THE EFFECT OF LOG GRADE ON SAWMILL PERFORMANCE

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SUMMARY

The major indicators of the performance of a sawmill are Conversion, Grade Recovery and Production Rate

There are six identifiable categories of log characteristic that significantly affect these indicators;

- Diameter
- Length
- Sweep
- Corewood/Pith
- Butt Flare and Buttressing (Fluting)
- Defects: (Knots, Damage, Stain and Decay)

If these characteristics are identifiable, then a mill can maximise log value by ensuring that mill procedures are optimised within the constraints of the grade parameters. The matching of sawpatterns to log type, and log types to market needs, are examples of how this is achieved. Similarly, the physical characteristics of the log will determine how efficiently a log can be processed, and as different machines have different capabilities, they rely on log grading to avoid serious production compromises.

In general, tight and narrow specification is easier to deal with than broader specification.

INTRODUCTION

The use of log grades that effectively identify a log's characteristics can mean the difference between profit and loss for any sawmill. The way in which these characteristics affect the performance of the sawmill is not straightforward, and can sometimes be frustratingly difficult to assess. This is especially true if the log grades under scrutiny are broad based and have wide within-grade latitude.

There is often some consternation amongst log suppliers when the sawmiller apparently does not know how to specify exactly the grades required. Part of the problem here is that the supplier often puts too many flavours into a single grade. This can be for quite legitimate reasons, such as the logistics of forest operations, but sometimes it is because no-one has ever asked for anything different.

The problem for the sawmiller is the log grade specification for optimum production and profitability is a moving target. The interaction between log variables and sawmill activities can create an enormous variety of products, as well as problems. This is becoming increasingly so as markets diversify away from traditional framing products. If any criticism can be levelled at the sawmiller, it is in the inconsistent (or in some cases, non-existent) keeping of records of the relationship between log grade, sawmilling method and timber grade out-turn. This is basic knowledge and is ignored at great peril!

My intention in this presentation is to briefly identify the important log grade attributes and discuss how each specifically affect the performance of the sawmill. The primary considerations are how the sawmill itself is affected, although it is recognised that further processing and remanufacture may also be influenced by log grade.

GRADABLE CHARACTERISTICS

First of all, it is worth listing the log variables that might be considered "gradable". These would include;

- Diameter
- Length
- Sweep
- Corewood/pith
- Butt Flare and Buttressing
- Defects
  - Knots
  - Damage
  - Stain
  - Decay

MEASURING THE MILLS PERFORMANCE

With the current high price levels on the world log market, conversion factor is increasingly becoming the most important measure of a mills performance. It is the only avenue of improvement open to the mill that will provide increased revenues at no extra cost, unlike production rate or grade recovery which incur the cost of extra logs or higher grade logs respectively. However, the real measure of success is the profitability of the mill. This is influenced by log grade not only through conversion, but also through the recovery of appropriate sawn timber grades and through production rate. The "gradable attributes" described in the previous paragraph, directly affect these three measures of a mill's performance.

GRADE CHARACTERISTIC / PERFORMANCE RELATIONSHIP

a) Diameter

Diameter affects the performance of a mill in three important ways.

Firstly, it determines the potential conversion factor of log to sawn timber, as shown in Figure 1. This is a well known relationship and it impacts dramatically on the profitability sawmills of any type.

Secondly, production rate is related to diameter, and in general the rate increases with the square of diameter. For a single pass system or a carriage system, this relationship holds true up to the point where it becomes difficult to handle the diameter, and production drops off. An example of this effect for a carriage and headrig is shown in Figures 2 and 3, and Figure 4 shows the effect for a single pass machine.

Thirdly, diameter can affect the probability of knots appearing in a given board, so that product value will result from an interaction between cutting pattern, knot distribution and diameter. Figure 5 shows how this can happen.

b) Length

The log length specification has two major effects on the performance of a sawmill. As with diameter, the conversion factor can be affected if the lengths produced from the log do not match the product requirement and have to be docked back. In some cases, docking for grade will negate the length advantage, but in general it is preferable to start with as much length as possible, and starting 5mm below a preferred 300mm increment can prove wasteful. Few mills have the luxury of being able to pull totally random lengths and win back any loss in this area.

Production rate is the second mill performance measure to suffer if lengths are below the specification. In general the handling time for a log being manoeuvred onto a carriage does not increase with length, so that as log length decreases, log volume decreases and the handling time per unit volume increases. Thus a 3m log effectively has twice the downtime associated with it when compared to a similar diameter 6m log. There is nothing that the sawmill can do to overcome this.

