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THE EFFECT OF SMALL-END DEFECTS ON THE SCALE VALUE OF EXPORT LOGS

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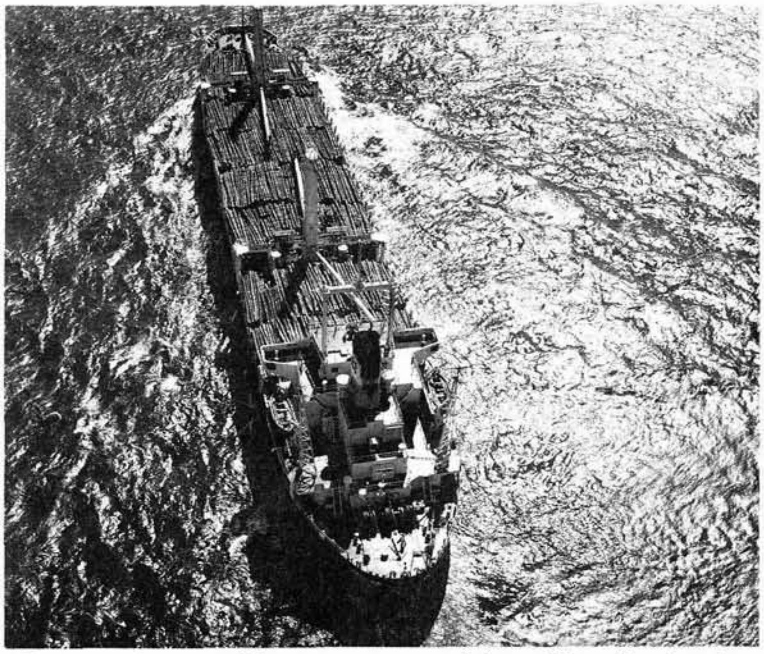

Figure 1 - Large volumes of logs are exported from New Zealand ports each year

ABSTRACT

The impact of small-end defects on the hand scaled diameters of export logs was examined. Defects most commonly originated from man-made causes; in particular, end splitting formed during cross-cutting. Bark encased knots were another major cause of scale diameter reductions.

Within the eleven log grades sampled, the proportion of logs having a defect, which reduced the scaled minimum small-end diameter, ranged from 2% to 9%. This was reflected in an average value loss varying from $0.28 to $1.20 per JAS unit when scaled with the JAS method.

Extending the results of the logs sampled gives an indicative figure of about $1-2 million being lost annually to the New Zealand forestry industry through the creation or inclusion of small-end defects during cross-cutting. While not all of these losses are avoidable, a proportion of this estimated loss may be recovered through closer attention to log-making during cross-cutting.

INTRODUCTION

In a desire to improve profitability, considerable emphasis in recent years has been placed upon the correct manufacture of logs in the forest. This emphasis has tended to be on obtaining the correct mix of logs from each stem ensuring maximum value recovery, and the production of logs which met customer specifications. However, the production of the correct mix of in-specification logs does not always mean that the log-maker has achieved maximum value recovery from a stem. As in the case of export logs, a key component in assuring full value recovery is careful attention to the actual cutting process.

In 1990, 31% of the volume of wood (in roundwood equivalent) exported from New Zealand went in the form of roundwood sawlogs (NZFOA, 1991). The current trend of the industry suggests that this figure will at least hold in the near future, and may rise as high as 3.5 million tonnes annually over the next five years.

Because of the strict scaling system used for export logs, and the importance of the export log market to the New Zealand forest industry, the losses caused to export log value by cross-cutting activities in the forest were examined.

ACKNOWLEDGEMENT

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LOG SCALING SYSTEM

Unlike many other products, export logs are individually measured. Hand scaling of each small-end is undertaken and a tag attached bearing a unique number for that log.

Scaling is undertaken to a variety of standards but a common one is the Japanese Agricultural Standard, commonly referred to as JAS (Ellis, 1988). A JAS unit is approximately the same as a cubic metre.

