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## Theme: Radiata Management Theme

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# Radiata Pine Heartwood Modelling

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# EXECUTIVE SUMMARY


This report presents new algorithms to predict the distribution of radiata pine heartwood using data collected from both North Island and South Island sites. The regulation of heartwood formation and the possible impact of genetics on heartwood distribution are beyond the scope of this study, as the relevant data are not available.

Heartwood in radiata pine is of interest to forest managers for three reasons:

1. Heartwood detracts from the values of clearwood from pruned logs if the heartwood diameter exceeds the defect core
2. Heartwood percentage strongly affects log moisture content, which in turn influences sonic measurements of velocity, leading to imprecise estimates of stiffness.
3. Heartwood formation may prevent the initiation of intra-ring checking.

Mature tree stems typically consist of a non-conductive central core, heartwood, and an outer water-conducting zone, sapwood. Heartwood differs from sapwood in properties such as colour, extractives content, permeability, wood density, durability, shrinkage, etc. In practical terms, heartwood is a desirable stem component for applications requiring stability and durability. However, heartwood affects the efficiency of preservative treatment, and can lower the value of clearwood products in certain markets that prefer light colour. Also, heartwood presence is a disadvantage for paper and wood composites due to its colour and high extractives content.

While end-product value of forest stands is now generally acknowledged as a function of wood quantity and quality, effectively managing the heartwood resource is becoming a hot topic in a global sense. Recent research has indicated an increasing interest in heartwood distribution in terms of:

- predicting the distribution of heartwood in current and future forest stands; and
- understanding the regulation of heartwood formation (i.e., the key factors influencing heartwood formation).

To be useful for incorporation into growth models, we established heartwood models to predict:

- heartwood area percentage by tree age and vertical position in the stem; and
- heartwood ring number by crop age at breast height.

The results of this study demonstrate that both tree age and vertical position in the stem are key parameters in predicting heartwood distribution. All new models were validated using t-tests at 95% confidence level, and the difference between the predicted and the measured mean values was proved to be insignificant. Further study has been suggested to explain the higher heartwood percentage obtained from the forest stands located at northern sites.

# BACKGROUND

## Characteristics of Heartwood

Mature tree stems contain an outer water-conducting zone (i.e., sapwood) and an inner "dead wood" zone (i.e., heartwood). Heartwood is a natural feature in the development of tree stems, and has physical and chemical characteristics different from sapwood, including colour, extractives content, permeability, wood density, durability, shrinkage, etc. In practice, therefore, heartwood and sapwood are considered two somewhat different types of timber.

Plantation-grown New Zealand radiata pine has a relatively small proportion of heartwood: a 20-year-old radiata pine tree has about 10% of its volume as heartwood (Kininmonth and Whitehouse 1991). The heartwood volume increases with tree age to the point where at 30 years of age the heartwood volume is about 20% of the tree volume, and at 40 years of age about 30% of the tree volume (Kininmonth and Whitehouse 1991).

Species tend to have a typical age at which heartwood starts to develop (Harris, 1954; Mörling and Valinger, 1998). Heartwood in New Zealand radiata pine usually begins to form at age 12 to 14 years (Cown and McConchie 1983). Young tree stems consist entirely of physiologically active sapwood, acting as a food and water reservoir. In the living trees, sapwood of radiata pine is about 90% saturated with water, which in low density radiata pine can mean >200% moisture content (based on the oven-dry weight of the wood). As the tree stem ages (after about 12 years), the inner rings at any stem level "die" and the inner zone of the tree increases in extractives content (resins) and becomes heartwood. At this stage, most of the "free water" has been lost from cell lumina. In radiata pine trees, water contained in heartwood is only one third to one quarter of the water present in sapwood. The average moisture content of the heartwood is typically around 45%. Heartwood can easily be distinguished from sapwood on the basis of moisture content and colour. Once heartwood initiates, the formation continues thereafter at a rate of about 0.5 growth rings each growing season (Cown and McConchie 1983; Harris and Cown 1991; Wilkes 1991). It appears that the development rate of heartwood may be influenced by geographic location: the development rate was approximately half a ring per annum at North Island sites whereas the rate was one-third of a ring per annum at South Island sites (Cown and McConchie 1983).