Similarly for a single pass machine, there is a minimum set time for the saw systems, which means that there must be enough time between presentation of consecutive logs for the saws to set and lock. For a machine running at 60m/min and taking one second to set (fairly quick!), there must be at least one metre between logs. The effect on unrecoverable downtime is shown in Figure 6. Without investing in expensive merchandising equipment, the only way to overcome this problem is to purchase large batches of fixed diameter logs. This would allow continuous operation without resets between each log.

A further effect of logs being outside length specification, and which arises occasionally, is the situation where a mill receives a premium for length. Loss of length would then affect price premium as well as conversion.

c) Sweep

The relationship between conversion and sweep has been demonstrated in studies on radiata pine (Cown *et al* 1984). Figure 7 shows this. The loss of conversion when sweep increases is more marked as diameter decreases, and small, swept logs in some cases produce very little timber of value to the market.

Handling swept logs is invariably more time consuming than handling straight logs, in that the sweep has to be oriented the correct way for presentation to the saw. This helps to improve conversion, but can reduce production rate. To add to this, simply manoeuvring the log on the carriage becomes difficult and moving swept logs around the mill can create delays. Often the transfer decks rely on the ability of a log to roll - something that swept logs are reluctant to do.

If the sweep occurs in two planes, then the manoeuvrability problem can be worse, as can the loss of conversion. It can be very difficult for the operator to choose the correct orientation for a log with sweep in more than one plane.

d) Corewood and Pith

No radiata pine log comes without some measure of corewood, nor without a generally unruly pith. Though they are a natural part of the resource, it is important that the percentage of corewood in certain products is controlled. There are end uses where corewood is perfectly acceptable, especially if it can be dried without inducing too much distortion. The predisposition of corewood to twist on drying, and it's lower density and strength, require that a mill has a ready market for certain types of product if it intends milling logs with high corewood percentages. This is generally related to age and diameter of the logs. Thinnings and top logs normally give most problems in this area.

Figure 8 shows the relationship between log diameter and corewood percentage, as indicated by the presence of pith. In general, careful attention to stacking and weighting of the drying stacks, and correct kiln schedules, will help to minimise any drying problem associated with juvenile wood. However, it is unlikely that it will be entirely eliminated.

e) Butt Flare and Buttressing

The major effect of butt flare and buttressing is conversion loss. However, it is a disproportionately high value loss, since it always occurs in the outer wood of the bottom part of the best logs - often pruned logs. Although the mill may pay for significant weight in this part of the log, it often loses several percent of the volume .

f) Defects

Knots: Knots can be considered to be an attractive part of the natural product, as they are in such popular products as "Baltic Pine", or they can be the scourge of mankind, as they are in radiata pine. In general radiata pine knots are defects, and detract from most end uses, thus devaluing the timber.

In traditional framing end uses the knot size has been the limiting factor for grade, and this has allowed us to capitalise on multi-nodal trees with many small to medium sized knots. However, for factory type end uses, the size of the knot is less important since it will probably be docked out. It is better for the knot frequency to be low, regardless of the knot size - in which case uni-nodal stock is preferable. Thus in determining the value of a log to the mill, the end use of the timber will determine which knot type and distribution is preferable.

Damage: Damage to logs affects a mills performance when there is loss of fibre as a result of the damage, such as with splits, or if there is a log jam created by the damaged log. In some cases, such as undetected felling shatter, the results can be spectacular and dangerous, as logs disintegrate in the machinery.

Stain: Stain is a problem if it appears in timber intended for an appearance grade, although some customers will not accept stain for any end use. The major effect of stain is to reduce the market value of the timber produced.

Decay: Decayed wood is not a common problem in plantation radiata pine, though it may be in older shelterbelt timber or in other species. The effect again is to devalue the timber if stain is associated with the decay, and also to reduce conversion through the rejection of some pieces.

PROBLEMS ARISING FROM GRADE INTERPRETATION.

When "gradable" characteristics have been identified, we should consider their effects before we can put them into any order of priority. It is worth noting that the way in which a characteristic is defined for purposes of a grade can make an enormous difference to the buyer (and, no doubt, the seller).

For example, if a log specification states that diameter range is 250mm to 500mm, the effect of this on how a mill operates may be very different from the effect of two grades specified as having diameter ranges of 250mm to 350mm and 351mm to 500mm. On the face of it the two situations are at least similar, but a lot can depend on the distribution of diameters within the range, and often this can depend on how the logs are selected. In some cases, the grade determining factor is influenced by decision making for other grades peripheral to the grade in question, and only by tightening the specification can this influence be controlled.

