REVIEW OF PAST WOOD QUALITY RESEARCH ON AGROFORESTRY SITES

O. Cox, D.L. McConchie, R.R. McKinley

Report No. 9 April 1995

FOREST & FARM PLANTATION MANAGEMENT COOPERATIVE

EXECUTIVE SUMMARY

REVIEW OF PAST WOOD QUALITY RESEARCH ON AGROFORESTRY STANDS

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The current review draws on the findings of 13 studies, 11 of which relate directly to the New Zealand agroforestry resource and two Australian studies which complement research that has been undertaken in New Zealand. The studies span the past 12 years but show an increase in allocated research effort in the last five years. The individual studies investigate a wide range of quality issues and include wood properties with an emphasis on wood density, log characteristics, grade recovery and conversion, sawmill productivity, drying characteristics and stability and mechanical pulp quality.

The review describes a piecemeal approach to understanding the wood quality issues that may impact on available utilisation options. It also highlights the difficulties in separating the influences that age, breed, site and silviculture have had on wood properties and indicates that good comparative "normal" forest sites are not available.

The review concludes that the quality of logs and subsequent products produced from stands grown on fertile agricultural sites differ from those predicted from forest locations. In part, the problem is that young, fast-grown trees have large amounts of juvenile wood which has inferior properties for most uses. This problem is not unique to radiata pine grown on fertile farm sites. The increasing proportions of juvenile wood are of concern the world over, where conifers are managed for fast growth and short rotation. The quality of the agroforestry stands, particularly those established at wider spacings, will reduce the range of utilisation options available. A better understanding of wood quality issues is required to successfully match this resource to appropriate products.

REVIEW OF PAST RESEARCH ON AGROFORESTRY

INTRODUCTION

This report outlines the results of wood quality and conversion studies carried out on trees grown on formerly agricultural sites. The sites have a generally higher fertility than normal plantation sites. A problem with the studies to date is that these have tended to be piecemeal and as a result comparisons between studies are difficult. The difficulty arises because in most cases there is more than one source of difference between the stands being studied making meaningful comparison difficult with a limited database.

In view of this difficulty this report outlines the broad trends and future work on wood quality to be undertaken on these sites.

The studies that have been carried out on wood properties and utilisation of trees from fertile pasture sites are summarised in the last section of the report. Where the studies are commented on, the text of the report and the month and year of the study are given in brackets.

The studies have concentrated on a few sites, notably Tikitere. Small processing trials have largely been carried out on an opportunistic basis and have often used very young material. Now the trials at Tikitere and Whatawhata are nearing harvest age planning is needed on expanding existing wood quality results and matching these with processing trials.

REVIEW OF RESULTS

The summary of studies investigating wood properties and the sawing, grade recovery and further processing characteristics of trees grown under a range of agroforestry regimes clearly indicate a piecemeal approach to this component of the forest resource. Individual studies have identified a number of departures from expected trends which require further definition and acknowledgment when processing logs from rapidly grown stands established on fertile sites.

The issues identified tend to be due to more than one cause. Fertile sites have high growth rates which often leads to shorter rotation ages. The effect of site alone is often difficult to separate from the effect of short rotation. In addition when wide spacings are used to both maximise growth on fewer trees and to reduce rotation age further additional difficulties arise in determining the site effects in isolation.

Much of the information to date relates to wood density alone. Density is an important property in determining, among others, timber strength and pulp yield from a given volume of log. Other properties are often more difficult to sample for, especially when stands are not felled. As yet there is nothing to link variations in

density between different sites to variations in other properties. The difficulty in sampling means there are little data to provide evidence of any correlation, or lack of any correlation, in variations in wood properties between sites.

Density

The studies of fertile pasture sites are difficult to interpret for the effect of site on density because of the lack of good controls in the studies. Wood density increases with age (Cown at al, 1991) and this means that there is a tree age effect on the average density of sawn timber sawn from trees grown on fertile sites in addition to the site effect. A number of studies do however indicate that density is significantly lower on agricultural sites than on normal forest sites for the same age.

The most detailed work on fertile pasture sites has been carried out at Tikitere and at Whatawhata. Results from these trials show a significantly lower than expected density when compared to normal plantation sites (as indicated by Cown et al, 1991). Exact comparisons are difficult as there are no plantation site controls in either trial (this was not possible at either site). The results for both trials are shown on the accompanying graphs alongside the high, low and medium curves identified by Cown et al (1991). The results that would normally have been expected for both of these sites are closer to the medium curves than the final curves given. In the Tikitere case a different seed source also plays a part.

Results from Tikitere and Whatawhata also show that outerwood density is lower in the lower stocking stands. The 100 spha stands had outerwood density between 4 to 7% lower than the 400 spha stands. The Tikitere stands are 850 series which, at Rotoehu, has outerwood density some 7% lower than comparable climbing select stands. Tikitere also has outerwood density some 8% lower than Whatawhata which is climbing select but site differences also affect the difference. The results for Tikitere and Whatawhata have been arrived at from resin extracted increment cores using the densitometer (Aug 1992) but similar results have been arrived at using disc samples (without resin extraction) (Jan 1993).

At Ngatira (Feb 1990) 18-year-old trees grown under an agroforestry regime had sawlog densities that were 8% lower (350kg/m^3 as opposed to 385kg/m^3) than expected if only latitude and altitude were taken into account.

Other studies which also found basic density to be lower than expected, based on altitude and latitude, included Waikite shelterbelt (Nov 1986) and studies in New South Wales (May 1991).

In summary the studies to date suggest that basic density is significantly lower on former pasture sites for a given age and tree breed. In addition lower stockings also seem to result in lower density for wood from a given growth ring and a given height.

This is consistent with the findings of the FRI wood properties survey (Cown et al, 1991) which suggested that higher soil pH, N and P levels reduced basic density in

both corewood and outerwood. In the survey only the P level was statistically significant at the 5% level. With the stocking effect competition could be reducing nutrient availability to individual trees.