High extractives content is an important feature in radiata pine heartwood. Resin content can be up to 30% by weight (in exceptional cases) in the heartwood of radiata pine butt log (Kininmonth and Whitehouse 1991).Resin acids interfere with the hydration and can weaken the bonding between elements in wood composites (Semple and Evans 2000). Because of the progressive accumulation of resin "extractives" and lower water content, heartwood colour is noticeably darker than sapwood. In New Zealand radiata pine, sapwood is creamy white, whereas heartwood is a deeper cream or pinkish in fresh logs but changes to brown when dry. High extractives of heartwood result in an apparent increase in wood density (unextracted density) but do not improve wood strength or pulp yield. Also, the increased extractives reduce the permeability of the wood to waterborne preservatives. Occasionally, heartwood resin bleed from dry timber is blamed for loss of value. This is mainly due to the use of heartwood in situations where heat (particularly direct sunlight) is involved, or where the wood has been preservative treated with a solvent carrier (LOSP). Another cause is the presence of resin blemishes near the surface of exposed wood (Cown 1999).

## Significance of Heartwood Formation

Managing the heartwood resource in forest stands is becoming a hot topic in a global sense, in situations where heartwood is highly sought after for stable and naturally durable products. It has been widely accepted that the end-product value of forest stands should be considered as a function of wood quantity and quality. Recent global signs have indicated an increasing interest in heartwood yield of both conifers and broadleaves (Hamza and Ringo 1991; Yang *et al*. 1994; Bhat 1999; Mörling and Valinger 1999**;** Björklund 1999; Climent *et.al*. 2002; Gjerdrum P 2003; Knapic and Pereira 2005).

Heartwood is not normally a big issue in radiata pine, but there are several factors that have a bearing on forest management and utilisation. The presence of heartwood reduces overall wood shrinkage - the volumetric shrinkage of heartwood is about 1% less than that of sapwood of the same basic density (Cown and McConchie 1983). Heartwood can affect the efficiency of preservative treatment and lower the value of clearwood products in certain markets which prefer light colour. From the point of view of the paper and wood composite industries, heartwood presence is a disadvantage due to its high resin content. Paper and particleboard producers are interested in the heartwood percentage in stems to minimize the adverse effects of heartwood on the properties of products (Semple and Evans 2000; Climent *et al*. 2002), whereas clearwood producers are interested in the diameter of the heartwood zone in butt logs, in relation to the defect core diameter.

The main interests in understanding heartwood distribution are:

1. Heartwood detracts from the values of clearwood from pruned logs if the heartwood diameter exceeds the defect core
2. Heartwood percentage strongly affects log moisture content, which in turn influences sonic measurements of velocity, leading to imprecise estimates of stiffness.
3. Heartwood development may prevent the initiation of intra-ring checking

There is some interest to predict heartwood development in terms of:

- predicting heartwood distribution in current and future forest stands; and
- understanding the regulation of heartwood formation (i.e., the key factors influencing heartwood formation).

In previous research, simulating heartwood distribution has been greatly limited. Regarding the regulation of heartwood formation, several hypothesises have been proposed, including hormones (Bamber 1976), crown biomass (Oren *et al.* 1986), stem spacing (Ojansuu and Maltamo 1995), fertilization and thinning (Mörling and Valinger 1999), hydrological site condition (Zwart 2004), and tree age (Harris and Cown 1991; Hazenberg and Yang 1991; Wilkes 1991; Björklund 1999). Average sapwood width has been found to be relatively constant within species, but to vary widely between species (Yang and Murchison 1992; Climent *et al.* 2003), but the regulation of heartwood formation remains unknown.

## Aim of this Study

To be useful for incorporation into radiata pine growth and wood quality models, heartwood information needs to be related to heartwood percentage and growth rings. Hence the aim of this study is to establish algorithms to predict the distribution of heartwood in terms of heartwood area percentage and heartwood ring number.

# INTRODUCTION

## Previous Heartwood Modelling

Few studies have attempted to simulate the distribution of heartwood. In the previous studies, parameters (tree age, tree height, growth rate, and climatic factors) were used to predict the development of heartwood - often in terms of diameter only. The predicted heartwood function included heartwood volume, heartwood diameter, or (rarely) heartwood ring number.