A similar situation exists with length. An upper and lower limit may not be sufficient information for a mill to control it's production process, unless the distribution of lengths is known. In some cases, fixed length grades make more sense to the mill.

It is accepted that no grade will be perfect for either buyer or seller, mainly because of the logistics of forestry operations, but also because processing industries ideally need a grade specification with some flexibility in the parameter mix. The paradox is that a sawmill needs a very tightly defined grade for maximum fibre recovery, while at the same time requiring flexibility to meet ever changing market needs. It is partly for this reason that many sawmillers have difficulty defining what it is that they really want!

CONCLUSIONS

The major indicators of the performance of a sawmill are;

Conversion
Grade Recovery
Production Rate

The log characteristics affecting these indicators are;

Diameter
Length
Sweep
Corewood/Pith
Butt Flare and Buttressing
Defects: Knots, Damage,
Stain and Decay

In order to best deal with these performance determining log characteristics, it must be possible to identify them using a grade indicator. The mill can then ensure that the grade mix is handled in a controlled way to maximise the objectives of the mill. No log grade will be perfect, bearing in mind the nature of the resource, but in a processing system all variables should be controlled as much as possible. To the sawmiller, the grading of logs is the first step in the control of the process.

Reference

Cown, D.J., McConchie, D.L., Treloar, C. Timber recovery from pruned radiata pine butt logs at Mangatu: Effect of log sweep . N.Z. J. For. Sci. 14 (1) pp109-123, 1984

FIGURE 1. Diameter and Conversion
(trend only)