The JAS scale requires the measurement of the shortest small-end diameter inside the bark through the pith of the log. A recent adjustment to this scale now allows the measurement through the centre of the log rather than the pith. The former option was used for these sets of measurements.

Figure 2 -An example of end splitting created during cross-cutting causing a considerable loss in value

A second measurement is also taken, again inside bark through the pith, but at a right angle to the first measurement. This is made to allow an adjustment in volume for out-of-round logs. In the case of logs where the shortest SED is greater than 14 centimetres, which covers the vast majority of logs exported, the two measurements taken are then rounded down to the nearest even two-centimetre interval. The effective SED used for volume calculation is based on the shortest diameter, which is adjusted up 2cm for each 6 or 8cm diference between shortest and longest SED.

The volume calculation for the JAS standard is based on the log length, and the adjusted shortest small-end diameter. Thus, the small-end diameter has a major impact on log volume, and hence log value, within a log length class. For example, a reduction from 370mm (scaled as 36cm) to 352mm (scaled as 34cm) in the small-end diameter will reduce the scaled volume, and therefore value, by about 10%.

For most logs, obtaining the small-end measurement is straightforward, merely a location of the smallest diameter and measuring it inside the remaining bark. However, for many logs a reduction to the "true" small-end diameter must be made because of some defect which occurs at the small-end (Figure 3). These defects fall into two categories; man-made (most commonly splits) and inherent (often surface bark-encased knots).

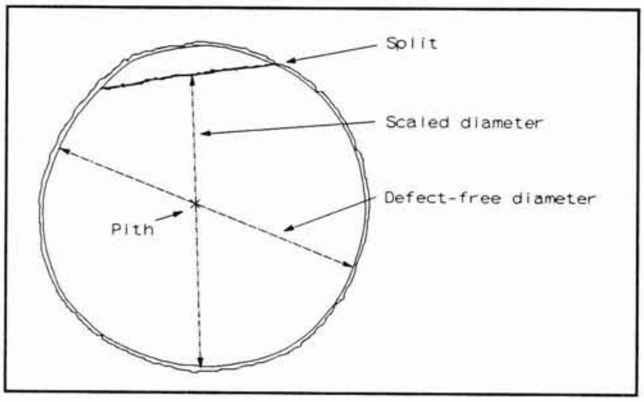

Figure 3 - Adjustment of minimum small-end diameter caused by end split

Due to the requirements of their task, the scalers record only the "inside defect" measurement. There is no record kept of what the volume and value of a log could/should have been if the defect was not present in the end of the log.

It must be noted that even though some logs have a defect, the defect does not necessarily reduce the scaled diameter. There are two reasons why this may occur. Firstly, the two centimetre round-down factor may have an influence. For example, a log may have a true small-end diameter of 357mm, and an inside defect diameter of 343mm. Even though there is a 14mm difference between the two measurements, when rounded down to the nearest even 2 centimetre class, the scale diameter will be recorded as 34 centimetres. Secondly, a defect may occur on a long axis so does not affect the shortest diameter measurement.

Figure 4 - Bark encased knots are also a major source of scale diameter reduction

STUDY METHOD

Stacks of known grade and length were randomly selected at the log storage area at the wharf-side at the Port of Tauranga. No attempt was made to select logs from any particular supplier.

The small-end of every log within the stack, identifiable because of the attached tag, was closely inspected for any diameter-reducing defect. Those logs which were judged to have a defect which would reduce the small-end diameter were first scaled as if the defect was not present (Full-scale), and then again taking into account the defect (Defect-scale). The two sets of scale measurements were recorded.

