

Pruning Injuries: Analysis of IRIS data 2018 - 2022

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION	2
METHODS.....	3
RESULTS & DISCUSSION.....	4
Lost time injuries	6
Injury event	6
Body part injured	7
Injury type	9
Medical treatment & minor injuries	10
Injury event	10
Body part injured	12
Injury type	12
CONCLUSIONS.....	13
ACKNOWLEDGEMENTS	14
REFERENCES	15

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EXECUTIVE SUMMARY

This report provides a baseline of injury types, frequency, and severity with associated causes which the Precision Silviculture Programme can use to measure progress and success of implemented initiatives and technologies. The report summarises lost time, medical treatment and minor injury reports related to silvicultural pruning supplied to the New Zealand Forest Industry Incident Recording Information System (IRIS) database from January 2018 to December 2022. There was a total of 128 pruning related injury incidents recorded over this five-year period. The incidents comprised 46 lost time injuries, 13 medical treatment injuries and 69 minor injuries. The most common cause of injury for lost time, medical treatment and minor injury events was slipping/tripping/falling while walking between trees. Overall, the hands, wrists and fingers were the most frequently injured parts of the body. Comparison with previous studies has shown the type and cause of injury has changed little in 25 years.

We need to develop technology or techniques that allow the worker to prune from the ground, or from a stable platform or with mechanised support. Until we develop new technology to make pruning safer the options for the pruning worker are the use of personal protective equipment, training in good technique, gaining experience without being injured, adequate rest breaks, good hydration and nutrition and sharp well-maintained tools and equipment for quick and safe cutting.

INTRODUCTION

The New Zealand Forest Industry's Incident Recording Information System (IRIS) database includes records for both injury events (lost time, medical treatment and minor injury) and non-injury events (contact and near hit incidents). This report focuses on injury events in silvicultural pruning for the period January 2018 to December 2022. Descriptions for event types are also provided in the context of the report.

An aim of the Precision Silviculture Programme is “to develop new pruning systems that decrease labour requirements and improve the safety and productivity of pruning operations.” This analysis will provide a detailed baseline of injury characteristics (type, cause, frequency and severity) against which comparisons can be made at the end of the Programme to measure progress and success of implemented initiatives and technologies. It will also help to guide the programme on where key areas for improvement are needed.

Findings from the report will also provide guidance in reducing injuries and improving productivity in pruning by providing identification of both high frequency and high consequence injury events.



METHODS

There are three injury types recorded in the IRIS database that are used in this report:

Lost Time Injury - an incident that results in injury to an employee to the extent that they do not return to work at the start of the next regularly scheduled workday.

Medical Treatment Injury - an incident requiring medical treatment for the injured party by a medical practitioner (including prescribed medication) other than on-site First Aid Treatment. Employee returns to work at the start of the next regularly scheduled workday or scheduled shift.

Minor Injury - also referred to as First Aid Cases or Treatment Not Required. For example, contact with an energy source (e.g. tool or falling branch) has occurred resulting in minor injury and treatment is applied on-site (first aid) or not sought.

Other categories in the IRIS database but not used in this report are:

- Contact – No Injury

Contact with an object or energy source where first aid treatment was not sought. The contact may have resulted in minor bruising and/or abrasions or personal protective equipment has prevented more serious injury.

- Near Hit

An event that given similar circumstances, could have resulted in injury or property damage. A near hit may be a warning that control measures may not be working as intended or management of a hazard is absent.

- Property Damage

Unintentional damage to property or machinery because of operational activity. No threat to personal safety

IRIS data was reviewed for the five-year period January 2018 to December 2022. The criteria for selection (Table1) were:

- ACTIVITY = Silviculture
- OPERATION = Pruning

Table 1: Variables used in the analysis

Variable	Categories ¹
Task	Ground pruning – Chainsaw, Ground pruning – manual, Ladder pruning – chainsaw, Ladder pruning – manual, Pruning – unknown, Travel
Lost hours	9 hours considered 1 working day
Body part	Foot, Ankle, Head, Eye, Face, Shoulder, Knee, Hip/upper leg/thigh, Hand/wrist
Injury type	Fracture, Crush, Bruising, Puncture, Sprain/strain, Sting/bite, Cut/Laceration
Injury cause	Chainsaw, Ladder, Manual hand tools, Uneven surface underfoot
Injury severity	Lost time, Medical treatment, Minor, Near hit, Property damage, Contact-no injury
Incident cause	Body stressing, Hit by object, Loss of control, Slip/trip/fall

¹ Not an exhaustive list of categories used in the database. There are more categories for many variables.