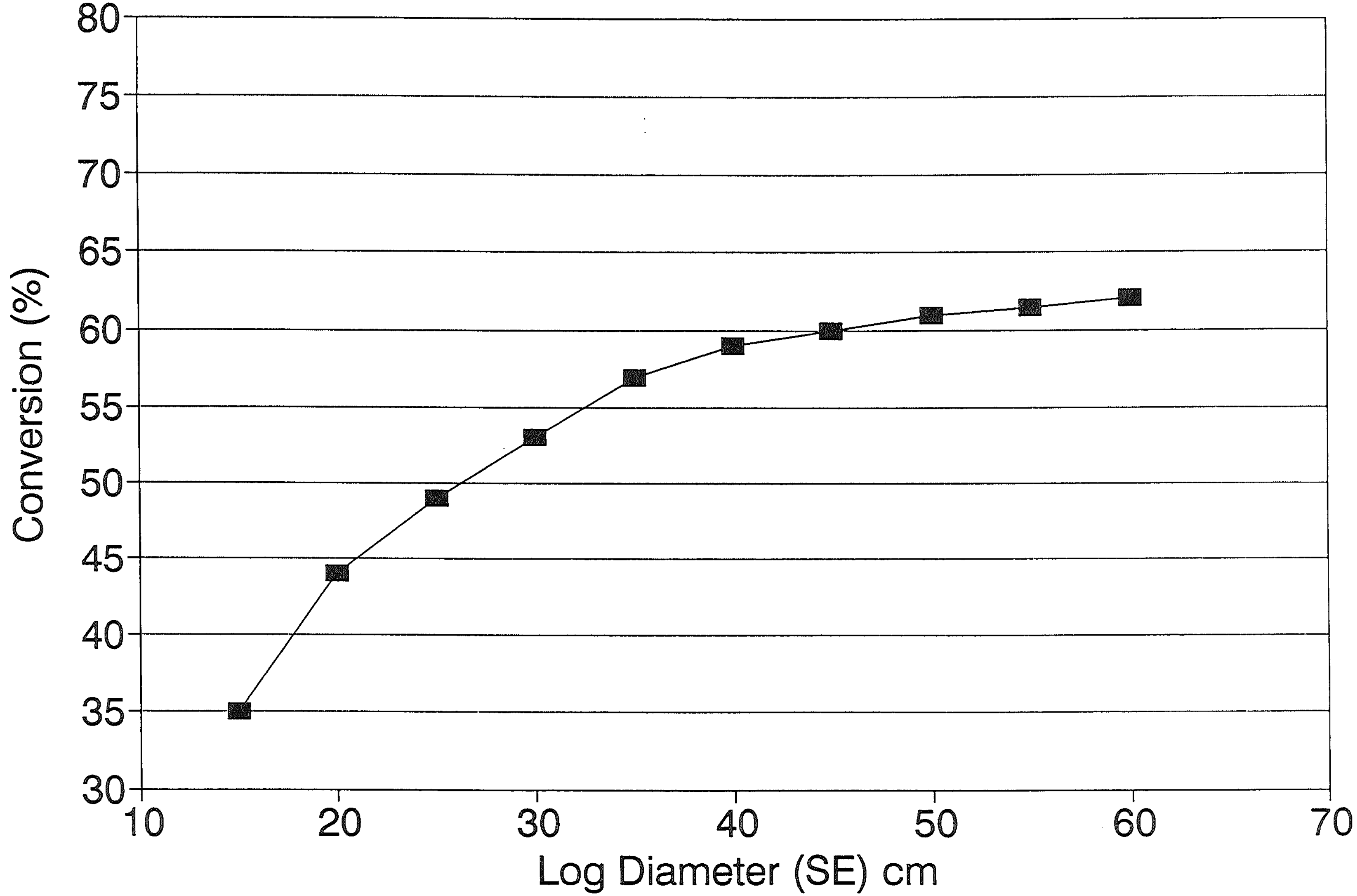


FIGURE 2. Piece processing / diameter relationship for headrig/carriage