A further mechanism which could reduce average stand density is intensive thinning. With large reductions in stocking through thinning there could be reductions in average density if high density is negatively correlated with growth and form in the material planted. This has not been investigated.

Latewood percentage

The densitometer results on Tikitere and Whatawhata (Aug 1992) indicated that latewood percentage was reduced with lower stockings. The Tikitere stands had lower latewood percentages than the Whatawhata stands.

Other Wood Properties

The effect of site on wood properties other than density is not well known. A number of observations from agroforestry sites have been made which, if indicative of trends would affect the value of wood from agroforestry sites.

Little is known about the effect of site on spiral grain. Tikitere (Jan 1993) did, however, show a more gradual decline in spiral grain from the highest levels (3 to 6 rings from the pith) suggesting that a higher proportion of sawn timber sawn from this stand will be prone to twist and other degrade than is normal.

The incidence of resin pockets was high in the Waikite shelterbelt (Nov 1986). This was not as evident in other studies with different planting configurations.

Tree form

In a number of studies, including at Thames Sawmilling (March 1986), McAlpines (June 1986), Tikitere (January 1993) and New South Wales (1991), the poorer form of trees grown at low stockings on fertile sites was noted. Factors affecting poorer form included higher taper, often high sweep and large nodal swelling.

Large branches are often a problem with fertile sites and low stockings. When multi-nodal trees are grown on fertile sites with wide spacings very few short clears can be produced.

Rapid Growth and Low Rotation Ages

A number of features of the studies has been the impact of factors which are affected by rapid growth and low rotation ages. Assuming harvest is held for a similar time to normal stands then some of these maybe no worse than for traditional sites and silvicultures.

With rapid growth and lower rotation ages there is a high percentage of corewood in the final crop trees. This has a major impact on the performance of solidwood products sawn from the timber. In addition to low density, corewood also has higher spiral grain and is therefore more prone to drying degrade and is less stable in use. Lower rotation age also means that wood has higher moisture content resulting in increased drying and transport costs and a greater susceptibility to sapstain.

Grade Recovery, Conversion and Drying

Grade recovery and conversion have often been low in the studies undertaken using young agroforestry logs. Major causes of problems to green rough sawn timber recovery have been large branches, sweep and taper (see for example June 1986 and March 1986). Lower than expected density also severely reduced recoveries of machine stress graded framing timber (and would reduce the strength of timber graded to visual rules) in a number of studies (Nov 1983, Nov 1986, Feb 1990, Dec 1989, Feb 1990 and May 1991). The lower density and resulting lower strength of the agroforestry logs was seen as restricting the range of potential end uses. Damage during processing was also noted during the Ngatira study (Dec 1989 and Feb 1990) and low density would have contributed to this.

Drying difficulties have been experienced with young fast grown wood. In addition the stability of wood from the centre of young logs has been identified as a problem in many uses but particularly in the higher value uses of solidwood such as joinery. The studies to date have not been comprehensive and have been aimed more to improving drying techniques than to evaluating changes in drying characteristics.

Twist was a serious problem with 50mm sizes sawn from the 18-year-old trees from Ngatira (Dec 1989 and Feb 1990). Difficulties with drying and high shrinkage were noted from timber sawn from 14-year-old thinnings (June 1986). However when sawn to 40mm sizes (for which the grading rules have a very high tolerance of twist) 19-year-old trees from Tikitere did not show high levels of reject due to warp (Jan 1993). The 19-year-old material did however show substantial spring and high levels of rejection as a result. Kinks were noted in the sawn timber but additional care with filleting could reduce this. In one of the few studies comparing wood of different ages in a particular product, laminated window components, wood from 19-year-old Tikitere trees distorted much more than similar wood from 30 year-old plantation material.

The results indicate more that young age is a problem in processing and in drying from fertile sites. It is not possible to separate out the effect of rapid growth resulting from fertile sites from the young age effect as young trees from "normal" sites have similar problems even though the logs may not be as large.

SUMMARY

The results of the studies to date can be summarised as follows:

For fertile sites:

- Basic density drops for a given growth ring.
  The implication of this is that strength and hardness are significantly reduced and mechanical performance drops.
- Latewood percentage is reduced.
- Spiral grain has been found at higher average levels in the one agroforestry site measured. If this repeated then higher degrade can be expected in solidwood from these sites.

Where fertile sites are combined with low harvest ages:

- Corewood proportion is high resulting in poorer average wood properties.
- Increasing processing costs, lower recoveries and grade outturns and poorer solidwood dimensional stability.

In the more extreme cases the effect of lower grade recovery, higher processing costs and higher degrade has been to substantially reduce the value of the crop. In other cases severe limitations as to the suitability of the wood from some studies for particular uses have been identified. Unless these are fully understood poor matching of wood to product will result in lower market acceptability of radiata pine.

Future Work

With the increasing planting on fertile farm sites it is important that the impact of this and of the silviculture applied on wood properties, log characteristics and on product recovery and product performance is fully understood. The purpose of the processing trials is to establish which wood gives problems in processing and service. The aim is to identify the wood properties causing problems (and at what level) and to establish ways of avoiding them. Issues of log shape, size and branching are less of a concern as these are already well established.

A number of studies are planned which will outline some of the processing and wood properties of trees grown on fertile agroforestry sites. These include work under the Government funded programme as well as other studies, in particular the Value Recovery Programme. Planned studies include:

1. Processing trials using logs sourced from a large agroforestry trial site or sites:

   Tikitere and Whatawhata would be suitable as these have a range of stockings. Additional wood property work would be carried out at harvest. The approval of the owners of the trials is needed before detailed planning

starts. A small processing trial of 19-year-old thinnings from Tikitere has been carried out.

2. Wood property data on low stockings:

The sampling for density at Tikitere and Whatawhata has not included the very low stocking (50 spha) treatments. In order to further clarify the stocking effect sampling of the 50 spha treatment is desirable.