A study of spruce and pine in Sweden explained the heartwood diameter using the stem diameter of the cross-section (Wilhelmson *et al*. 2002). Gjerdrum (2003), working with Scots pine, found that heartwood rings could be predicted by tree cambial age alone. Meanwhile, it was claimed that heartwood distribution and volume were highly predictable via position in the stem in *Pinus canariensis* (Climent *et al.* 2003). Regarding New Zealand radiata pine, a multivariate non-linear model (Logistic curve model) was developed to predict heartwood diameter by tree age and disc height in the stem using data obtained from four Central North Island stands (Tian and Cown 1995). Recently, Mason and Dzierzon (2007) developed two multivariate linear models (Multiple Regression models) for WQI using the National Benchmarking Dataset (25-year-old stands). The first model predicted heartwood diameter by height in the stem, stem diameter and temperature with a regression coefficient $R^2 = 0.70$, and the second predicted heartwood ring number by height in the stem, stem diameter and rainfall with a regression coefficient $R^2 = 0.53$ (Mason and Dzierzon 2007).

## Heartwood Modelling in this Study

In this study, we have established models to predict:

- heartwood area percentage by tree age and vertical position in the stem; and
- heartwood ring number by crop age at breast height

Models are developed using data from both North Island and South Island forests, in order to test whether heartwood develops differently in the two regions. The established models were validated using t-tests at 95% confidence level, and the difference between the predicted and the measured mean values was proved to be insignificant.

# METHODS

There were three steps in model creation, including data collection, model development, and model validation.

## Predicting Heartwood Area Percentage by Tree Age and Vertical Position in the Stem

- Data collection

Data for models were collected from Scion historical records. A total of 1703 radiata pine discs were obtained from 14 forest sites. In the 1703 discs, 1537 were from the North Island and 166 were from the South Island (Appendices 1 and 2). The discs were cut at different height levels, and heartwood diameter and disc diameter inside bark were measured (Appendices 3 and 4). The genetic makeup of the material was not recorded, but most of the older work (data collected in the 1980s and 1990s) was done on unimproved stands. Recent studies have shown that heartwood formation has a moderate heritability averaging 0.36 (Kumar and Stovold, 2008).

- Model development

1. Measured heartwood area percentage (%)

Heartwood diameter and disc diameter inside bark were measured (Appendices 3 and 4). Original data were sorted according to tree age. Within each single age group, average value of heartwood area percentage was obtained at different disc heights by following equation:

$$HP\%(measured) = \frac{\pi(\frac{D_h}{2})^2}{\pi(\frac{D_c}{2})^2} \times 100\% = (\frac{D_h}{D_c})^2 \times 100\% \qquad (1)$$

where HP is heartwood area percentage based on the measured diameter data, %; $D_h$ is diameter of heartwood, mm; $D_c$ is diameter of disc inside bark, mm.

2. Data analysis

The relationship between average value of measured heartwood area percentage and disc height in the stem was analysed in each single-age group for North and South Island sites to identify the influence of vertical position in the stem on heartwood area percentage.

3. Model creation

Based on the obtained relationships, the functions of heartwood area percentage with respect to tree age (a) and vertical position in the stem (h) were built for the North Island and South Island sites. Coefficient functions $f_0(a)$, $f_1(a)$, and $f_2(a)$ with respect to tree age were determined by curve fitting.

- Model Validation

Computer programmes were written using mathematical language (MathCAD) to generate the values of predicted heartwood area percentage. The simulation outcomes were paired with the data of measured heartwood area percentage. The developed models were validated using t-tests at 95% confidence level.

## Predicting Heartwood Ring Number by Tree Age at Breast Height

- Data collection

Data for the model were collected from Scion historical records, which provided heartwood ring number and total ring number in 106 radiata pine discs (Appendix 5). The discs were cut at breast height and obtained from different-age stems. The studied sites included Berwick, Dumgree, Geraldine, Golden Downs, Hamner, Herbert, Hokonui, Kaingaroa, Longwood, Maramarua, Milton Bay, Omihi, Patanamu, Rai Valley, Rankleburn, Riverhead, Rotoehu, Tairua, Waitangi, Whakamaru, and Woodhill.

- Model development

First, heartwood ring number at breast height was sorted according to tree age for all available sites. Second, average heartwood ring number at breast height was calculated for each single-age group. Then, the relationships between tree age and average heartwood ring number were analysed for all available age groups to create the model.

- Model validation

The predicted values were paired with the measured heartwood ring number data. The developed function was validated using a t-test at 95% confidence level.