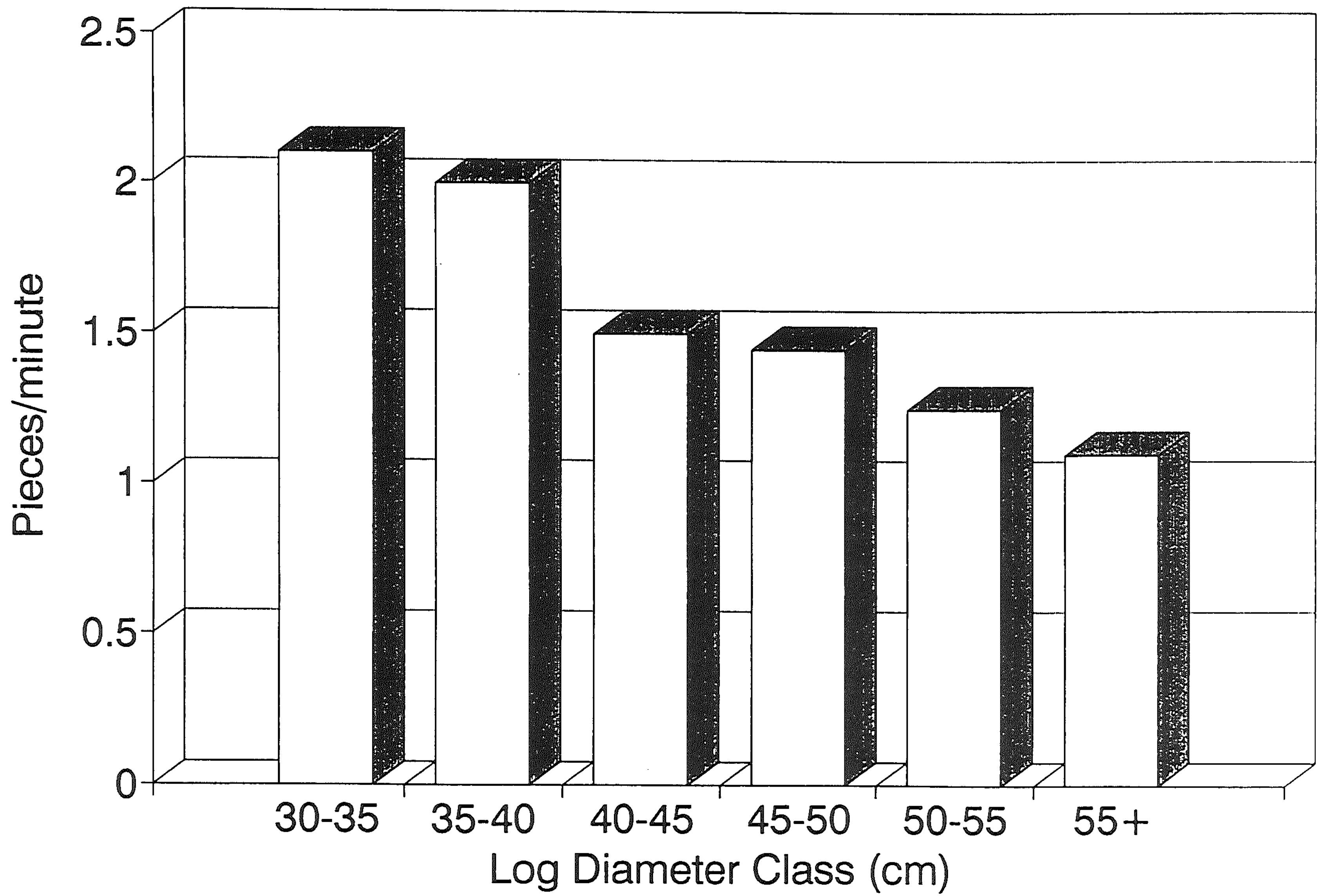


FIGURE 3. Volume processed by diameter class for