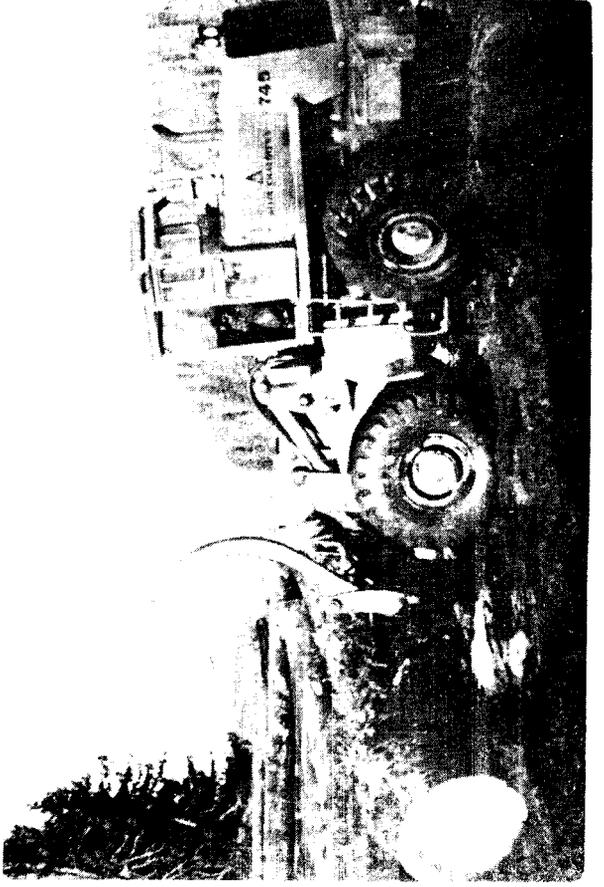


Plate F-101. Lifting Log with Fork Loader.

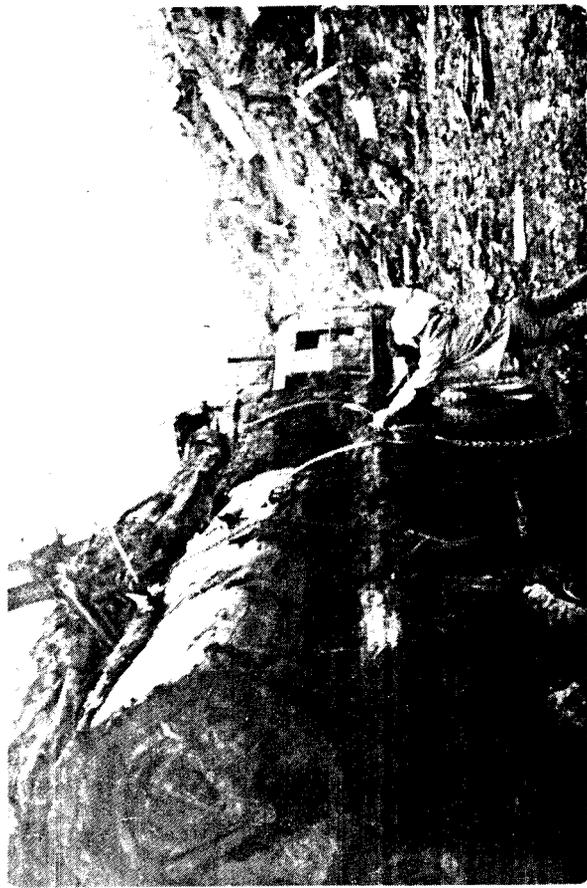


Plate F-103. Emplacing Binder Cable on Loaded Truck.



Plate F-105. Tightening Binder Cable Around Log Load.