3. Wood properties in the Low and High Density Zones:

The two large trials sampled to date have not included one from what would normally be regarded as the "low density zone" or the "high density zone". The third large trial in Otago is the logical one to sample and could provide additional material for processing trials should the wood property sampling suggest that this is desirable. It is also important to identify a suitable high density site for comparative purposes.

4. Puruki Wood Property and Processing Trials:

The Puruki trial site contains a range of tree stockings from low (50 spha) to very high planted on a former pasture site. The site provides a further opportunity to examine the effect of silviculture on wood properties and product outturns as well as permitting site contrasts with the other main trial blocks.

SUMMARY OF INDIVIDUAL STUDIES

Date: November 1983
Study: Sawmilling trial of Agroforestry and Conventionally - Grown Radiata Pine
Reference: Siemon, G.R., White, K.J. and Thomson, A.B. (Unpublished) Western Australia Dept. of Conservation and Land Management, Crawley, W.A
Description: A sawmilling trial cutting mainly structural lumber from an agroforestry trial (age 13 years), a fuel reduced buffer (age 14 years), three conventionally grown plantations (28, 25 and 21 years) and a private plantation (17 years) was completed. The trial included a comparison of visual stress grading and mechanical proof grading. A subsample of the fast grown trees (the agroforestry stand, fuel reduced buffer and the 28-year-old ex-pasture site) were milled entirely into boards.
Key Points:

- The sawn graded recoveries and percentage of F5 stress grade timber produced were similar for each treatment.
- The timber from stands of fast grown pine (the agroforestry stand, fuel reduced buffer and the 28-year-old ex-pasture site) produced a high percentage of docked F5 stress grade material indicating that wood quality is poorer. The reason for this being the large proportion of juvenile wood.

- The recoveries from the agroforestry stand, fuel reduced buffer and the 28-year-old ex-pasture site sawn to appearance grades were higher than those from the larger sample milled to produce mainly structural lumber indicating the milling of agroforestry timber into boards rather than structural lumber should be considered.

Date: March 1986
Study: An Assessment of Sawlogs Cut From Agroforestry Thinnings and Sawn by the Thames Sawmilling Co. Ltd.
Reference: Forest Research Institute, Rotorua. Project Record No. 1148
Description: At a sawmiller's request the suitability of sawlogs cut from agroforestry thinnings was investigated. A sample of 15-year-old pruned and unpruned logs were measured, cut to a range of sizes both for structural and appearance grades, and then graded and tallied.
Key Points:

- Sawmill personnel commented that logs were more susceptible to sapstaining. An expected result given that younger logs have a higher moisture content along with higher proportions of sapwood.
- For the pruned logs sweep was the most common defect. Defect cores were not measured but indications from the initial opening cut revealing some occlusion scar or branches suggest they were relatively large. Sawmillers should make the effort to determine the potential value of pruned logs prior to submitting tender prices.
- For the unpruned logs sweep and excessive branch size were the most common defect.
- Spiral grain was noted, often associated with excessive nodal swelling. This characteristic can lead to additional problems when drying either before sale or in service.
- Mill productivity, conversion and grade recovery were all below the values of comparable batches of older logs.

Date: June 1986
Study: An Assessment 14-Year-Old Agro Forestry Thinnings Sawn at McAlpine's Sawmill, Rotorua
Reference: Forest Research Institute, Rotorua. Project Record No. 1208
Description: At a sawmiller's request the suitability of sawlogs cut from agroforestry thinnings was investigated. A sample of 14-year-old pruned and unpruned logs were measured, cut to a range of sizes both for structural and appearance grades, and then graded and tallied.
Key Points:

- High taper and sweep values (an apparent characteristic of agroforestry thinnings) had a significant effect on mill productivity and recovery of longer length boards and framing sizes.
- Sawmillers should make the effort to determine the potential value of pruned logs prior to submitting tender prices.

- Sawmiller's comments included; reduced productivity (approximately 20 %), conversion and value, increased drying times, and higher shrinkage to the air-dry condition. These findings were consistent with previous studies carried out by the Wood Quality and Conversion Group at F.R.I.
- Spiral grain was noted, often associated with excessive nodal swelling. This characteristic can lead to additional problems when drying either before sale or in service.

Date: November 1986
Study: Comparison of Radiata Pine Shelterbelts and Plantations
Reference: Agroforestry Symposium Proceedings. FRI Bulletin No. 139
Description: Part 1: Trees and logs from seven shelterbelts in Canterbury and the Central North Island were measured and compared with measurements on log samples and model predictions representing plantation trees.
Key Points:
- Branch index was found to be larger than for a widely spaced forest stand.
- As a result of the large branches (and therefore larger whorls), internode index for the shelterbelts was reduced.
- Recovery of short clear cuttings was reduced.

Description: Part 2: A 22-year-old shelterbelt at Waikite, Rotorua was felled and analysed in greater detail.
Key Points:
- Plantation-derived models accurately predicted for stem diameter distribution, taper, sawn conversion, and grade out-turn.
- Wood density was lower than predicted.
- Incidence of resin pockets was shown to be high.

Date: February 1990
Study: Wood Properties of 18-Year-Old Pinus Radiata Grown Under an Agroforestry Regime
Reference: Forest Research Institute, Rotorua. Project Record No. 2383
Description: A range of wood properties were measured on fifteen trees (selected to cover the diameter range and proportionally represent the distribution of log grades determined by MARVL assessment) sampled for a sawing trial of 18-year-old radiata pine grown under an agroforestry regime at Ngatira.
Key Points:
- Moisture content was found to be 11% higher than would be predicted for trees of this age.
- Shrinkage levels were lower than figures normally quoted for radiata pine and indicate an overall improvement in stability, although the short term dimensional stability is worsened (particularly without surface coatings) due to the greater proportion of sapwood.