headrig/carriage

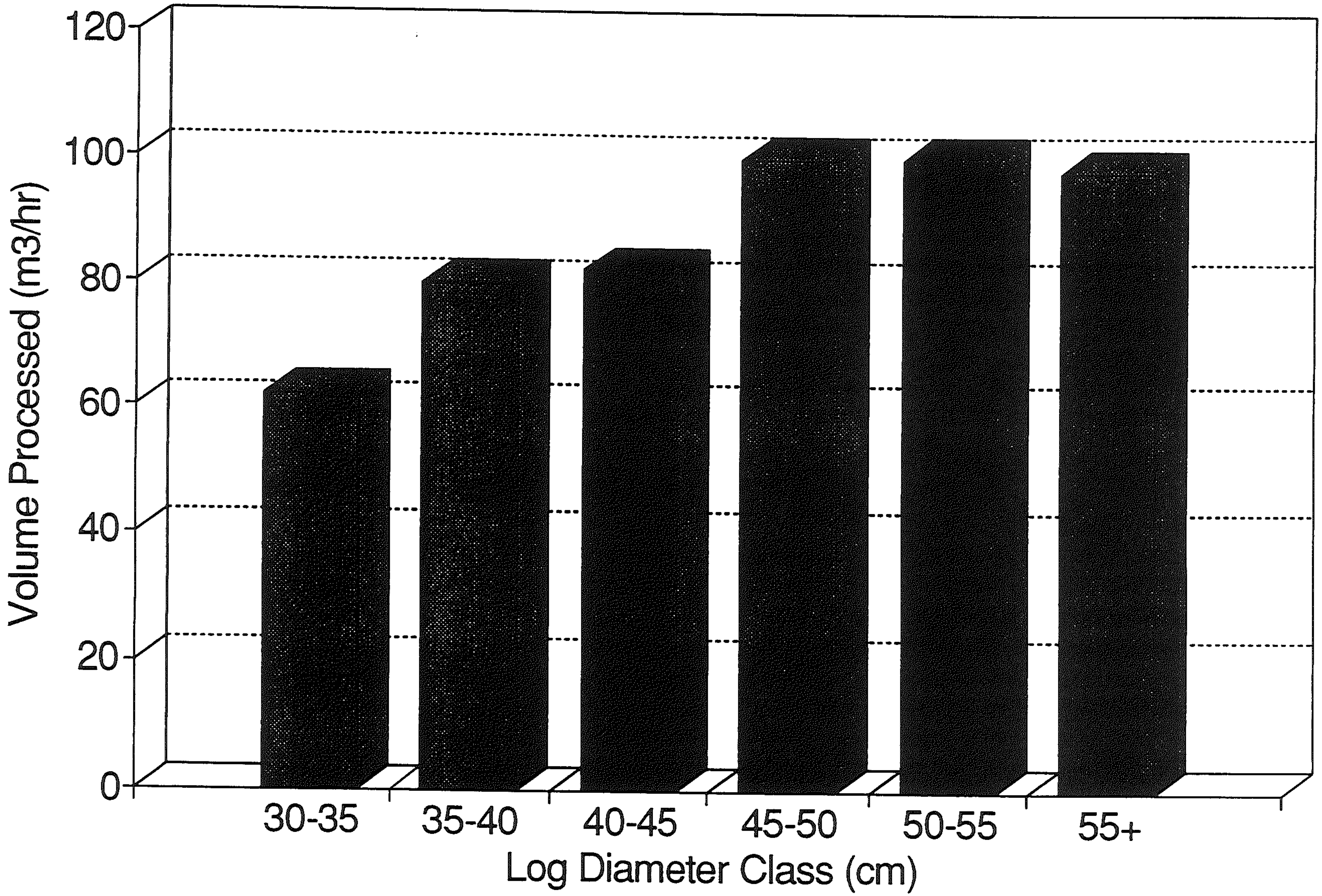
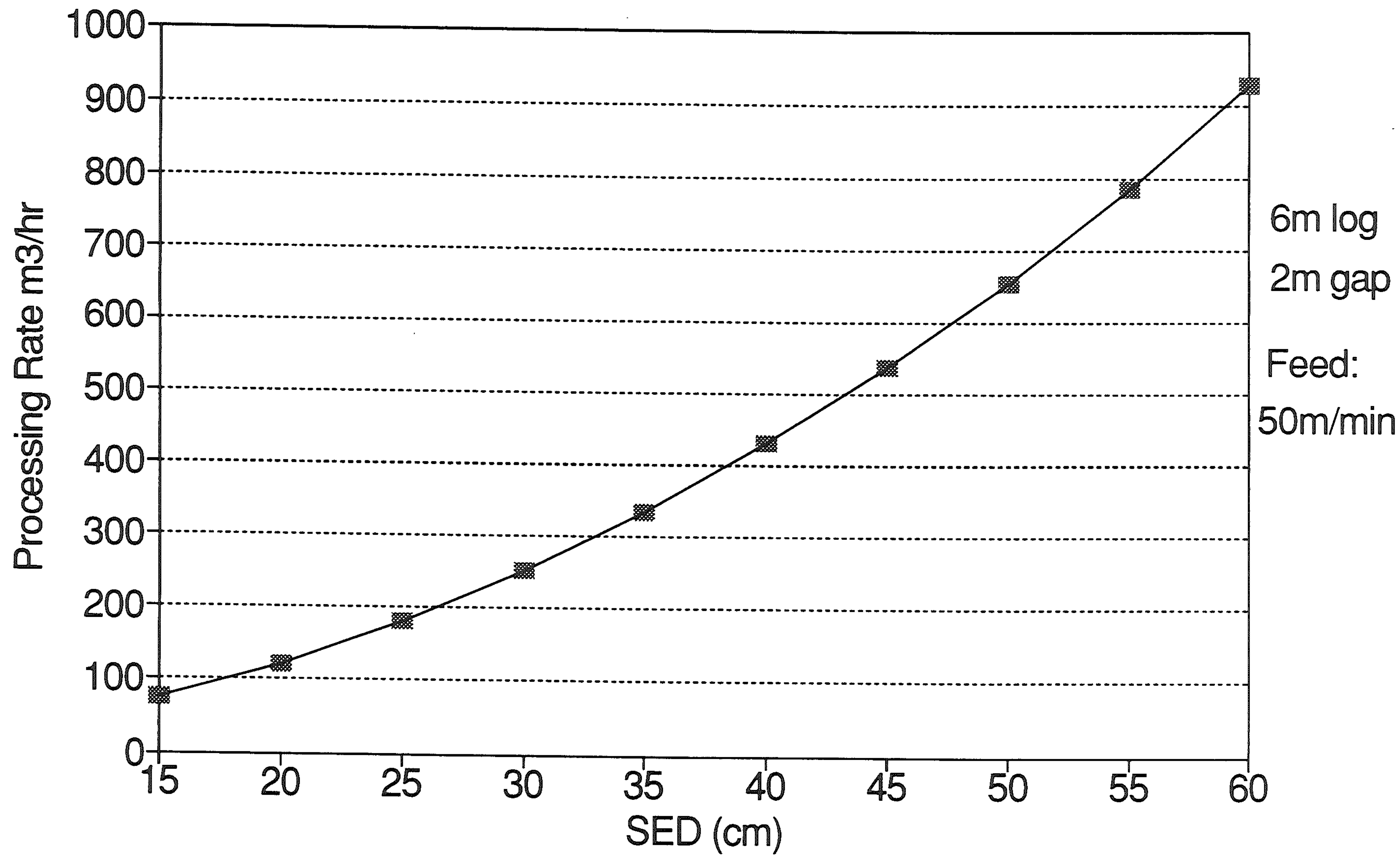