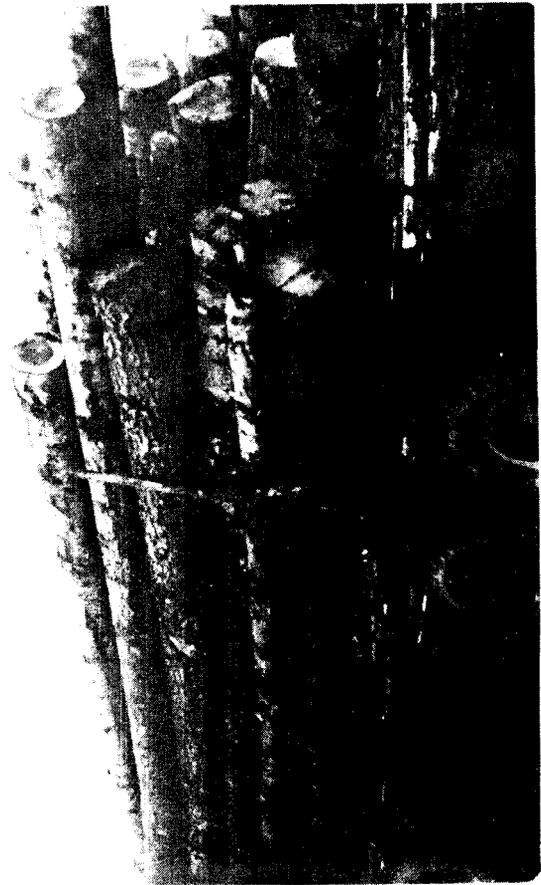


Plate F-104. Binder Emplaced Around Log Load.

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Plate F-106. Load Binder Chain.



Plate F-107. Unloading of Logs from
Truck.

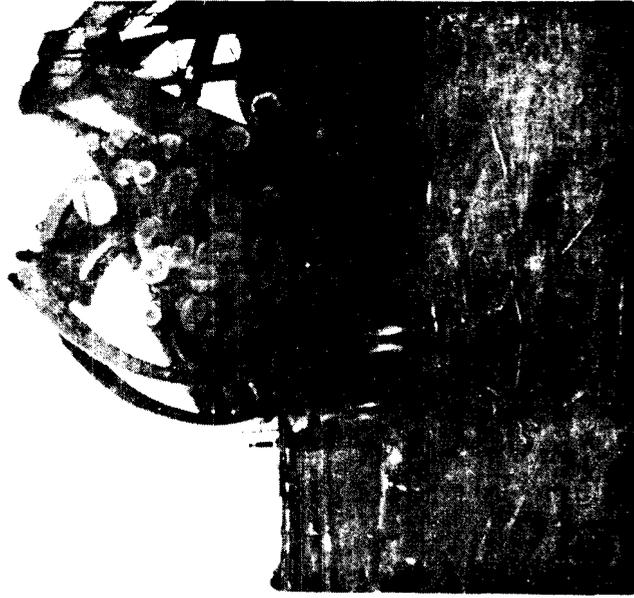


Plate F-108. Load Stabilization
During Binder Removal.



Plate F-109. Lifting Log Load from Truck.

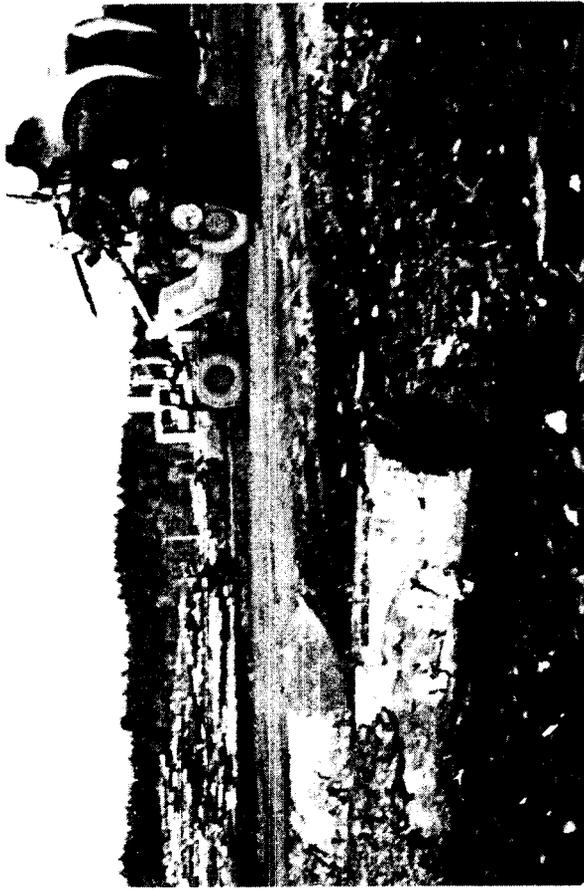


Plate F-110. Log Movement in Sorting Yard.