# RESULTS

## I: Predicting Heartwood Area Percentage by Tree Age and Vertical Position in the Stem

### Relationship between heartwood area percentage and disc height in the stem

Figure1 and Table 1 show the relationships between average heartwood area percentage and disc height in the stem obtained from North Island sites, whereas Figure 2 and Table 2 indicate the relationships obtained from South Island sites. Some meaningful features are shown in the results:

1) The distribution of heartwood area percentage varies with tree age in both North Island and South Island sites (Figs. 1 and 2).

2) The average value of heartwood area percentage has a strong polynomial (quadratic) relationship with disc height in the stem in every single age group in both North Island and South Island sites (Tables 1 and 2).

3) The heartwood development of North Island sites differs from that of South Island sites. For the same age stands (27-year-old), the average heartwood area percentage of North Island sites is significantly higher than that of South Island sites at any given height in the stem (Figs. 1 and 2). For the different age groups, the younger North Island stands (e.g., 19, 23, 27, 30-year-old) have larger average heartwood area percentages than the older South Island stands (32-year-old) at any given height in the stem (Figs. 1 and 2). Further, in the first few meters of stem height (0 ~ 1.4m), the heartwood percentage increases with disc height in all age groups of South Island sites (Fig. 2). For North Island sites, only three age groups (27, 30, 37-year-old) have measured data at 1.4 m. However, two age groups (27 and 30-year-old) present a slight reduction in heartwood percentage with disc height from base to 1.4 m (Fig. 1).

4) The pattern of heartwood area percentage with disc height differs slightly, and there is some crossover of curves obtained from different age groups (Figs. 1 and 2).

The first two features indicate that both tree age and vertical position in the stem should be considered as key predicting parameters in model creation. Two models can be created to reflect and distinguish the difference presented in the third feature. The features (3 and 4) may imply the impact of genetics or climatic factor on the formation and development of heartwood, which is beyond the scope of this study as the relevant data are not available.

