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**An Ergonomics Analysis of Manual versus  
Chainsaw High Ladder Pruning of *Pinus  
radiata* in New Zealand**

A thesis in partial fulfilment of the requirements for the degree of Master of  
Philosophy at Massey University.

## Abstract:

Two methods of ladder pruning *Pinus radiata* from 4.5 - 6.0 metres were compared using a cost-benefit approach within a framework provided by ergonomics. Chainsaw pruning is practiced in areas of New Zealand where large branches occur.

The objectives of the research were to compare the costs and benefits of the two pruning techniques and provide recommendations as to whether or not the practice of chainsaw pruning should continue. These objectives were achieved by comparing the risk of injury, the physiological costs, the musculoskeletal costs, the productivity and the quality associated with the use of the two techniques.

The general methods used to assess the relative costs and benefits of the two techniques were:

1. Numeric descriptions of the 'risk' involved with each method of pruning
2. The use of a relative heart rate index to compare the physiological costs of the two techniques
3. Using questionnaires focusing on musculoskeletal pain and discomfort to assess any relative differences between the two techniques
4. Using continuous time study to quantify any difference in labour productivity between the two techniques
5. Sampling pruned trees to assess differences in the quality of work between manual and chainsaw pruning

The research concludes that although both methods of pruning are hazardous, chainsaw pruning is more hazardous than manual pruning. Chainsaw and manual pruning were found to have the same physiological costs. Findings of the research indicate that manual pruning is not associated with a higher prevalence of musculoskeletal discomfort than chainsaw pruning on a yearly basis, although it is associated with a greater relative increase in BPD on a day to day basis and that this may lead to the development of musculoskeletal disease. Chainsaw pruning was found to be significantly more productive than manual pruning, although this was at the cost of quality.

The research concludes by recommending that the use of chainsaw pruning should be limited to areas where the branches are demonstrably large. Further research is called for to compare the physiological and musculoskeletal costs of manual pruning in plantation areas of both large and small branch sizes. Further research is called for to compare the safety of two methods of chainsaw pruning with the use of the technique of wrapping one leg around the tree as opposed to not wrapping the leg around the tree. Research to investigate new ladder designs which are safer to use in the New Zealand forest environment is also called for.

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# Table of Contents

<b><u>CHAPTER 1</u> INTRODUCTION TO ERGONOMICS AND FORESTRY</b>	<b>1</b>
1.0 Introduction	1
1.1 An Ergonomics Framework	1
1.2 General Ergonomic Concepts	6
1.3 Forestry (Background)	10
1.4 Study Background	15
1.5 Summary	17
<b><u>CHAPTER 2</u> LITERATURE REVIEW</b>	<b>18</b>
2.0 Introduction	18
2.1 Safety and Ergonomics	18
2.1.1 Personnel Characteristics	19
2.1.2 Machinery, Tools and Equipment	28
2.2.3 The Organisation of Work	30
2.2.4 The Physical Environment	30
2.2 Productivity and Quality	32
2.3 Cost-Benefit Analyses	32
2.4 Summary	33
<b><u>CHAPTER 3</u> METHODOLOGY</b>	<b>34</b>
3.0 Introduction	34
3.1 Research Design	34
3.2 A Quasi-Experiment: Sample Size and Subject Selection	35
3.3 Statistical Design for Quasi-Experiment	37
3.4 Ethical Approval	39
3.5 Subject Characteristics	39
3.6 Hazard Identification and Analysis	42
3.6.1 Definitions of Hazard Classes	43
3.6.2 Method of Collection for Hazard Frequency Data	44
3.6.3 Calculation of the Risk Score	46
3.6.4 Observed versus Perceived Hazard Frequency	47
3.6.5 Retrospective Accident Surveys	47
3.7 Physiological Costs	48
3.7.1 Method of Monitoring Heart Rates	48