Plate F-111. Fork Loader Operation.

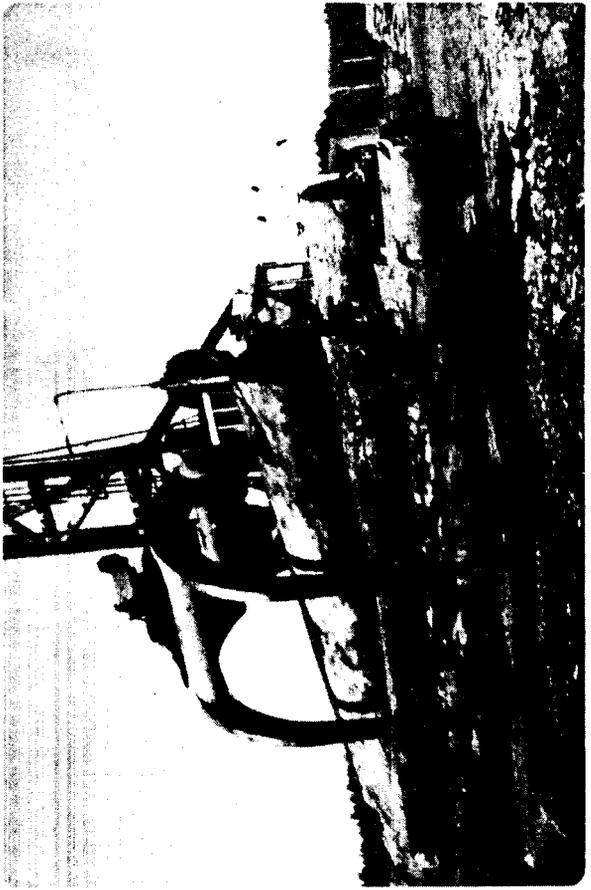


Plate F-112. Release of Logs from Fork Loader.

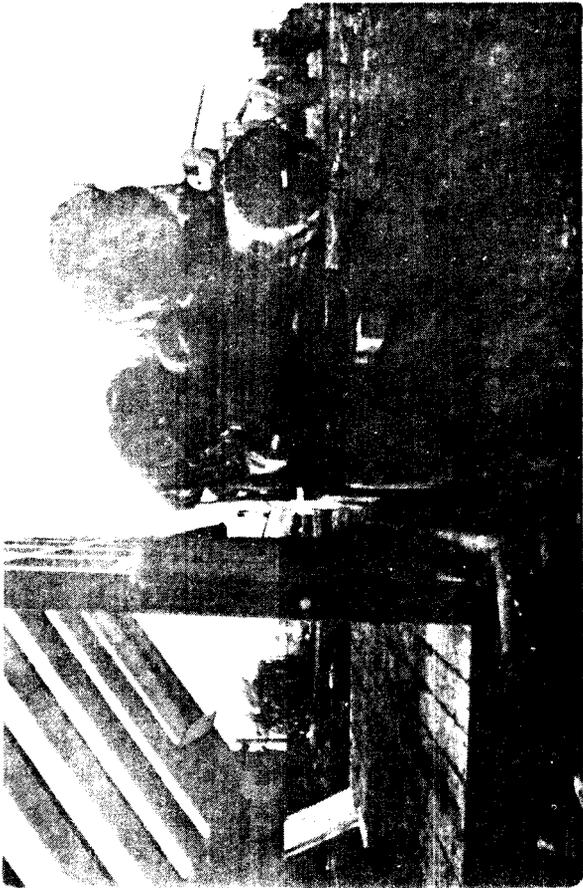


Plate F-113. Barrier Used to Protect Personnel During Binder Removal.