Most records in the database were entered accurately and fully however approximately ten percent of records in the database had to be recoded because of errors or omissions when the data was entered. For example, using the category “Other” rather than the actual Task (pruning) or Operation (ground pruning, ladder pruning, etc). Accurate data makes analysis faster and the results more reliable.

RESULTS & DISCUSSION

There was a total of 128 pruning related injury reports to the IRIS database during the period January 2018 to December 2022. Most reports were for minor injuries followed by lost time injuries and there were more reports in the period 2020 to 2022 (Table 2).

Table 2: Pruning related injuries reported to the IRIS database

Event type	2018	2019	2020	2021	2022	Total
Lost time injury (LTI)	6	4	15	15	6	46
Medical treatment injury (MTI)	2	0	4	5	2	13
Minor injury	12	13	12	11	21	69
Total	20	17	31	31	29	128

Most injuries occurred during ladder pruning operations (Figure 1). These injuries include any injury event and are not limited to falling from ladders (e.g. walking while carrying a ladder). There is no data indicating the number of people ground pruning compared with ladder pruning. Reasons for more ladder pruning injuries could be ladder pruning takes more time than ground pruning so the worker is exposed to risk for a longer time. Also ladder pruning is inherently more hazardous because the worker: 1) has to carry the ladder between trees (risk of slip, trip and falling) and 2) climb the ladder (risk of falling) and 3) prune while on the ladder (risk of falling, cutting hands and being hit by branches). Ground pruning occurs less frequently than ladder pruning because a tree is pruned once from the ground but multiple times from a ladder in subsequent lifts.

There is little chainsaw pruning compared with lopper pruning with chainsaws used only on the biggest branches (Pers comm. various silviculture companies). One reason given for less chainsaw pruning was the greater cost of maintaining a chainsaw compared with loppers. The chainsaw is also noisy, needs fuel and produces exhaust fumes.

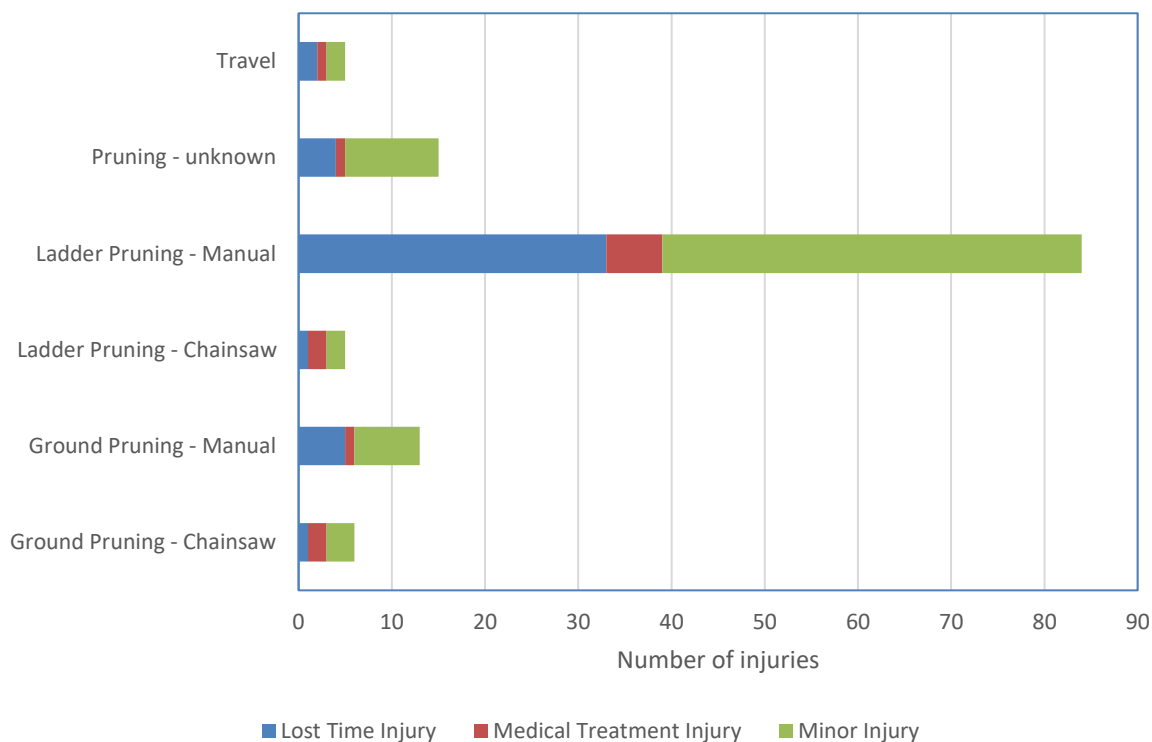


Figure 1: Number of injuries by pruning task

The greatest number of pruning incidents occurred in the period 2020 to 2022 and the majority of those occurred during manual ladder pruning (Table 3).