- Sawlog basic density averaged 350 kg/m^3 compared with expected density of 385 kg/m^3, a decrease of 8% indicating potential problems and higher costs in drying, and restrictions on end uses for timber produced.
- Utilisation of the upper sawlogs would be best suited to pulping or input to reconstituted board products. The butt log although not suitable for structural, furniture or some joinery applications, clear lengths from it could be targeted to a high value non-impact end use such as moulding, beadings, architraves, etc.

Date: December 1989 and February 1990
Study: 18-Year-Old Radiata Pine From Ngatira: Stand Assessment, Sawing, Timber Grades and Drying Characteristics of Pruned and Unpruned Logs
Reference: Forest Research Institute, Rotorua. Project Record No. 2312 and 2374.
Description: Fifteen trees selected to cover the diameter range and proportionally represent the distribution of log grades determined by MARVL assessment, were sampled for a sawing trial. 63 logs consisting of 15 pruned butt logs and 48 unpruned upper logs were sawn at Tasman's Putaruru mill. The pruned logs were cut to maximise clearwood in a mixture of 25mm and 40mm sizes and assessed for green grade recovery and drying degrade. The unpruned logs were assessed for actual and predicted grade recoveries and drying degrade using two sawpatterns, one maximising 200x50mm framing and the other maximising 100x50mm framing. The 200x50mm timber was resawn after grading and drying to be reanalysed with the 100x50mm.
Key Points:

- In terms of green grade recovery the pruned logs were of good quality yielding 65% of all timber sawn in Clears Grades and only 10% in BOX.
- Although the sample size was small, indications are that collapse and internal checking could cause further degrade in clear grades from the pruned butts.
- A branch index of 6.5cm was recorded for the unpruned logs and resulted in poor grade recoveries for framing grades.
- The multi-nodal nature of this '850' breed has resulted in low internode indices which virtually precludes the recovery of cuttings grades from unpruned logs.
- Overall grade recoveries including drying degrade were 7% No. 1F and 56% BOX when maximising 200x50mm, and 5% No. 1F and 59% BOX when maximising 100x50mm.
- Actual recoveries compared to predictions were consistently low for No.1F and high for BOX (Actual recoveries for No.1F and BOX were 8% and 52% of sawn volume with respective predictions of 21% and 32%)
- Using the standard machine grading programs for dry radiata pine the minimum cutoff point for both No. 1 Framing and F5 graded timber were not obtainable as both minimum strength and average stiffness were inadequate.
- Although nail holding power and tension strength were not tested it was felt that these would also be inadequate for structural purposes.
- Twist caused serious degrade in framing sizes, particularly 100x50mm and was most pronounced in lengths containing pith.
- Final moisture contents were variable indicating a need for longer drying times for timber from young trees.

- The significant breakage and mechanical damage noted during this study must be taken into account in the valuation of this stand.

Date: October 1990
Study: Wood Density of Radiata Pine as Affected by Genetics, Silviculture and Site - A Preliminary Analysis of Fertile Sites
Reference: Forest Research Institute, Rotorua. Project Record No. 2620
Description: The outerwood density of breast height increment cores collected from stands representing the various stocking and genetic combinations available in agroforestry trial areas at Tikitere, Whatawhata and Rotoehu.
Key Points:

- Stand stocking at Tikitere and Whatawhata was shown to have a significant effect on outerwood density; the lower stocked stands producing the lower outerwood density.
- The effect on density is essentially due to growth rate with a reduction in stocking from 400 s/ha to 100 s/ha resulting in a reduction of outerwood density of about 4% to 7%.
- The '850' seed source at Rotoehu produced outerwood density approximately 7% lower than comparable 'climbing select' seed.
- The '850' seed source at Tikitere produced outerwood density approximately 8% lower than the 'climbing select' seed source used to establish the Whatawhata stands. Associated site effects could not be separated.

Date: May 1991
Study: Workshop on the Impact and Implications of Pasture Plantings on Radiata Pine Production, Timber Quality and Plantation Management
Reference: Workshop on the Impact and Implications of Pasture Plantings on Radiata Pine Production, Timber Quality and Plantation Management. Summary prepared by E.M. Birk, May 22, 1991. Forestry Commission of N.S.W., Div. of Wood Tech. and Forest Research, Beecroft, N.S.W., Australia.
Description: Relevant key points selected from various presentations but predominantly from a study investigating the effects of ex-hardwood and ex-pasture sites on timber from 20-year-old radiata pine trees.
Key Points:

- Wood quality may not be acceptable to industry, particularly if ex-pasture trees form the bulk of the timber supplied.
- Productivity measured as stand basal area is higher in former pastures than in comparable ex-native forest stands (despite reduced stocking) but merchantable volume in ex-pasture plantations is lower than expected due to defects.
- Basic density was about 5% lower in the ex-pasture site.
- Maximum branch size was generally greater in the ex-pasture site trees for the same branch diameter. This was most evident in the larger trees where maximum branch size was about 20% higher.
- Sawn recovery was approximately 8% lower due to poorer form for ex-pasture site trees compared to ex-hardwood site trees.

- The average timber value per tree was lower in the ex-pasture site by between 18% and 33% with the medium and large trees being most affected.
- Timber stiffness (an indicator of stress grade) was lower in the ex-pasture trees. This appeared to be independent of tree diameter and was about 15% overall.

Date: August 1992
Study: Densitometric Analysis of Radiata Pine Grown on Fertile Agroforestry Sites
Reference: N.Z. Forest Research Institute, Rotorua. Project Record No. 3322
Description: A selection of pith-to-bark breast height increment cores collected from trees representing various stocking and genetic combinations available in agroforestry trial areas at Tikitere and Whatawhata were analysed using an X-ray densitometer.
Key Points:

- Stocking influenced ring width - the lower stocked stands producing wider growth rings.
- Stocking influenced latewood density and percent - both increased with stocking levels.
- Trees established from 'climbing select' seed at Whatawhata produced higher latewood percentages and higher wood density, including ring mean, earlywood and latewood than comparable trees established from the '850' seed source at Tikitere. Associated site effects could not be separated.