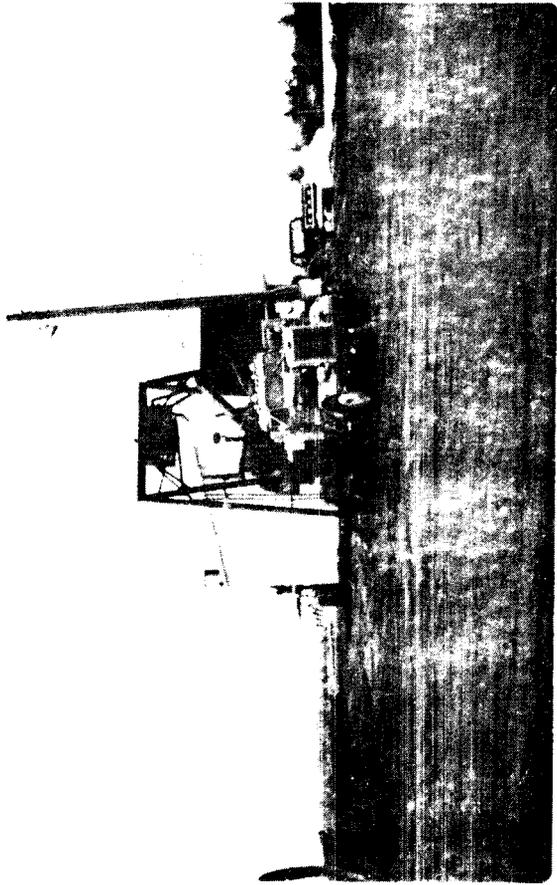


Plate F-114. Hoist Used for Placing Trailer on Truck Bunk.



Plate F-115. Log Sorting Chain.

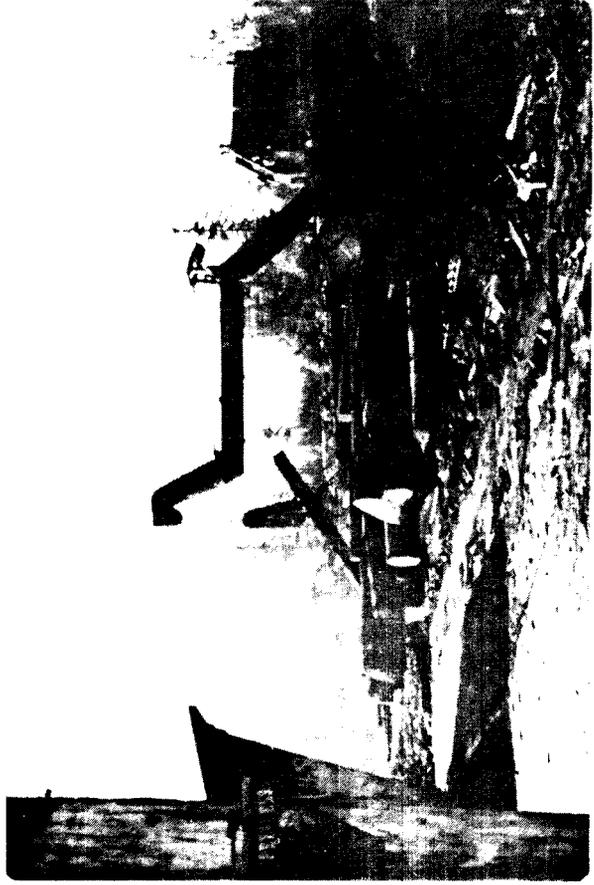


Plate F-116. Boom Loader Operation in Conjunction with Sorting Chain.