FIGURE 4. Maximum processing rate and diameter for a single-pass machine



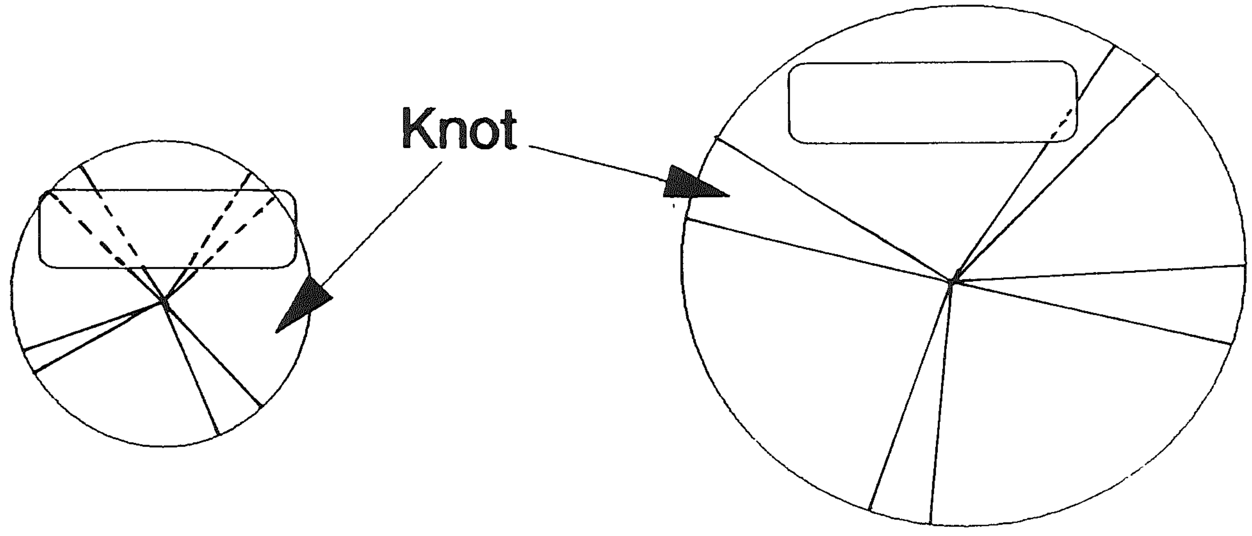


Figure 5. Effect of diameter on probability of hitting knots

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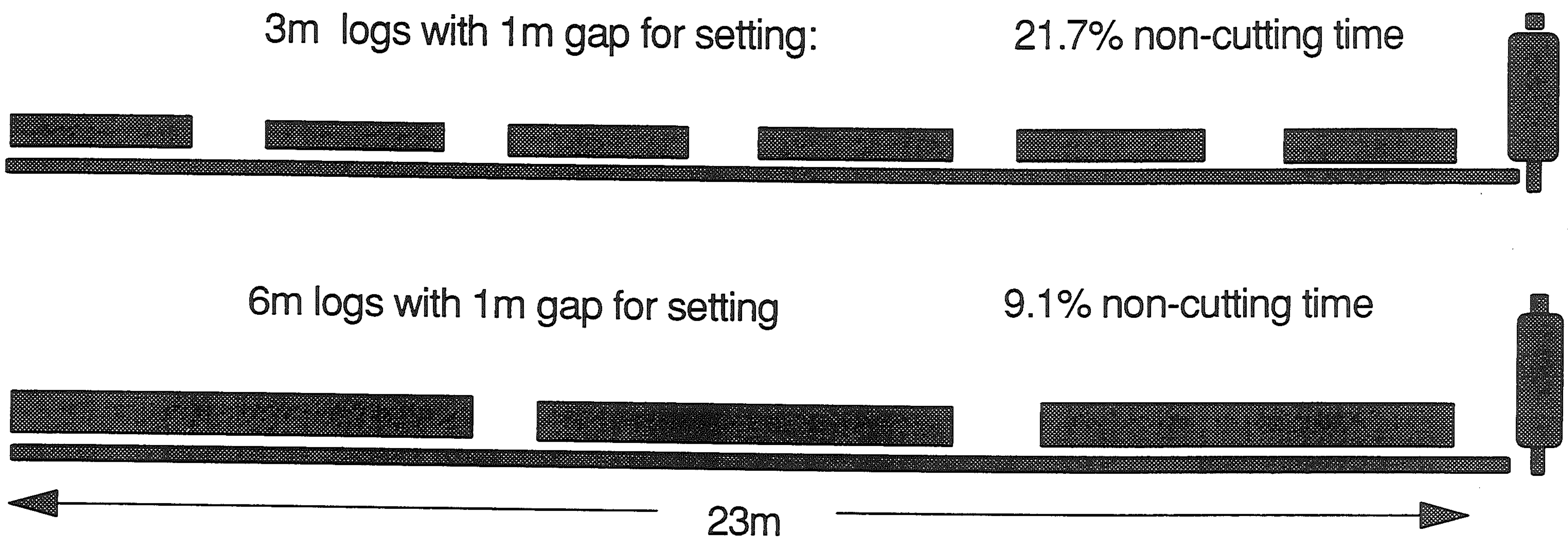