Table 3: Type of pruning ground / ladder / chainsaw

Pruning type	2018	2019	2020	2021	2022	Total
Ground Pruning - Chainsaw	0	2	1	2	1	6
Ground Pruning - Manual	3	3	3	3	1	13
Ladder Pruning - Chainsaw	0	0	2	2	1	5
Ladder Pruning - Manual	14	10	22	20	18	84
Pruning - unknown	2	2	2	3	6	15
Travel	1	0	1	1	2	5
Total	20	17	31	31	29	128

The number of LTI reports has fluctuated over the 5-year period with a drop in 2022 (Figure 2). Medical Treatment Injuries (MTI) have remained relatively stable over the five-year period. More minor injuries were reported in 2022 than any year previously. A possible reason for the increase in minor injuries is more treatment was done onsite as first aid rather than by a medical practitioner. Improved first aid training and better stocked first aid kits could result in injuries being handled on site. Most of the minor injuries were cuts and bruises which could be dealt with on site.

Figures for the actual number of people engaged in pruning each year could not be found. There is information available showing trends in pruning activity. Manley (2022) reported a reduction in pruning area from 28% of eligible stands in 2010 to 19% in 2020. However, he stated “this reduction is almost solely due to the decision by one large entity to stop pruning”.

The National Exotic Forest Description (NEFD) pruned area estimate is the area of forest in that year containing pruned trees aged 6-10 years old (NEFD, 2018 – 2022). Note, this is not the actual area pruned in that year but provides a proxy of pruning activity over time. Pruning activity has declined over time as seen by less area of forest under pruned trees in 2022 compared with 2018 (Figure 2).

Previous work (Ashby & Parker, 2003) showed that 30% of injured silviculture workers had less than six months experience. Their data included thinning, planting and pruning workers but is representative of the pruning workforce as most (50%) injuries were to pruning workers. Current data in the IRIS database does not have that level of detail about experience but presumably less experienced workers are more likely to be injured where work hardening, experience and technique would help them avoid injury.

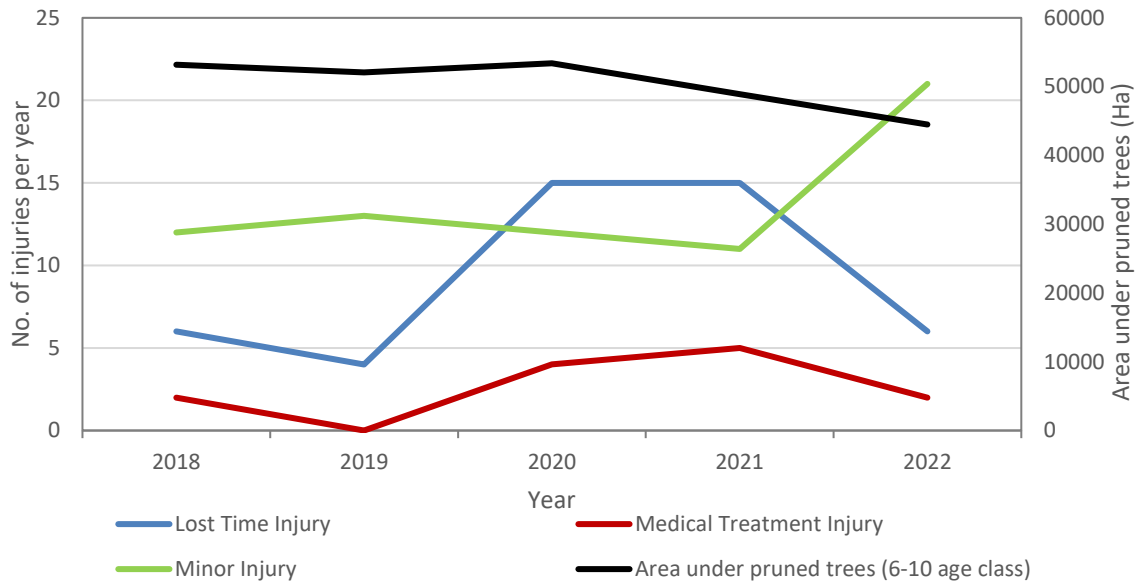


Figure 2: Trends in pruning-related injury incidents
 Note: “Area” is a proxy of pruning activity over time

Lost time injuries

LTIs are incidents that result in injury to an employee to the extent that they do not return to work at the start of the next regularly scheduled workday or any other subsequent scheduled shift. A total of 46 LTI events occurred during pruning in the five-year period 2018 to 2022. The peak of injuries were during the years 2020 and 2021 (Figure 2).