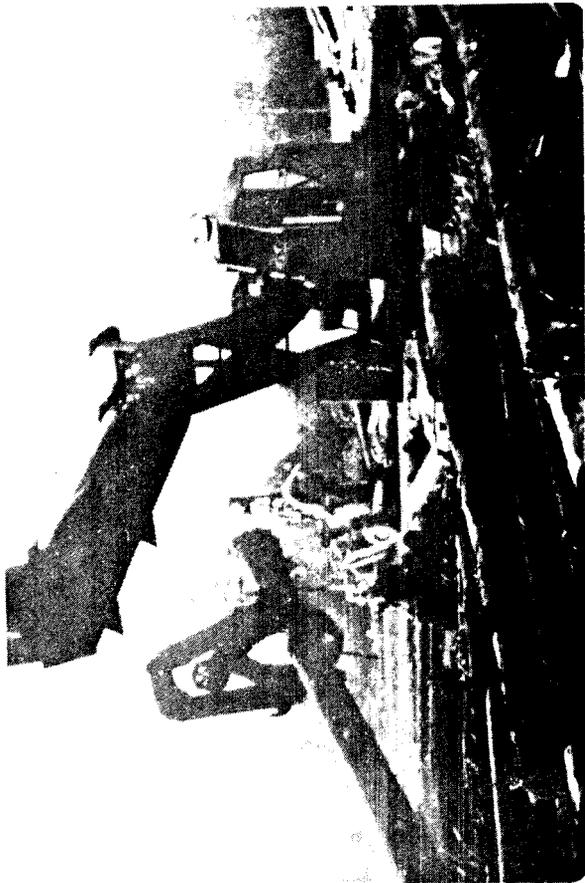


Plate F-117. Boom Loader Operation in Conjunction with Sorting Chain.

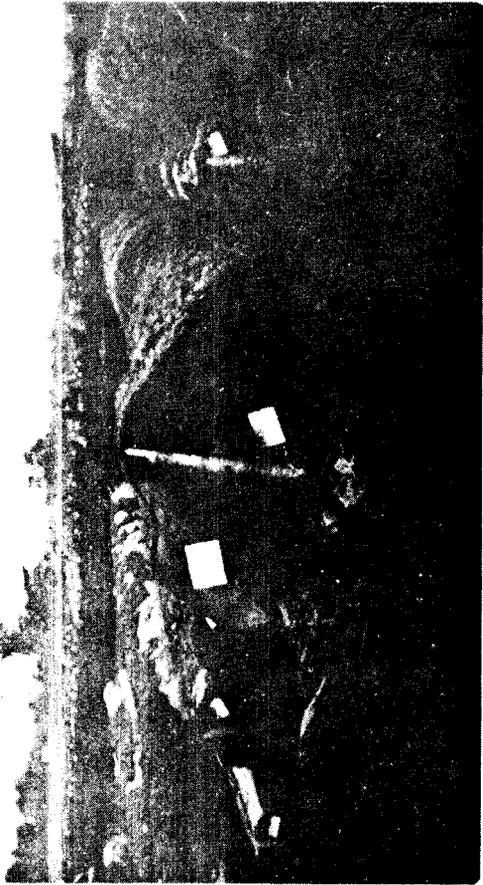


Plate F-118. Tagging of Logs for Ownership Identification.



Plate F-119. Log Scalers in Operation.