3.7.2 Methods for the Determination of Physiological Cost Parameters	49
3.7.3 Rated Perceived Exertion (RPE) Protocol	52
3.7.4 Environmental Temperature Monitoring	53
3.8 Musculo-Skeletal Discomfort	53
3.8.1 'Health and Safety Executive' Questionnaires	54
3.8.2 Body Part Discomfort (BPD) Surveys	55
3.9 Productivity	57
3.10 Quality	63
3.11 Summary	63
<b>CHAPTER 4 RESULTS</b>	<b>65</b>
4.0 Introduction	65
4.1 Subject Characteristics	65
4.2 Hazard Analysis	66
4.2.1 Risk Score	66
4.2.2 Retrospective Accident Survey in Conjunction with the HSE Questionnaire	70
4.2.3 Retrospective Accident Survey in Conjunction with the Risk Score Questionnaire	71
4.3 Physiological Costs	72
4.3.1 Percentage Heart Rate Range (%HRR) at Work	72
4.3.2 Resting Heart Rates at Work (RHR)	73
4.3.3 Calibration of Heart Rate Monitors	73
4.3.4 Rated Perceived Exertion (RPE)	74
4.3.5 Thermal Environmental Monitoring	75
4.4 Musculo-Skeletal Discomfort	76
4.4.1 Health and Safety Executive Questionnaires	76
4.4.2 Body Part Discomfort (BPD) Surveys	76
4.5 Productivity	79
4.5.1 Delays	80
4.5.2 Tree Characteristics	80
4.6 Quality	81
4.7 Summary	82
<b>CHAPTER 5 DISCUSSION</b>	<b>83</b>
5.0 Introduction	83
5.1 Subject Characteristics	83
5.2 Hazard Analysis	88
5.2.1 Observed versus Perceived Frequencies of Hazards	88
5.2.2 Hazard Frequency and Ratings	89
5.2.3 Retrospective Accident Survey	105
5.3 Physiological Costs	109

<b>5.4 Musculo-Skeletal Discomfort</b>	<b>115</b>
5.4.1 Health and Safety Executive Questionnaires	115
5.4.2 Body Part Discomfort	116
5.4.3 Summary	117
<b>5.5 Productivity</b>	<b>117</b>
<b>5.6 Quality</b>	<b>123</b>
<b>5.7 Cost-Benefit Analysis</b>	<b>126</b>
5.7.1 Cost-Benefit Decision Criteria	127
<b>5.8 Summary</b>	<b>129</b>
<b><u>CHAPTER 6 CONCLUSIONS</u></b>	<b>130</b>
6.0 Introduction	130
6.1 Conclusions (Operational Hypotheses)	130
6.2 Conclusions (General Hypotheses)	131
6.3 Cost-Benefit Analysis	131
6.4 Summary	132
<b><u>CHAPTER 7 RECOMMENDATIONS</u></b>	<b>133</b>
7.0 Introduction	133
7.1 Recommendations (Operations and Techniques)	133
7.2 Recommendations (Future Research)	133
<b><u>REFERENCES</u></b>	<b>135</b>
<b>GLOSSARY OF TERMS</b>	<b>147</b>
<b>List of Figures</b>	
FIGURE 1.01 THE HUMAN-MACHINE SYSTEM	5
FIGURE 1.02 STRESS-STRAIN MECHANISM	7
FIGURE 1.03 MODEL OF LIMITED CAPACITY	9
FIGURE 1.04 PRUNING TOOLS	13
FIGURE 1.05 PRUNING CHAINSAW	13
FIGURE 4.01 OBSERVED VS PERCEIVED HAZARD FREQUENCY FOR CHAINSAW PRUNERS	69
FIGURE 4.02 OBSERVED VS PERCEIVED HAZARD FREQUENCIES FOR MANUAL PRUNERS	69
FIGURE 4.03 COMPARISON OF MUSCULOSKELETAL DISCOMFORT FOR CHAINSAW AND MANUAL PRUNERS	77
FIGURE 4.04 COMPARISON OF DAMAGE EVENTS PER TREE	82
FIGURE 5.01 MODEL OF BRANCH OCCLUSION	125