Injury event

The total amount of lost time from pruning LTIs over the five years was 3800 hours, with an average of 83 hours lost per incident (Table 4).

Table 4: Pruning related LTIs by injury inflicting event

Event “Incident cause”	Number of injuries	Total number of hours lost	Average number of hours lost
Slip/Trip/Fall	23	2872	125
Body Stressing	5	137	27
Poor Technique	5	176	35
Hit by object	4	97	24
Loss of Control	3	277	92
Environmental	2	143	72
Equipment Failure	2	78	39
Fatigue	1	4	4
Hit object with body	1	16	16
Total	46	3800	83

The event which featured most frequently in LTI reports was “Slip/Trip/Fall” with 23 injuries which comprised 50% of all pruning LTIs and a total of 2872 days lost. The most frequent cause of injury was slipping over while walking between trees, resulting in 11 lost time injuries and 1051 hours lost. The majority (8 of 11 injuries) were sprains to the lower leg and ankle. The most severe was a sprained ankle when the worker slipped on a patch of wet clay and rolled his ankle resulting in 450 hours off work.

Nine injuries were the result of falling from the ladder (total of 653 hours lost). The most serious injury was when the high pruning ladder was placed against the tree at a low angle to get under the branches of a missed pruned tree from the previous operation. When the worker was descending the ladder one of the rungs broke causing the worker to fall - injuring his knee and resulting in 440 hours lost time. The next most severe injury was bruising after falling 4.5 m from a ladder resulting in 80 hours lost time. Other reasons for falls from the ladder included poor ladder placement and the ladder moving, muddy boots slipping on rungs and being hit by a branch and then falling from the ladder.

Poor technique was implicated in five lost time injury reports, and all were lacerations to the hands. The common feature of these injuries was being cut by the loppers or the epicormic knife. A total of 176 hours were lost.

Of the five injuries that were classified as “Body stressing” four were strains / sprains resulting from pulled muscles and one was a dislocated shoulder which occurred while pruning. These resulted in a total of 137 hours lost.

Body part injured

The most frequently injured body parts were the hands, wrists and fingers (Table 5). There were 12 lost time injuries and a total of 754 hours lost. The most severe hand injury was a lacerated finger when the worker was trying to cut branches behind the tree and swung the loppers around the tree and his fingers were caught by the blade. This injury resulted in 252 hours lost. Most hand injuries (8) were the result of being cut by loppers (3), chainsaw (1), epicormic knife (1), machete (1) and Silky saw (1).

Table 5: Pruning related LTIs by part of body injured

Body part	Number of injuries	Total number of hours lost	Average number of hours lost
Hand/Wrist/Finger	12	754	63
Ankle	6	529	88
Shoulder	5	193	39
Back/Spine	4	166	42
Chest	4	122	31
Knee	4	712	178
Eye	3	57	19
Head	2	1048	524
Lower Leg	2	32	16
Abdomen/Pelvis	1	135	135
Elbow	1	32	32
Foot	1	16	16
Neck	1	4	4
Upper/Lower Arm	1	8	8
Total	47	3808	1319

It is useful to have a greater understanding of the circumstances leading to injury rather than just presenting raw summaries of numbers. In Table 6 the available narrative associated with each hand injury report is paraphrased. Pruning workers must use their hands to not only control tools like loppers and knives but also to hold on to the tree and ladder for balance. This need can place their hands close to sharp tools.