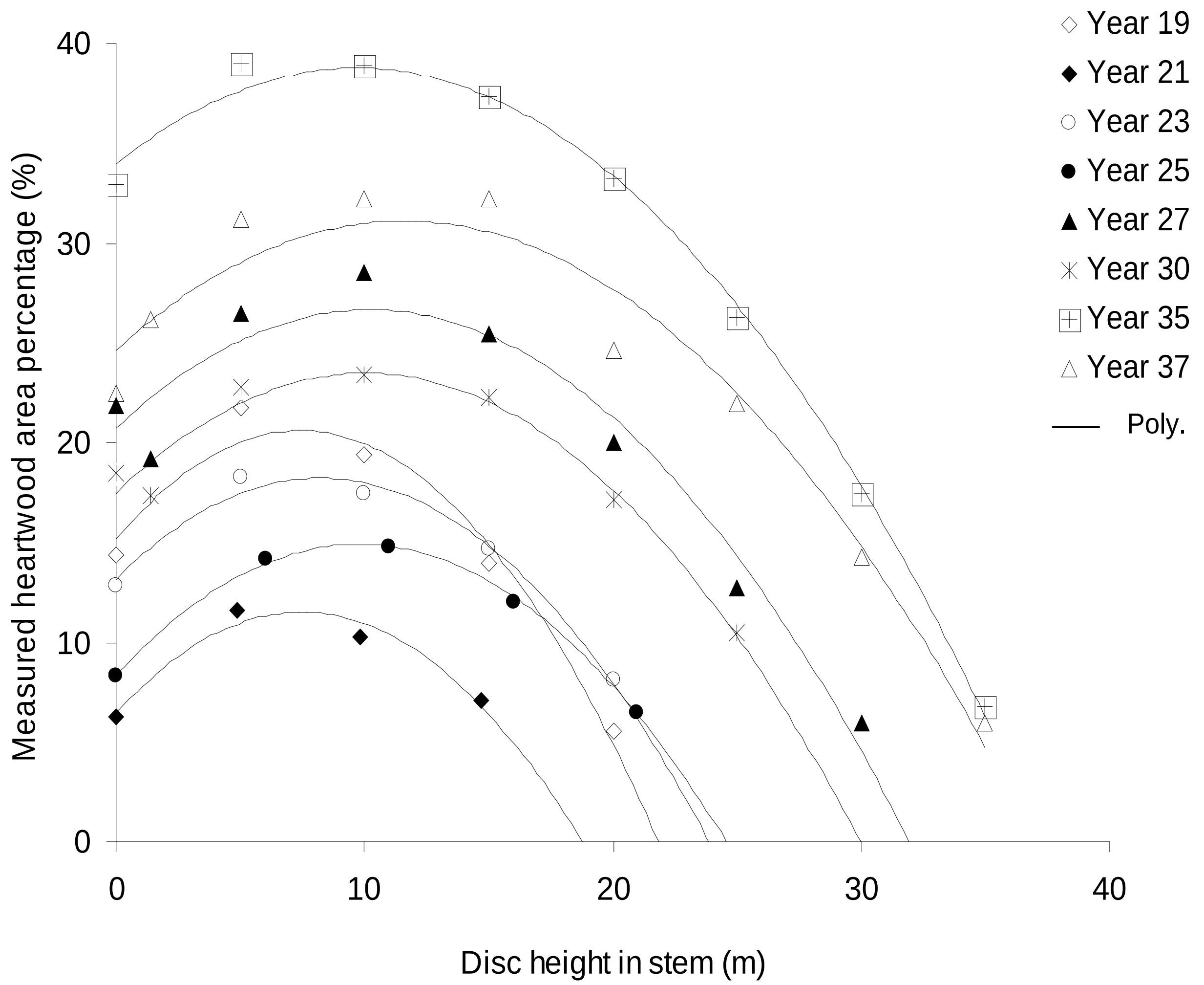



Figure 1. Relationships between average heartwood area percentage and disc height in the stem at different ages (North Island sites).

Table 1. Polynomial equations and $R^2$ for trendlines shown in Fig. 1

| Age group | Polynomial equations of trendlines shown in Fig. 1 | $R^2$ |
|---|---|---|
| 19 | $Y = -0.0991x^2 + 1.4693x + 15.147$ | 0.9679 |
| 21 | $Y = -0.0900x^2 + 1.344x + 6.481$ | 0.9416 |
| 23 | $Y = -0.0744x^2 + 1.226x + 13.167$ | 0.9819 |
| 25 | $Y = -0.0682x^2 + 1.3351x + 8.3635$ | 0.9974 |
| 27 | $Y = -0.0565x^2 + 1.1556x + 20.741$ | 0.9448 |
| 30 | $Y = -0.0592x^2 + 1.1912x + 17.480$ | 0.9613 |
| 35 | $Y = -0.0508x^2 + 0.9861x + 33.900$ | 0.9959 |
| 37 | $Y = -0.0480x^2 + 1.1121x + 24.251$ | 0.9588 |