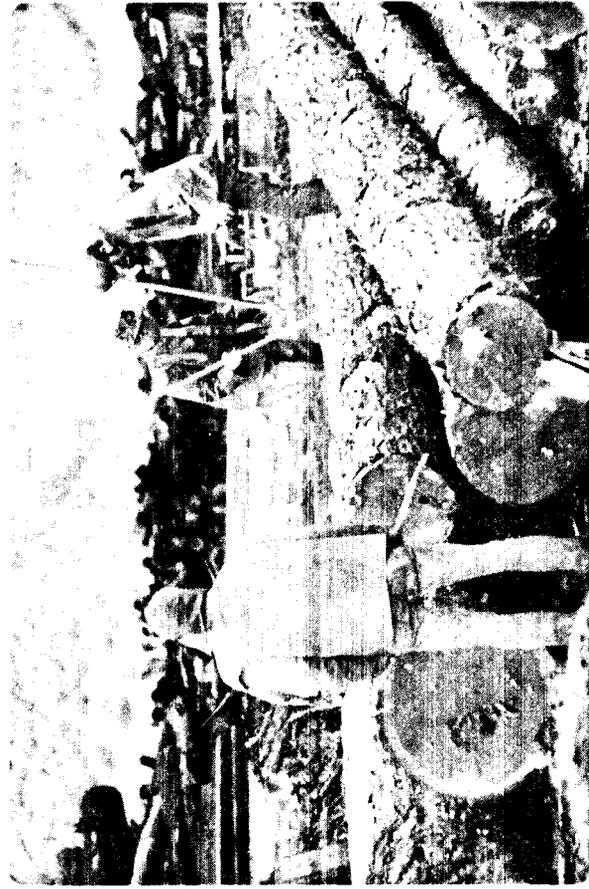


Plate F-120. Log Scalers Estimating Wood Quality.



Plate F-121. Use of Boat in Log Pond Operation.



Plate F-122. Logger Moving Logs in Pond.



Plate F-123. Log Raft Used for Moving Logs over Waterways.



Plate F-124. Logs Bound in Groups Prior to Formation of Raft.



Plate F-126. Arranging Logs on Log Train.

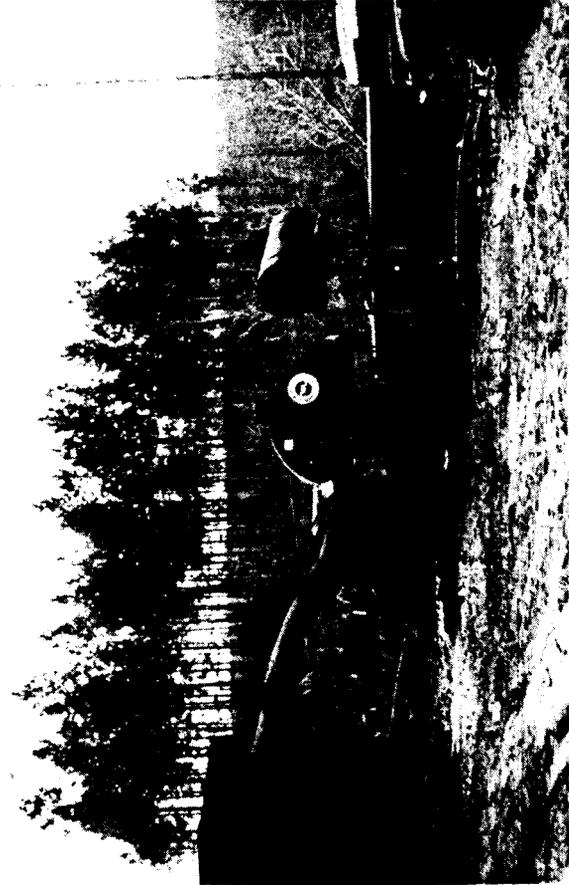


Plate F-127. Portable Pulp Chipping Machine.