Table 6: Narrative report from hand, wrist and finger LTI events occurring during pruning

Walking on steep slope, stepped into an unseen hole and fell over. He was carrying his ladder on the downhill side and fell back on to it. His hand was caught by one of the rungs on the ladder and his thumb was bent backwards as the weight of his body fell on to it. Torn ligament in the thumb and placed in cast for the next four weeks
Finger sliced when pruning at full extent with chainsaw
Trying to prune the branches from behind the tree, swung lopper around and finger was on the blade that automatically closed, and it struck his finger causing a laceration
Cleared area with hand and was stabbed with sharp point of cutty grass in hand
Hand slipped off the loppers on to his machete, which was inside the pruning pouch upside down, in turn cutting open his wrist
He was up a tree and folding away his pruning loppers, slipped, and cut his right hand
Went to pull loppers out of pruning pouch, loppers opened up and elbow/forearm grazed along lopper blade, causing cut to arm
Pruner was on a 2.4m ladder on a steep slope. As the pruner climbed the ladder moved and the pruner fell onto his right wrist
Pruning a tree at the top of his ladder. The loppers got stuck in a large branch and when he tried to remove the loppers they came free and began to fall. As they were falling the pruner tried to grab the loppers and cut his finger on the blade.
Holding onto a branch while balancing on the ladder. He was unable to see his hand and has caught the tip of his finger with his silky saw
While I was on top of my ladder, I finished pruning and had my hand behind the tree for support when clearing epicormics with my knife, I unintentionally cut my hand that was supporting me

Insights from the narrative descriptions:

- Wearing gloves would reduce the chance of hand injury but gloves must be good quality and well-fitting to provide a good sense of touch and maintain dexterity
- Working on a ladder is inherently risky, especially on a slope and using hand tools.

The ankle was the second most frequently injured part of the body with six injuries and a total of 529 hours lost. All of the ankle injuries were sprains due to lost footing (Table 7) and the severe injury resulted in 450 hours lost.

Table 7: Narrative report from ankle LTI events occurring during pruning

Twisted ankle when stepping over trees.
A worker was pruning through the rows, he went to drop down to the next line of trees and slipped on a clay patch and rolled his ankle with all his body weight on top of his ankle causing instant pain. The pruner was taken to hospital for X-Rays
He climbed down his ladder and stepped off the bottom rung and stood on a stick rolling his ankle
Worker jumped a creek and landed on a branch and rolled his ankle when landing.
Walking from one tree to another and was on uneven ground when he stood in a small hole and sprained his ankle
Stood in an unseen hole, fell to the ground and twisted his ankle

Insights from the narrative descriptions:

- Lace up boots with good ankle support will provide protection for ankles
- Inspect the soles of boots regularly to ensure there is enough tread to provide grip.

Injury type

Sprains and strains were the most common injury type with 23 injuries and a total of 1325 hours lost (Table 8). Lacerations were the next most common injury and most of these were to the hands and fingers. Fracture injuries were the most severe with an average of 524 hours lost time; however, there were only two fractures.

Table 8: LTI type during pruning

Injury type	Number of injuries	Total number of hours lost	Average number of hours lost
Sprain/Strain	23	1325	58
Cut/Lacerated	8	517	65
Bruising	5	192	38
Fracture	2	1048	524
Puncture	2	143	72
Burn	1	40	40
Concussion	1	16	16
Dislocated	1	40	40
Foreign Body	1	7	7
Internal Injury	1	440	440
Scratch/Abrasion	1	32	32
Total	46	3808	1329

When sprain and strain injuries are broken down by body part the ankles were the most frequently injured (Figure 3). As discussed earlier and highlighted in Table 7, silvicultural workers move through an uncontrolled and, at times, steep environment with hazards underfoot so the ankle is exposed to injury. The back, knees and shoulders were the next most frequently sprained or strained body parts.