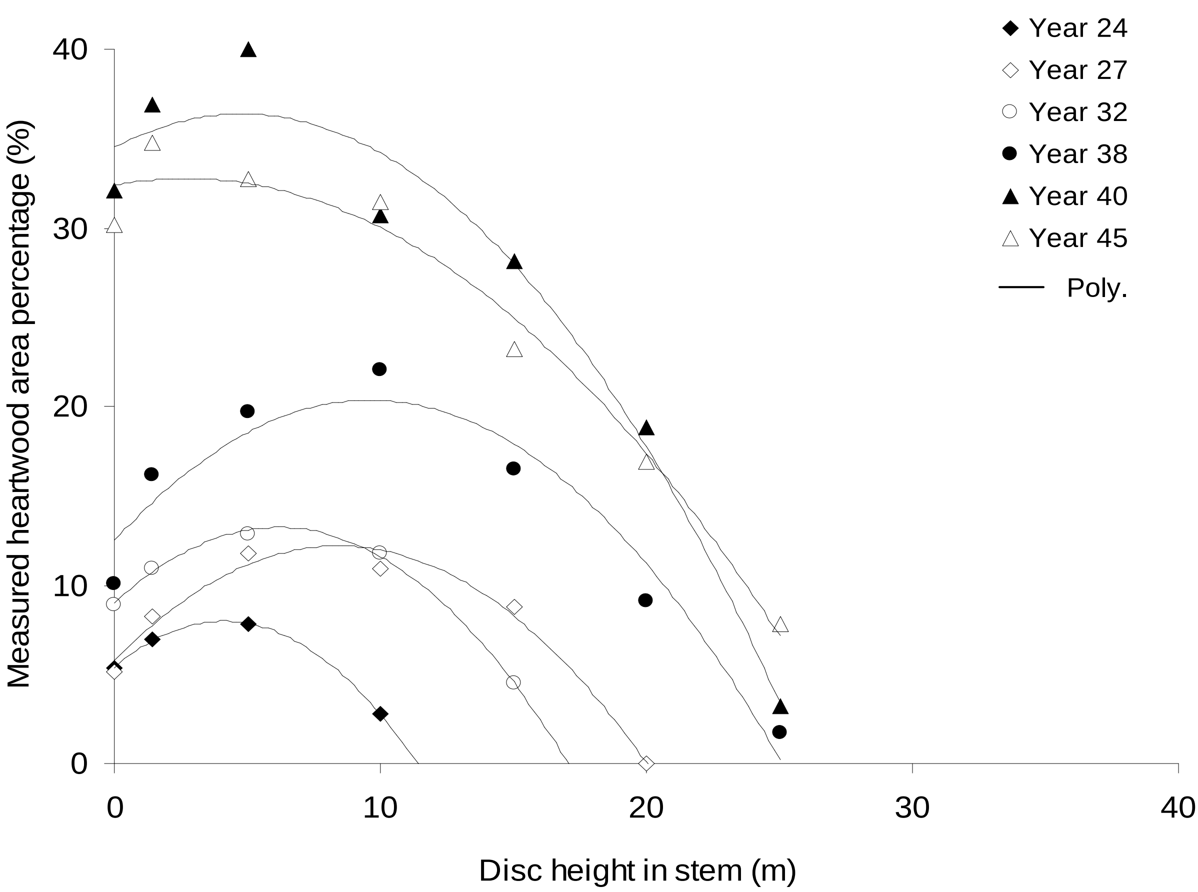



Figure 2. Relationships between average heartwood area percentage and disc height in the stem at different ages (South Island sites).

Table 2. Polynomial equations and $R^2$ for trendlines shown in Fig. 2

| Age group | Polynomial equations of trendlines shown in Fig. 2 | $R^2$ |
|---|---|---|
| 24 | $Y = -0.1516x^2 + 1.2507x + 5.3924$ | 0.9976 |
| 27 | $Y = -0.0905x^2 + 1.5254x + 5.7554$ | 0.9754 |
| 32 | $Y = -0.111x^2 + 1.3701x + 8.9945$ | 0.9961 |
| 38 | $Y = -0.0851x^2 + 1.6374x + 12.467$ | 0.9307 |
| 40 | $Y = -0.0807x^2 + 0.7769x + 34.495$ | 0.9633 |
| 45 | $Y = -0.0514x^2 + 0.2761x + 32.386$ | 0.9739 |

## Model Development

1. North Island sites

The relationship between average heartwood area percentage and disc height in the stem was studied in all available age groups obtained from North Island sites, and then the functions of heartwood area percentage with respect to tree age (a) and vertical position in the stem (h) were built for the North Island sites as below.

$$HPn(a,h) = f_0(a) + f_1(a)h + f_2(a)h^2 \quad (19 \le a \le 37;\ 0 < h \le 25;\ \text{north sites}) \tag{2a}$$

$$f_0(a) = 1.0901a - 12.127 \tag{2b}$$

$$f_1(a) = 0.001a^2 - 0.0757a + 2.5269 \tag{2c}$$

$$f_2(a) = 0.0026a - 0.1397 \tag{2d}$$

where $HP_n(a, h)$ is a function of average heartwood area percentage with respect to tree age and vertical position in the stem for North Island sites, %; *a* is tree age, year; *h* is vertical position in the stem, m; $f_0(a)$, $f_1(a)$, and $f_2(a)$ are coefficient of constant term, coefficient of linear term, and coefficient of quadratic term, respectively.

Coefficient functions $f_0(a)$, $f_1(a)$, and $f_2(a)$ with respect to tree age were determined by curve fitting. The fitting curves are highly correlated with the values shown in Table 3 according the coefficients of determination ($R^2$= 0.6279, 0.8134, and 0.8469, respectively).