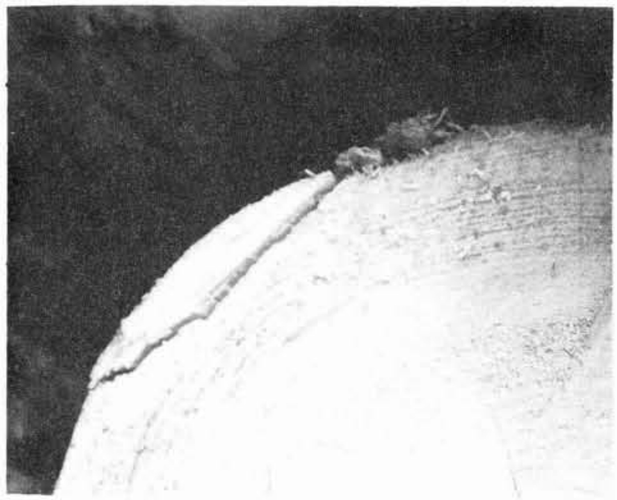

Figure 5 - Even small splits can result in significant value loss

If a defect was present, but did not reduce the unrounded-down diameter, it was not recorded. This sometimes occurred where the defect was on a long axis across the small-end. After a stack had been fully checked, a count was made of the total number of logs in the stack. Defect-free logs were not check scaled.

Subsequently, the proportion of logs with diameter-reducing defects was calculated, and the impact upon the JAS scale volume, and the value of the logs, assessed. As defect-free logs were not measured, the distribution of the total population was assumed to be that of the defect logs sampled.

RESULTS

GRADE	LENGTH	SAMPLE SIZE	AVERAGE VOLUME (JAS)	AVERAGE FULL-SCALE SED (CM)	PROPORTION WITH DEFECT	GRADE VALUE LOSS ($ PER JAS)
A	12	1973	2.23	39	8.7	0.87
	8	1615	1.38	40	5.4	0.66
	4	1507	0.64	40	7.0	1.20
J	8	1542	0.80	30	2.2	0.28
H	8	1436	0.70	28	4.3	0.57
	6	1835	0.40	25	2.9	0.45
	4	1985	0.32	29	2.6	0.28
K	11	1382	1.35	31	4.1	0.49
	7.3	2000	0.85	32	3.9	0.51
	3.6	1395	0.42	33	3.3	0.58
PB	Various	1210	1.24	46	2.7	0.38
TOTAL/OVERALL AVERAGE		17880			4.3	0.63

Table 1 - Defect proportions and average value losses for measured export log grades

Not all of the log grades exported from the Port of Tauranga were assessed. Eleven common grades/lengths were selected, and over 17,000 logs within those grades checked for small-end defects.

The results indicated that small-end scale reduction defects average from around 30 cents per JAS scale to $1.20, and that from 2% to 9% of logs within a grade have a diameter-reducing end defect. The log value of all grades was assumed to be $85 per JAS unit, except for the pruned log grade, which was valued at $150.

The importance of these results is that if this sample is representative of the total log export production, conservatively estimated at 3 million tonnes for 1991, then roughly $1.6 million is being lost to New Zealand forest companies from these defects. The losses are extended into the trucking fleet, as in some cases truck contractors are paid on the delivered scaled JAS results.

Placed in overall perspective, the scaling losses are not overly dramatic, accounting for less than 1% of total product value. However, they do represent an area where some avoidable losses are occurring, so need continual monitoring.

Twelve metre A-grade logs represent the greatest proportion of logs by volume exported from the Port of Tauranga. An analysis of the end defects of this grade is therefore presented in detail.

Defects in A-Grade 12 Metre Export Logs

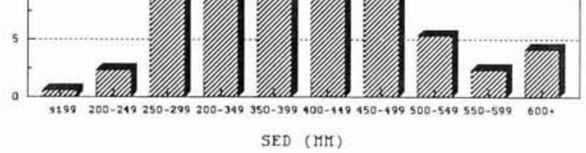

Figure 6 - Distribution of "Full-scale" SED for 12 metre A-grade sample

The frequency of the Full-scale small-end diameter is assumed to be similar to the total population of 12 metre A-grade logs exported over the study period (Figure 6). It has the expected left-skewness imposed by the minimum diameter restrictions of the grade.

The value loss distribution reveals that in most logs where a defect occurs, between $10 and $19 are lost, although nearly 10% of defective logs suffer a loss of over $50 (Figure 7).