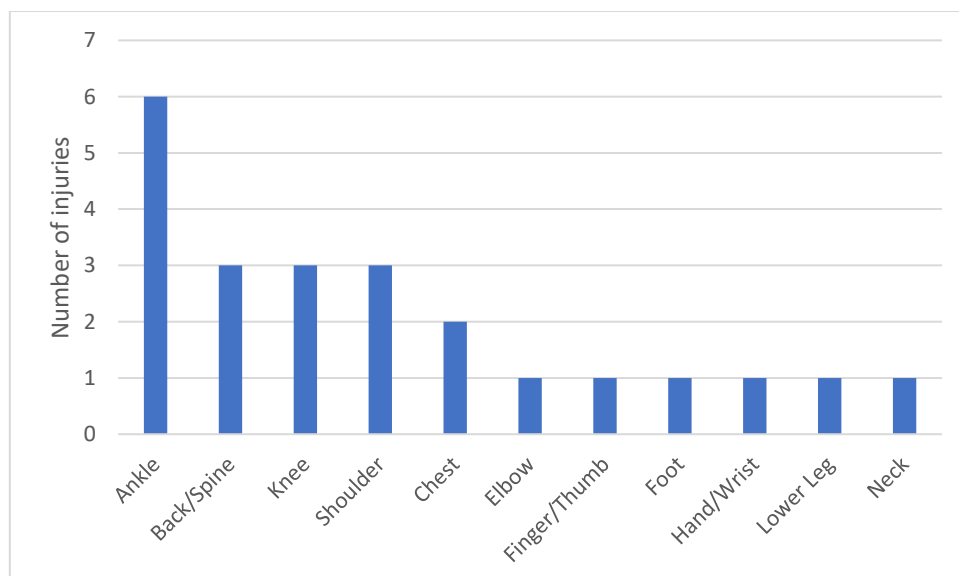


Figure 3: LTI sprain and strain injuries by body part

Medical treatment & minor injuries

Medical treatment injuries (MTIs) are injury events that are serious enough to require some treatment by a medical practitioner and are too serious to be just treated by first aid on site. These injuries do not result in the loss of the whole next day off work. Minor injuries are where treatment is applied on-site. Medical treatment and minor injury reports are important because they add another dimension to the understanding of the exposure to risk during pruning operations. They may have resulted in more serious lost time injury under slightly different circumstances.

Injury event

There were 13 MTIs and 69 minor injuries recorded for pruning over the five years examined. Because of the small number of MTIs they have been combined with minor injuries for analysis. The most frequently recorded event was slipping, tripping and falling while walking between trees or into and out of the block (Figure 4). The forest environment is uncontrolled and unlike a factory or human modified worksite cannot be swept of hazards such as fallen branches holes in the ground filled or the site levelled.

The second equal most frequently reported injury event were pruning workers being hit by the branch they had just cut, and workers cutting themselves on the lopper blades, knife or saw (Figure 4).

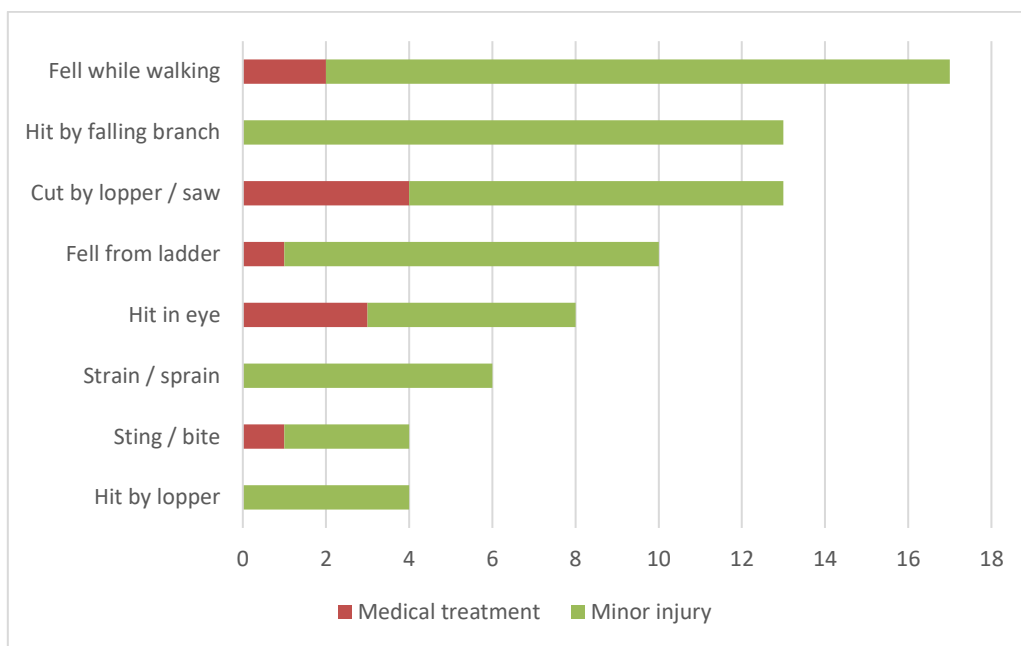


Figure 4: Medical treatment and minor injuries by injury inflicting event

The narrative text describing the circumstances related to injury are very informative because they give the reader a better understanding of what happened. In some cases, there is a bare description of events but in others a more detailed story emerges which helps understand the circumstances leading up to injury (Table 9).