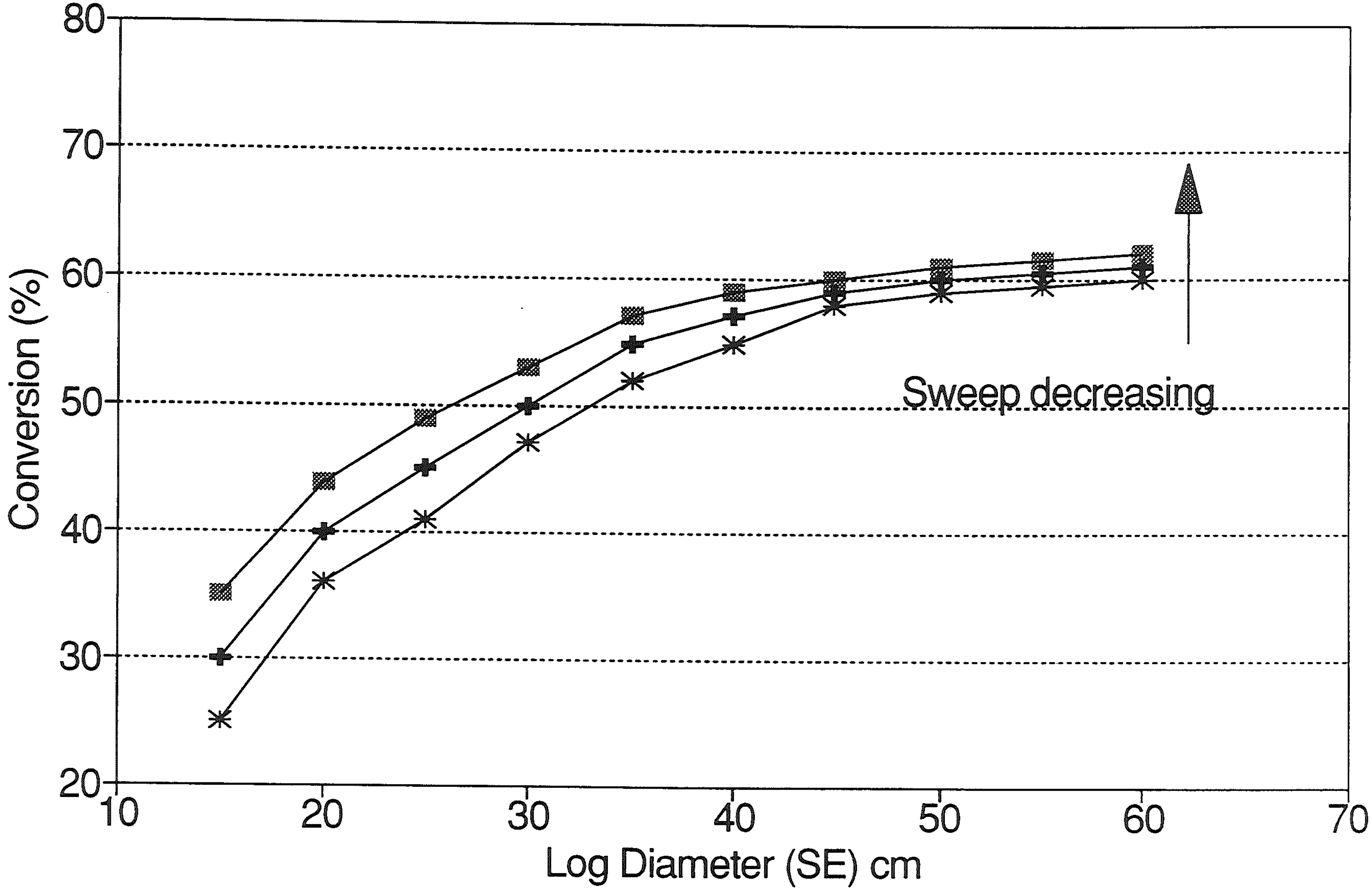


FIGURE 6. Effect of log length on production rate - single pass system

FIGURE 7. Diameter and Conversion for 3 Sweep Levels (trend only)



After Cown et al

FIGURE 8. Juvenile wood - presence of pith as an indicator