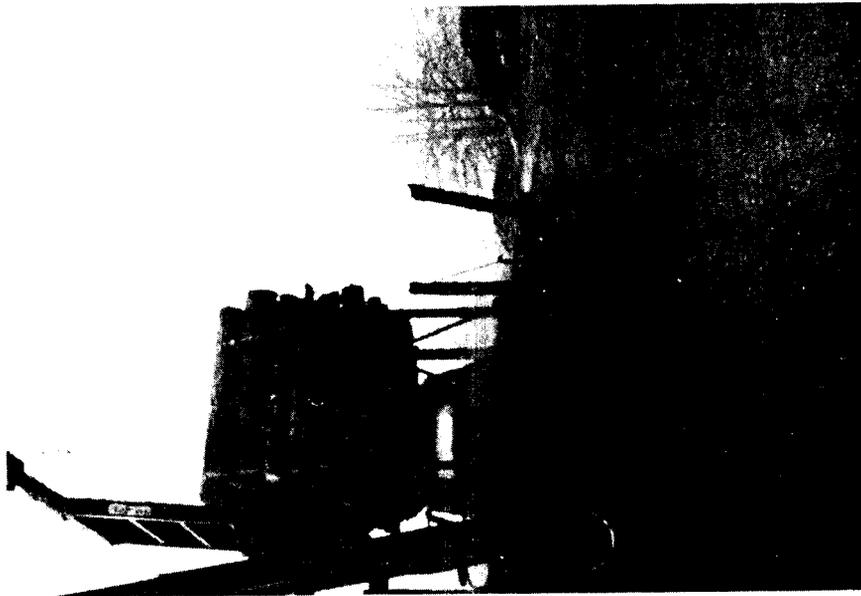


Plate F-125. Unloading Pulpwood from Truck.

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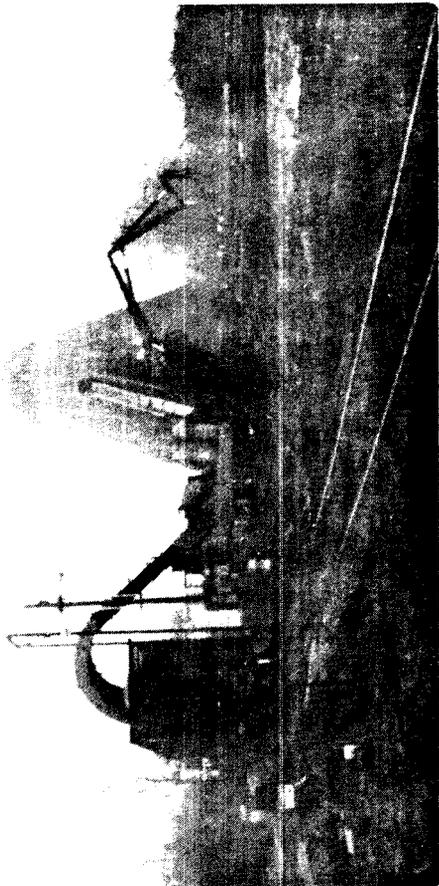


Plate F-128. Chipping Machine with Conveyor Used to Load Train Cars.



Plate F-129. Crew Bus.

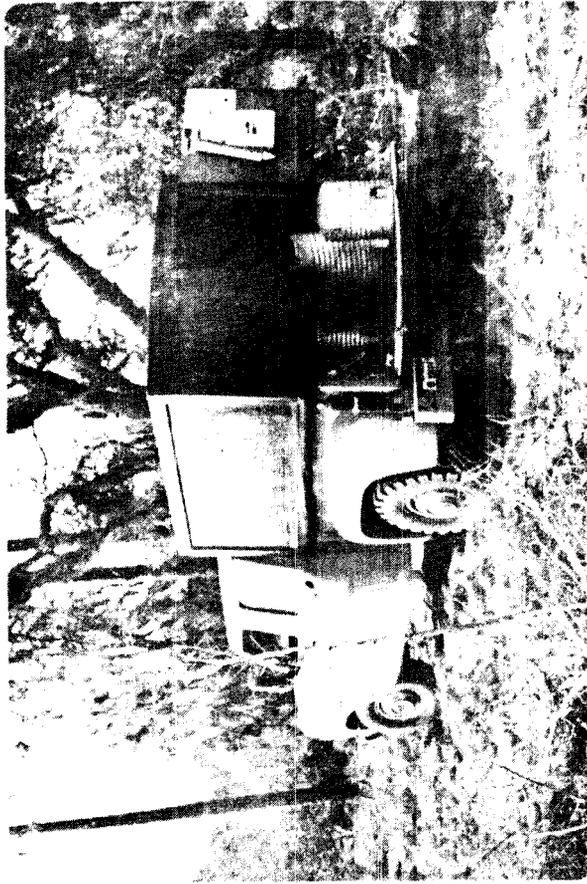


Plate F-130. Crew and Equipment Bus.