Pruning always means branches are being cut and they can fall on the worker. It is especially difficult to get out of the way of the falling branch when on the top of a ladder and all the cutting is above head height (Table 9). Good technique is essential to avoid being hit.

Table 9: Narrative report of medical treatment and minor injuries from being hit by a branch

As worker was pruning a big branch hit them in the shoulder. Worker was put on light duties for the rest of the day
Branch came down grazing forehead
High prune operation, pruning top whorl. Overreached to prune branch, not balanced and branch dropped on workers head. Forehead cut and first aid applied
Branch flicked back and hit worker in the face
Branch fell on left hand while pruning
Worker was crossing under the tree while the branch fell down, the branch hit the ladder and hurt his finger
A silviculture workers fingers were bruised by a large branch that fell as he pruned it from a tree
A pruned branch fell straight onto the left side of pruners face causing scratches and bruising
Pruned branch hit worker on nose
Pruning and branch fell and poked him in the eye
While pruning up a ladder a branch fell straight onto pruner's elbow causing a sore elbow
While pruning a branch fell and hit pruner in the chest causing minor injury
A pruner was up a ladder pruning and a medium sized branch came down and hit him in the ribs

Insights from the narrative descriptions:

- Good technique is essential to avoid being hit by the branch being cut
- Maintain sharp loppers so cutting is quick and the branch falls away from the tree

Pruning workers need sharp tools to work safely and efficiently. However, there is opportunity for injury when those sharp tools are being handled on a ladder and one hand is being used to hold on to the tree for support (Table 10). There is also risk of injury just from handling the tools when reaching for them in the pouch or during maintenance.

Table 10: Medical treatment and minor injuries from being cut with a pruning tool

Cutting branch with handsaw, cut finger, was too close to branch
Chainsaw pruning came down and nicked finger
Cutting a branch with the silky saw when pruning, had his left hand on the left side of the tree and holding below the saw. His right hand was sawing the branch off. As he had his hand below the saw the saw just nicked his finger as he cut through the branch.
Chainsaw pruning tree got kickback and cut chin
Pruning from his ladder and used his right hand to reach loppers. He has run his hand down the exposed part of the blade as his hand slipped due to wet weather, cutting his lower right palm area
He returned his knife back to his pouch without realising the knife was pointing up, he reached for his loppers and accidentally cut his right wrist
Went to saw off ramicorn because it was too low to scar, slitting right index finger
Using handsaw and made contact with thumb
Cut tip of finger during ladder pruning
A silvicultural worker was tightening the bolts on their pruners and testing the movement by opening and closing the pruners rapidly. While doing this the pruners slipped and gave the worker a small cut on the chin
Up ladder chainsaw cutting out a double leader which was slightly over head. Cut leader 10cm away from the trunk to take the weight off the branch. Attempted to cut the branch flush to the trunk and the chain came off cutting worker on the elbow. Stitches at hospital for his cuts

Insights from the narrative descriptions:

- Most cut injuries are to the hands and wearing well-fitting gloves which are thin enough to maintain dexterity could reduce hand injury. However, gloves can make the hands uncomfortably hot, get covered in sticky gum which makes tool handling difficult and if they are too thick or poorly fitting reduce dexterity.

Body part injured

Workers hands and fingers were the most frequently injured body part (22 injuries) for medical treatment and minor injuries which is similar to LTIs. However, ankle injuries, which were the second most common body part injured for LTIs, were rarely reported. Normally ankle injuries are strain and sprains that are severe and result in time off work. There were 9 head injuries, 9 face injuries and 8 eye injuries reported for MTI and minor injury events. This is much greater than the numbers reported for LTIs. The head and face are exposed because work is being done at or above head height. Most impacts are not severe, so the injury does not result in a LTI.

Injury type

Figure 5 reiterates the findings reported earlier, that lacerations are common medical treatment and minor injuries for pruning workers. This is in contrast with LTIs where sprains and strains were most frequent. Most MTI and minor injury lacerations were inflicted by the loppers (6) hand saw (4), chainsaw (3) and knife (1).

Bruises are also a common injury type for pruning workers and are less likely to result in a LTI (see Table 8). Bruises are more commonly seen as medical treatment or minor injury where the injured worker can return to work the next day. The most common event that resulted in bruising was being hit in the upper body or hands by a branch that had been cut (9 events). Other events were falling from the ladder (6) and slipping, tripping and falling while walking between trees (4).