Date: December 1992
Study: Investigation into the Suitability of Radiata Pine for Window Components
Reference: N.Z. Forest Research Institute, Rotorua. Project Record No. 3402
Description: Timber from 30-year-old plantation grown logs was compared with timber from 19-year-old agroforestry logs for stability by measuring warp movement with changing moisture content. Samples consisted of laminated sections of final size 86 x 72 mm.
Key Points:

- The laminated samples of 19-year-old material distorted three to five times more than those prepared from the 30-year-old material and are therefore not suitable for window components.

Date: January 1993
Study: Effect of Spacing on Wood Properties of 19-Year-Old Radiata Pine Grown Under an Agroforestry Regime.
Reference: N.Z. Forest Research Institute, Rotorua. Project Record No. 3424
Description: A range of wood properties were measured on 36 trees of 19-year-old trees grown under an agroforestry regime at Tikitere. Three stocking levels were investigated: 100, 200 and 400 s/ha.
Key Points:

- Results showed no significant difference from those found in past studies investigating the effect of rapid tree growth on wood quality.

- Density for whole trees was shown to decrease with increased stocking. This is the result of the low stockings having a higher proportion of denser outerwood although this outerwood was of lower density than that recorded for the more highly stocked stands.
- Compression wood was more severe and occurred further up the stem compared to recent studies on 25-, 26- and 30-year-old trees from typical forest stands.
- Spiral grain angles (excluding the butt disc) declined at a much slower rate compared to earlier studies on material from typical forest sites, resulting in a higher proportion of wood likely to cause problems with further processing.
- Tree size and shape were closely related to stocking level with the more widely spaced stands producing larger and more tapered trees.

Date: January 1993
Study: Kiln Drying of 19-Year-Old Agroforestry-Grown Radiata Pine Sawn Timber
Reference: N.Z. Forest Research Institute, Rotorua. Project Record No. 3423
Description: Matched 150 x 40mm timber sawn from the butt log of 5 agroforestry-grown trees was either high temperature (HT) or accelerated conventional temperature (ACT) dried at 90°C and drying characteristics then assessed.
Key Points:

- Both schedules yielded good results with similar wood colour and no surface checking and either would be suitable for drying this material .
- Twist was not a problem, but this maybe due to the twist allowance being greater for the 40 mm dimension.
- Spring caused substantial rejection particularly after ACT drying and this is mainly due to high longitudinal shrinkage.
- Localised kinks were evident after drying; the large branches and subsequent grain deviation coupled with wide growth rings would have accentuated the kinks. Additional care in the placement of fillets would help reduce kinking and sagging.
- Collapse and internal checking were not a significant problem.

Date: August 1993
Study: Papermaking characteristics of thermomechanical pulp, (TMP), from radiata pine with low latewood content.
Reference: Unpublished PAPRO data.
Description: Thermomechanical pulps were refined from samples of toplog and slabwood material from radiata pine trees grown in the Tikitere trial area at stocking rates of 100, 200 and 400 stems/ha. Newsprint freeness pulps (direct from mainline refining with no screening or long fibre refining) were made into paper sheets and calendered to a range of newsprint sheet densities. The slabwood had latewood contents in the range of 16.6% (100 stems/ha) to 22% (400 stems/ha) which were lower than a reference slabwood from Kaingaroa Forest, which had a latewood content of 29.1%

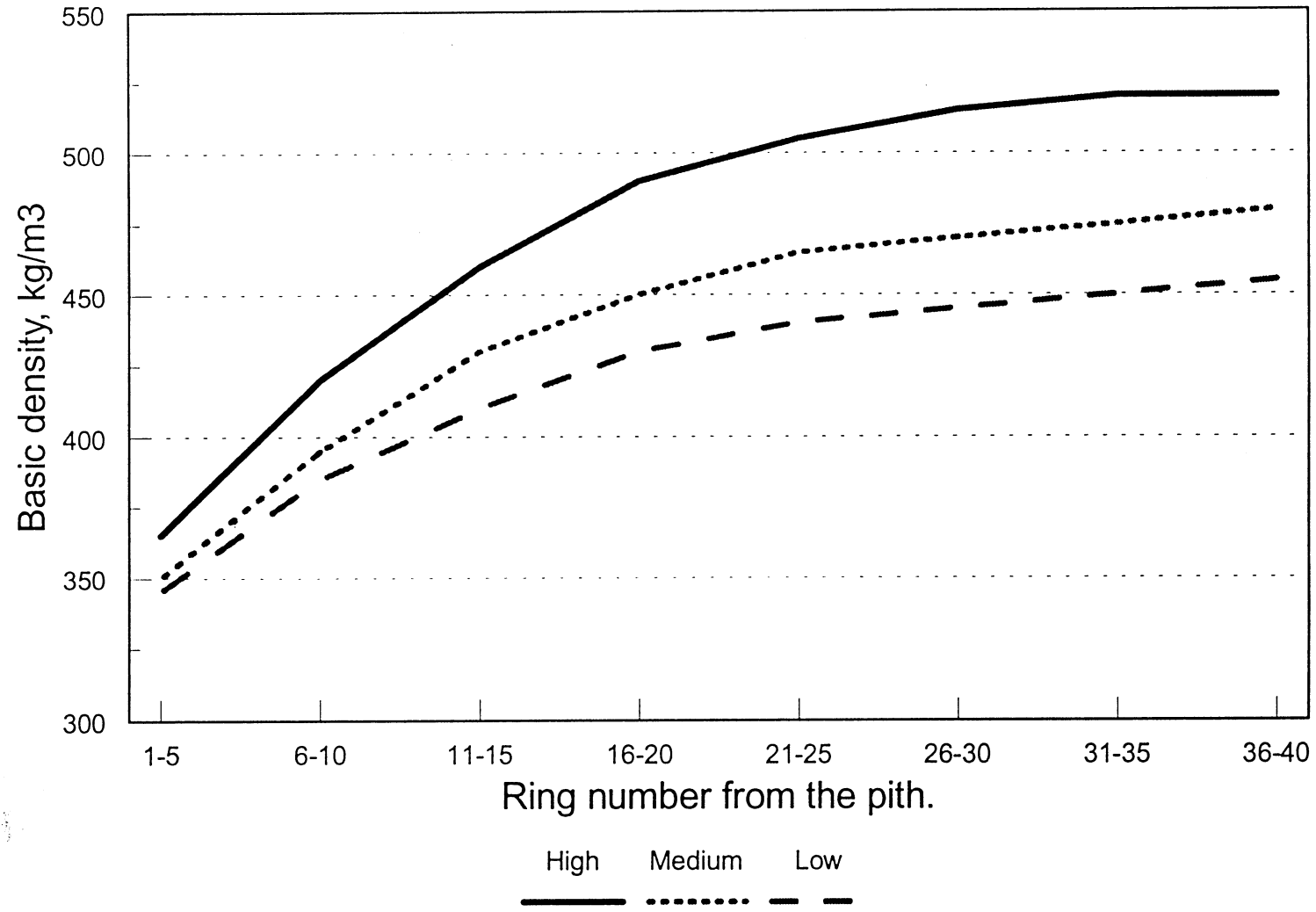
Key Points:

- At a given sheet density, paper from the wood with lower latewood content (i.e. less coarse fibre) had improved smoothness and optical properties, but poorer strength.
- This result is of considerable importance to the printing paper industry which seeks to produce paper with improved printing properties of the type allowed by the low latewood content pulp.
- Further work is required to develop the understanding of the relationship between printability, strength and latewood content and, potentially, the production of wood with reduced latewood content.

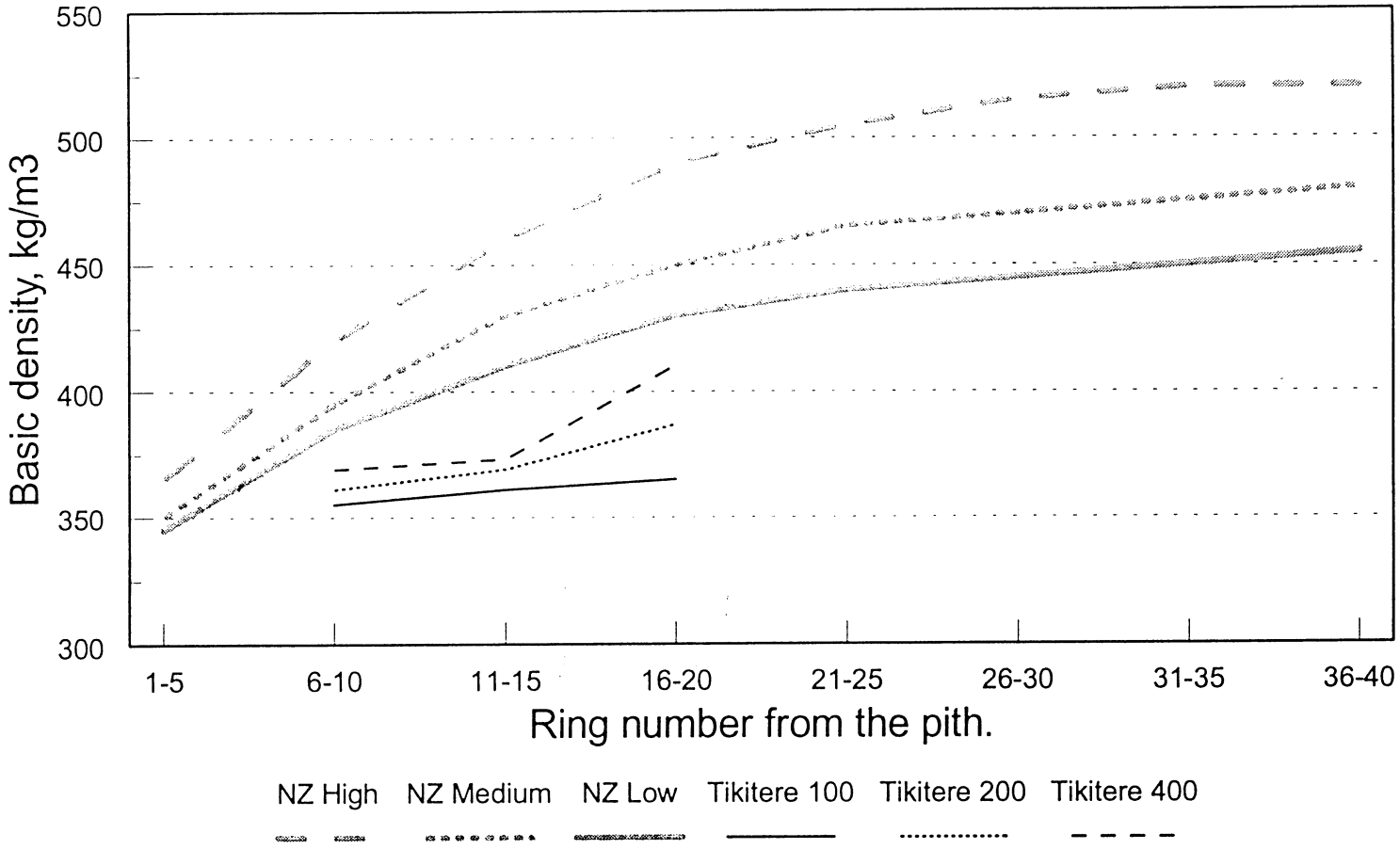
Other References

Cown DJ, McConchie DL and Young GD (1991) Radiata Pine Wood Properties Survey. FRI Bulletin No 50 (Revised Edition)