## List of Tables

TABLE 3.01 AGE CORRECTION FACTORS FOR $V_{O_2}$ (MAX) ESTIMATES	41
TABLE 3.02 LADDER HAZARDS	43
TABLE 3.03 CUTTING LARGE BRANCHES ABOVE THE HEAD	43
TABLE 3.04 CUTTING ACROSS THE ARMS OR LEGS	43
TABLE 3.05 OVERREACHING HAZARDS	43
TABLE 3.06 CUTTING BRANCH TOO CLOSE TO THE STEM HAZARDS	43
TABLE 3.07 HOLDING ON TO THE BRANCH BEING CUT HAZARDS	44
TABLE 4.01 SUBJECT CHARACTERISTICS OF CHAINSAW PRUNERS.	65
TABLE 4.02 SUBJECT CHARACTERISTICS OF MANUAL PRUNERS.	66
TABLE 4.03 ESTIMATED $V_{O_2}$ (MAX) OF CHAINSAW PRUNERS.	67
TABLE 4.04 ESTIMATED $V_{O_2}$ (MAX) OF MANUAL PRUNERS.	67
TABLE 4.05 FREQUENCY OF HAZARD OCCURRENCE.	68
TABLE 4.06 CHAINSAW PRUNERS' HAZARD FREQUENCY. MORNING VS AFTERNOON.	68
TABLE 4.07 MANUAL PRUNERS' HAZARD FREQUENCY. MORNING VS AFTERNOON.	68
TABLE 4.08 AVERAGE NUMBER OF TREES PRUNED PER DAY	70
TABLE 4.09 RISK SCORES FOR MANUAL PRUNERS.	70
TABLE 4.10 RISK SCORES FOR CHAINSAW PRUNERS.	71
TABLE 4.11 RETROSPECTIVE ACCIDENT SURVEY OF PRUNERS IN THE STUDY	71
TABLE 4.12 ACCIDENT FREQUENCIES OCTOBER 93 - OCTOBER 94	72
TABLE 4.13 %HRR OF CHAINSAW PRUNERS	73
TABLE 4.14 %HRR OF MANUAL PRUNERS	73
TABLE 4.15 TEST OF SIGNIFICANT DIFFERENCES BETWEEN RHR <i>PRE-WORK</i> AND RHR <i>POST-WORK</i> .	73
TABLE 4.16 HEART RATE CALIBRATION TESTS.	73
TABLE 4.17 RPE CORRELATIONS FOR CHAINSAW VS MANUAL	75
TABLE 4.18 ALL RPE CORRELATIONS	75
TABLE 4.19 CYCLE ELEMENTS FOR MANUAL AND CHAINSAW PRUNERS	79
TABLE 4.20 ACTUAL VS THEORETICAL PRODUCTION RATES	80
TABLE 4.21 COMPARISON OF DELAY TIMES BETWEEN CHAINSAW AND MANUAL PRUNERS	80
TABLE 4.22 COMPARISON OF TREE CHARACTERISTICS FOR CHAINSAW AND MANUAL PRUNERS	81
TABLE 4.23 DAMAGE EVENTS PER TREE. CHAINSAW VS MANUAL PRUNING	82
TABLE 5.01 CONSEQUENCES TIMES LIKELIHOOD OF INJURY FOR CHAINSAW PRUNERS	104
TABLE 5.02 CONSEQUENCES TIMES LIKELIHOOD OF INJURY FOR MANUAL PRUNERS	104
TABLE 5.03 ACCIDENT REPORTING DATA BASE FROM CHHF (CENTRAL)	108
TABLE 5.04 PERCENTAGE OF AFTERNOONS WITH A SIGNIFICANT ELEVATION IN RHR	112
TABLE 5.05 PREDICTED PRUNE TIME VS CROSS-SECTIONAL AREA OF BRANCHING	122
TABLE 5.06 COST-BENEFIT MATRIX FOR CHAINSAW VS MANUAL PRUNING	126

## Table of Appendicies

<u>APPENDIX - 1</u> -HEALTH AND SAFETY EXECUTIVE (HSE) QUESTIONNAIRE	150
<u>APPENDIX - 2</u> $V_{O_2}$ TESTING PROTOCOL.	156
<u>APPENDIX - 3</u> LIRO PRUNING STUDY.	157
<u>APPENDIX - 4</u> BORG'S RPE SCALE.	162
<u>APPENDIX - 5</u> BODY PART DISCOMFORT (BPD) SURVEY	163
<u>APPENDIX - 6</u> USE OF SUNNTO CLINOMETER	164
<u>APPENDIX - 7</u> BRANCH SAMPLING SHEET.	165
<u>APPENDIX - 8</u> PRIORITIES FOR ACTION	166
<u>APPENDIX - 9</u> CORRELATIONS OF HEART RATE AND RPE	167
<u>APPENDIX - 10</u> PRUNE TIME VERSUS THREE TREE CHARACTERISTICS	170