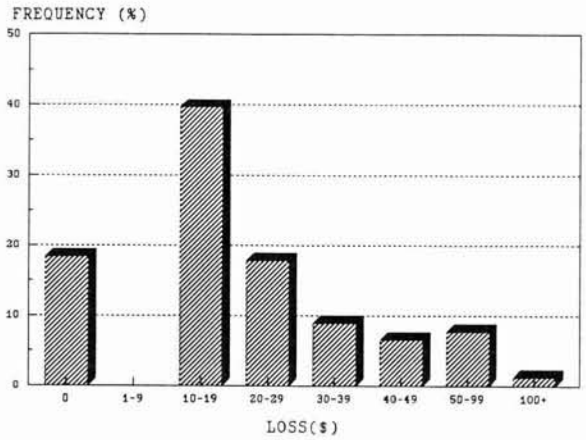

Figure 7 - Distribution of value losses from SED defects in 12 metre A-grade export logs

Just under 20% of logs with a defect do not incur a value reduction as the diameter difference allows the measurement to remain within the same 2 centimetre class. However, the 2 centimetre class structure has its disadvantages. A small defect of 4mm which, for example, shifts the small-end diameter from 422mm to 418mm, has the same impact as a 22mm defect. In both cases, the SED used for the volume calculation will be 40 centimetres.

As noted, scaling reductions come from both man-induced and from inherent stem characteristics. The man-induced defects are most often from end splitting created at the time of cross-cutting. Typically, a split will be created at the final point of severing.

Another defect that can be attributed to the cross-cutting procedure occurs when a cross-cut is not fully completed, and a section of the stem is torn from the log as it has been lifted by a loader.

Inherent defects resulting in diameter reduction most commonly come from bark encased knots. When a cross-cut is made

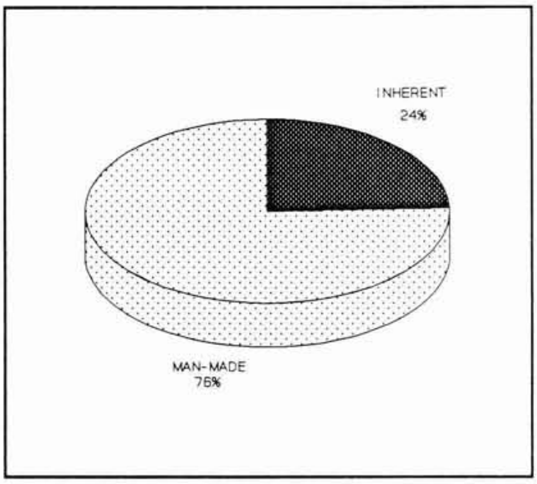

Figure 8 - Causes of scale diameter reductions in 12 metre A-grade export logs

on a surface branch on some occasions the bark may fully surround the branch causing a scale reduction.

Defects from the man-made causes, primarily splits, are most prevalent (Figure 8). The inherent defects, most frequently knots, caused about one-quarter of the loss occurrences. The average loss from splits was $22.54 per occurrence, while for knots the average was $24.51. These were not significantly different at the 5% level.

A trend was detected using regression analysis of the dollar value loss increasing with increasing small-end diameter. This is to be expected as a two centimetre diameter reduction would have a greater volumetric impact on a 55 centimetre SED log than it would on a 25 centimetre log.

No trend, however, could be detected between full-scale small-end diameter and the size of defect diameter reduction for splits. Large diameter logs therefore do not show any evidence of having a greater severity of end splitting than do small diameter logs.

JAS Scale Compared to JHD Scale

For consistency in assessing defects amongst grades the JAS scale was used for all grades. However, most commonly, A-grade logs are sold based on the Japanese Haakon-Dahl (JHD) scale.