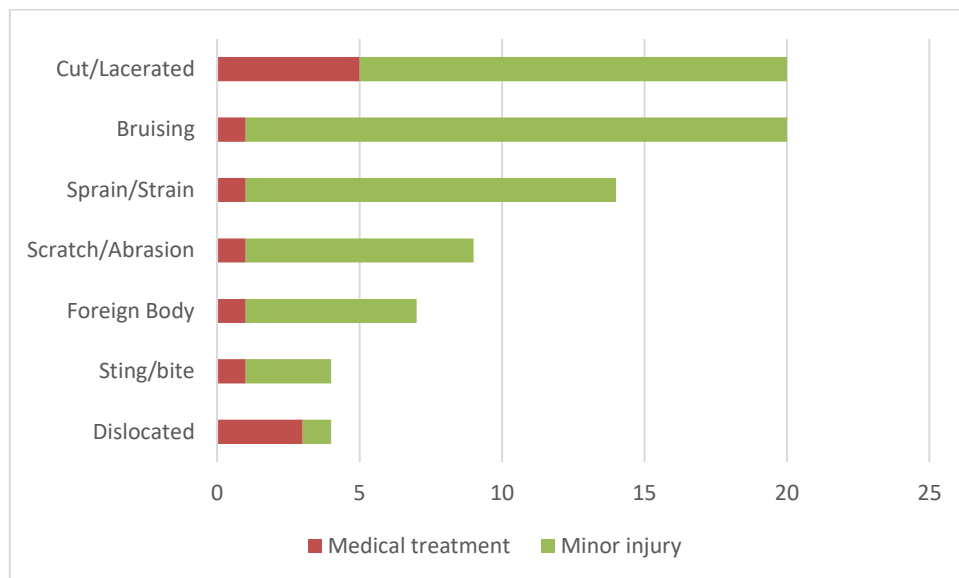


Figure 5: Medical treatment and minor injury by injury type

CONCLUSIONS

One of the purposes of this report is to identify high frequency and high consequence injury events to help provide guidance in reducing injuries and improving productivity in pruning. The analysis was divided into two parts – LTIs which are high consequence and lower frequency; and MTI and minor injuries which occur more frequently but have a lower consequence (i.e. less time off work).

Most injury events in both LTI, MTI and minor injury occurred during ladder pruning. This is a consequence of carrying additional equipment (ladder) while often walking on difficult terrain which is a characteristic of the uncontrolled nature of a forest environment. The worker has to contend with holes, branches, debris, understory vegetation and slopes. Risk is also increased by having to ascend and descend the ladder, sometimes in the wet or with mud on the soles of boots. Finally, working at height is inherently risky, and for a pruning worker, using sharp tools and holding on to the tree for stability with one hand. Technology or techniques that allow the worker to prune from the ground, or from a stable platform or with mechanised support would be a great safety advantage.

There are few studies of injuries to workers in silvicultural pruning. However, the analyses of New Zealand pruning worker injuries that have been published have reported the most frequent cause of injury was slipping over while walking between trees (Parker, 1997) and the hand was the most frequently injured by part (Byers & Parker, 1997). These findings show the types, and presumably the causes of injury have not changed in 25 years and there is a great need to develop pruning technology and methods to reduce injury.

Until we develop new technology to make pruning safer the options for the pruning worker are:

- Personal protective equipment
 - boots that provide ankle support and provide good grip.
 - gloves to protect hands but thin enough for good dexterity.
 - eye protection but practical issues with gum and water droplets
- Good technique acquired by training and experience including adequate rest breaks, hydration and nutrition.
- Sharp well-maintained tools and equipment for quick and safe cutting.

One of the aims of the Precision Silviculture Programme is “to develop new pruning systems that decrease labour requirements and improve the safety and productivity of pruning operations.” This analysis provides a detailed baseline of injury characteristics (type, cause, frequency and severity) against which comparisons can be made at the end of the Programme to measure progress and success of implemented initiatives and technologies.

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REFERENCES

Ashby, L. & Parker, R. 2003. The forest silviculture accident reporting scheme – 2002. Centre for Human Factors and Ergonomics Report 4, 2.

Byers, J & Parker, R. 1997. Lost time injuries in forest silviculture – 1996. LIRO Report 22,15.

Manley, B. 2022. Trends in radiata pine tending regimes being applied by large-scale entities – 2010 to 2020. *New Zealand Journal of Forestry* 67:1 31-32.

National Exotic Forest Description. 2018, 2019, 2020, 2021, 2022. Ministry for Primary Industries.

Parker, R. 1997. Lost time injuries in forest silviculture – 1995. LIRO Report 22,7.