Basic Density - Radial Trends

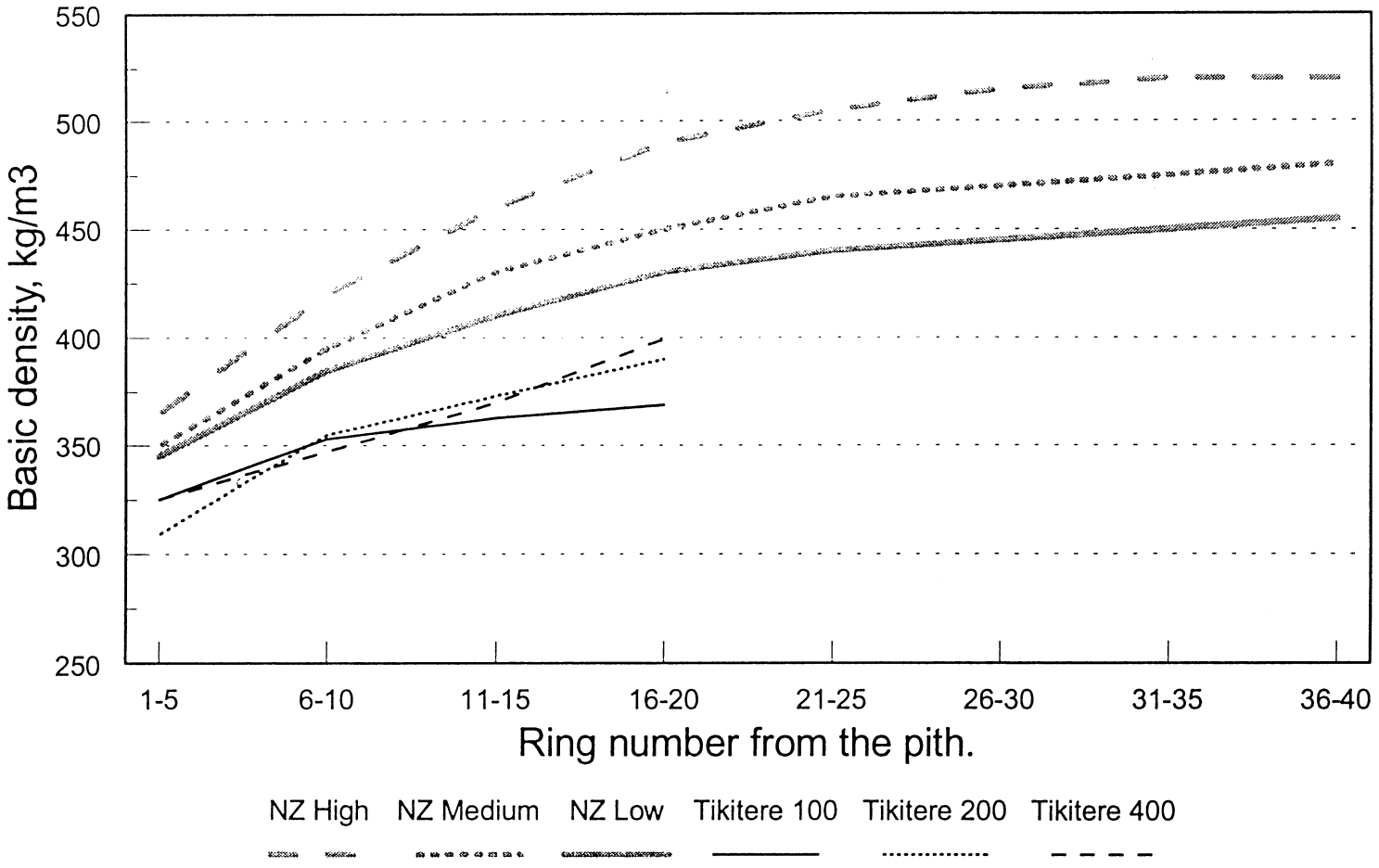


Basic Density - Radial Trends
Tikitere and New Zealand Trends



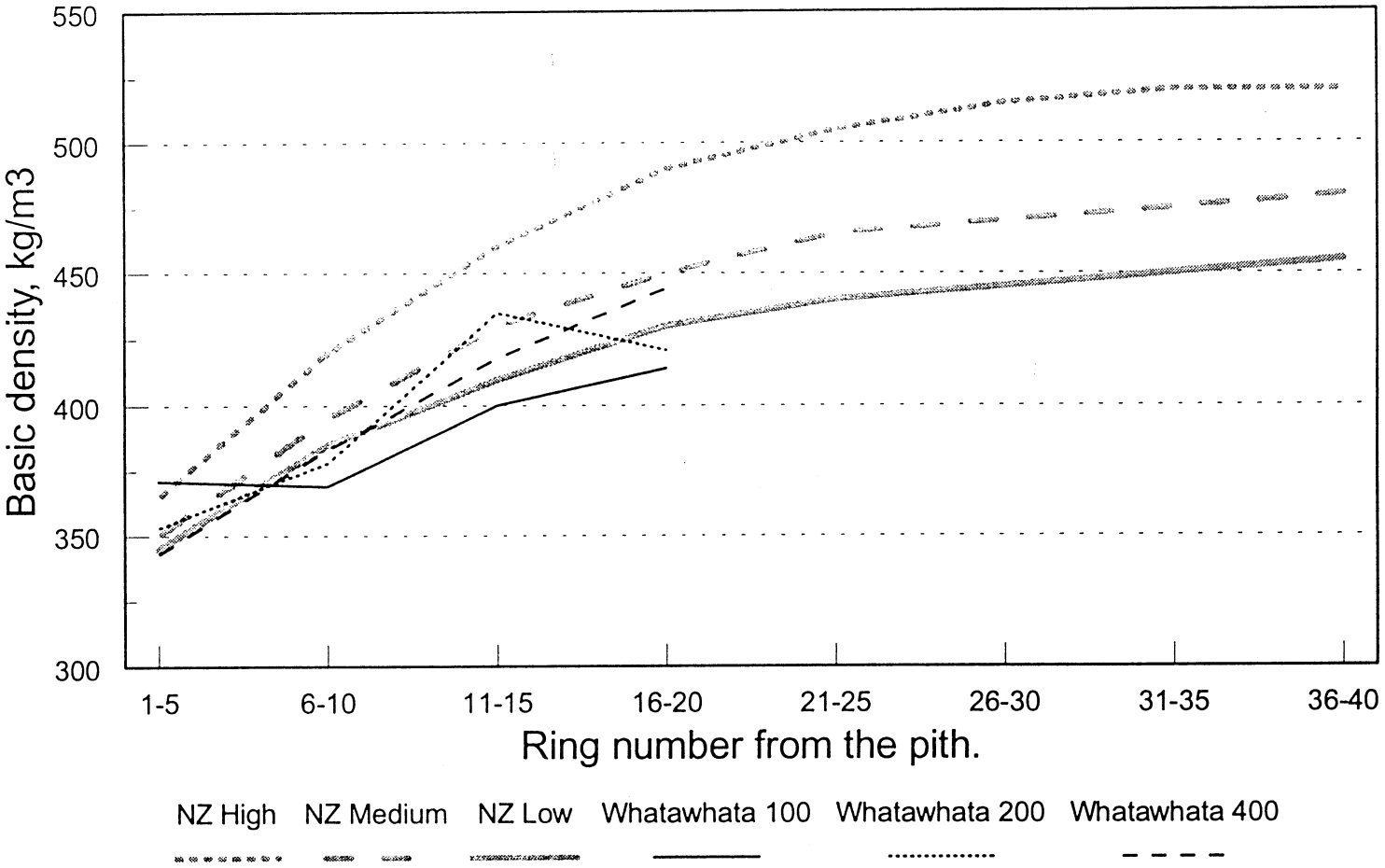
From BH discs - 5 ring ave
Not resin extracted