GRADE	GRADE VALUE LOSS ($ PER JAS)		CHANGE (%)
	JAS SCALE	JHD SCALE (in JAS equivalent)	
A-12	0.87	0.39	- 55
A-8	0.66	0.44	- 33
A-4	1.20	1.72	+ 43

Table 2 - Effect on defect losses in A-grade using JAS and JHD scales

To assess what impact the scaling method has upon the results, all of the A-grade samples were re-calculated using the JHD scale method. The results obtained are not accurate as JHD requires the small-end to be measured through the log centre rather than the pith, but they do give an approximation of the impact of the scaling method.

The JHD system uses imperial measurements and diameters are rounded down to the nearest half-inch (1.2cm), rather than 2cm as in the JAS scale. A key difference between systems is that the effective SED in JHD is based on the average of the shortest and longest SED whereas the effective SED in JAS is based on the shortest SED.

Conversion from the JAS to JHD scale affected the three lengths (12m , 8m and 4m) differently. With 12 metre logs the average cost impact of small-end defects in the JHD scale was reduced to about 45% of that of the JAS scale, while for 4 metre logs the average cost for defects was raised by 43% (Table 2).

Man-Made Versus Inherent Defects

As seen in Table 1 the proportion of logs with a diameter reducing defect varies amongst grades. Within the A-grade 12 metre logs, the losses were found to occur mainly from man-made defects, especially splits.

A review of the other log grades, as shown in Table 3, revealed the same trend with splitting dominant as the cause of most value loss. Accumulating all of the measured grades showed 77% of the scale reduction coming from man-made defects, while 23% were a result of inherent defects.

Figure 9 - Some splitting is so severe it can result in the log being rejected

While surface bark-encased knots do not occur as a defect as frequently as end splits, the severity of their presence on value over all of the grades tends to be higher than that for splits ($18.82 versus $12.79).

When cross-cutting, the log-maker should, therefore, be aware of the effect that cutting right on a branch whorl may have on export log value. This is particularly important in older stems with larger branches, as with this material the branch is more likely to be bark encased.

GRADE	LENGTH	PROPORTION OF DEFECT VALUE LOSS (BY CAUSE GROUPING)		COST PER OCCURRENCE ($)	
		MAN-MADE	INHERENT	SPLIT	KNOT
A	12	76	24	22.54	24.51
	8	66	34	14.31	27.94
	4	77	23	10.20	14.57
J	8	56	44	8.42	13.99
H	8	94	6	9.19	10.68
	6	86	14	6.88	3.91
	4	80	20	3.03	7.24
K	11	95	5	17.21	14.41
	7.3	70	30	9.33	22.02
	3.6	59	41	5.27	13.23
PB	Various	82	18	15.57	33.80
OVERALL AVERAGE		77	23	12.79	18.82

Table 3 - Proportion and cost of both man-made and inherent small-end defects

Impact of Log Size on Value Loss

It might be expected that larger diameter logs would tend to exhibit a greater propensity for value loss caused by splitting simply because the opportunity for greater loss in the larger logs. This supposition was checked by accumulating all of the split defects in similar length logs, including the 8 metre A, J and H log grades and the 7.3m K grade.

A regression analysis showed that value loss did increase with both increasing small end diameter and increasing volume, although there was considerable variation within this trend.

CONCLUSION

The small-end diameter of export logs are scaled inside of diameter-reducing defects. No record is kept of what the diameter would have been if the defect was not present.

A check of a sample of export logs at one export facility revealed that from 2% to 9% of all logs have a defect which reduces the small-end diameter. Most of these defects occur as a result of end splitting created when the log is cross-cut in the forest.

Additional care by log-makers would assist in minimising the losses from this source of defect. A key step would be the instruction of the scaling method to log-makers, and how defects reduce value. Log-makers should also be made aware that making a cut right on a surface branch whorl can also substantially reduce log value and by shifting the cut slightly, this defect can often be eliminated. Loader operators should also be shown how their actions can influence value. For example, when picking up a log which has not be completely severed, the loader should not attempt to break the remaining wood, but get the log cleanly severed by chainsaw.

Log exports will continue to be an important market to New Zealand forest companies for the foreseeable future. Closer attention to log-making will not only improve the value of individual logs, but also maintain a high standard of product presentation to present and future customers.

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