Basic Density - Radial Trends
Tikitere and New Zealand Trends



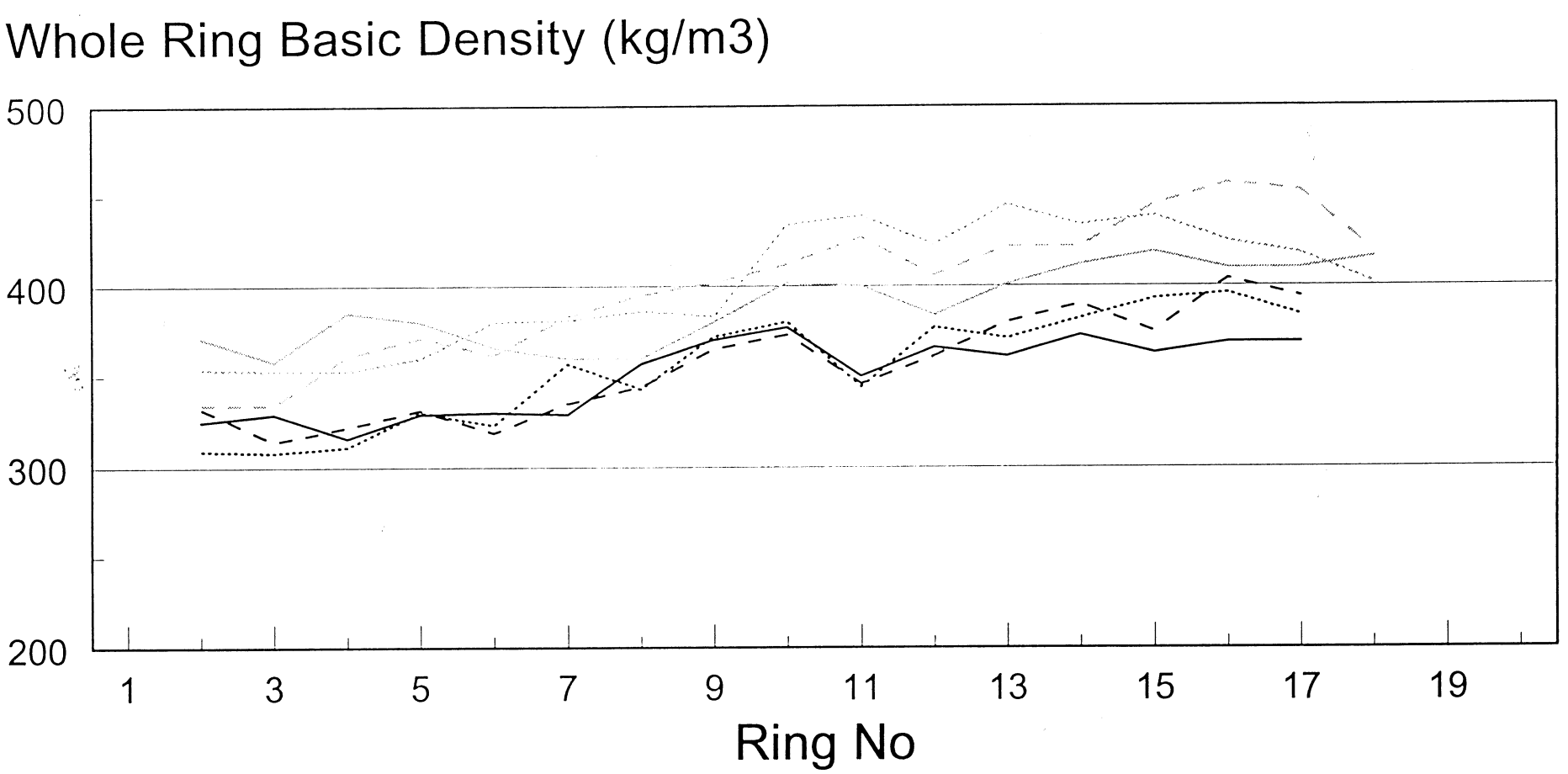
Densitometer data

Basic Density - Radial Trends
Whatawhata and New Zealand Trends



Densitometer data

Basic Density Trends
Whatawhata and Tikitere



Densitometer data