Table 3. Determination of coefficient functions $f_0(a)$, $f_1(a)$, and $f_2(a)$ with respect to tree age

| Age | $Y_0$ | $Y_1$ | $Y_2$ |
|---|---|---|---|
| 19 | 15.147 | 1.4693 | -0.0991 |
| 21 | 6.481 | 1.344 | -0.090 |
| 23 | 13.167 | 1.226 | -0.0744 |
| 25 | 8.3635 | 1.3351 | -0.0682 |
| 27 | 20.741 | 1.1556 | -0.0565 |
| 30 | 17.480 | 1.1912 | -0.0592 |
| 35 | 33.900 | 0.9861 | -0.0508 |
| 37 | 24.251 | 1.1121 | -0.0480 |
| Eq. | $f_0(a) = 1.0901a - 12.127$ | $f_1(a) = 0.001a^2 - 0.0757a + 2.5269$ | $f_2(a) = 0.0026a - 0.1397$ |
| $R^2$ | 0.6279 | 0.8134 | 0.8469 |

Note: Analysis was based on the measured data obtained from North Island sites (Appendix 3). Values in $Y_0$ column are the coefficients of constant terms of polynomial equations indicated in Table 1; values in $Y_1$ column are the coefficients of linear terms of polynomial equations indicated in Table 1; and values in $Y_2$ column are the coefficients of quadratic terms in polynomial equations indicated in Table 1.

2. South Island sites

The relationship between average heartwood area percentage and disc height in the stem was studied in all available age groups obtained from South Island sites, and then the functions of heartwood area percentage with respect to tree age (a) and vertical position in the stem (h) were built for the South Island sites as below.

$$HPs(a,h) = f_0(a) + f_1(a)h + f_2(a)h^2 \quad (24 \le a \le 45;\ 0 < h \le 20;\ \text{south sites}) \qquad (3a)$$

$$f_0(a) = 1.4377a - 32.778 \qquad (3b)$$

$$f_1(a) = (-0.0067a^2 + 0.413a - 4.8298) \qquad (3c)$$

$$f_2(a) = 0.0036a - 0.2187 \qquad (3d)$$

where $HP_s(a, h)$ is a function of average heartwood area percentage with respect to tree age and vertical position in the stem for South Island sites, %; *a* is tree age, year; *h* is vertical position in the stem, m; $f_0(a)$, $f_1(a)$, and $f_2(a)$ are coefficient of constant term, coefficient of linear term, and coefficient of quadratic term, respectively.

Coefficient functions $f_0(a)$, $f_1(a)$, and $f_2(a)$ with respect to tree age were determined by curve fitting. The fitting curves are strongly correlated with the values shown in Table 4 according the coefficients of determination ($R^2$= 0.7576, 0.8054, and 0.7424, respectively).

Table 4. Determination of coefficient functions $f_0(a)$, $f_1(a)$, and $f_2(a)$ with respect to tree age

| Age | $Y_0$ | $Y_1$ | $Y_2$ |
|---|---|---|---|
| 24 | 5.3924 | 1.2507 | -0.1516 |
| 27 | 5.7554 | 1.5254 | -0.0905 |
| 32 | 8.9945 | 1.3701 | -0.111 |
| 38 | 12.467 | 1.6374 | -0.0851 |
| 40 | 34.495 | 0.7769 | -0.0807 |
| 45 | 32.386 | 0.2761 | -0.0514 |
| Eq. | $f_0(a) = 1.4377a - 32.778$ | $f_1(a) = (-0.0067a^2 + 0.413a - 4.8298)$ | $f_2(a) = 0.0036a - 0.2187$ |
| $R^2$ | 0.7576 | 0.8054 | 0.7424 |

Note: Analysis was based on the data obtained from South Island sites (Appendix 4). Values in $Y_0$ column are the coefficients of constant terms of polynomial equations indicated in Table 2; values in $Y_1$ column are the coefficients of linear terms of polynomial equations indicated in Table 2; and values in $Y_2$ column are the coefficients of quadratic terms in polynomial equations indicated in Table 2.

## Model Validation

Figures 3a-g show the predicted and the measured values of heartwood area percentage for North Island sites (19 ≤ a ≤ 37, 0 < h ≤ 25), whereas Figures 4a-f show the predicted and the measured values for South Island sites (24 ≤ a ≤ 45; 0 < h ≤ 20).

The developed algorithms (Equations 2a-d and 3a-d) were validated using t-tests at 95% confidence level, and the difference between the predicted and the measured mean values was proved to be insignificant (Tables 5 and 6).

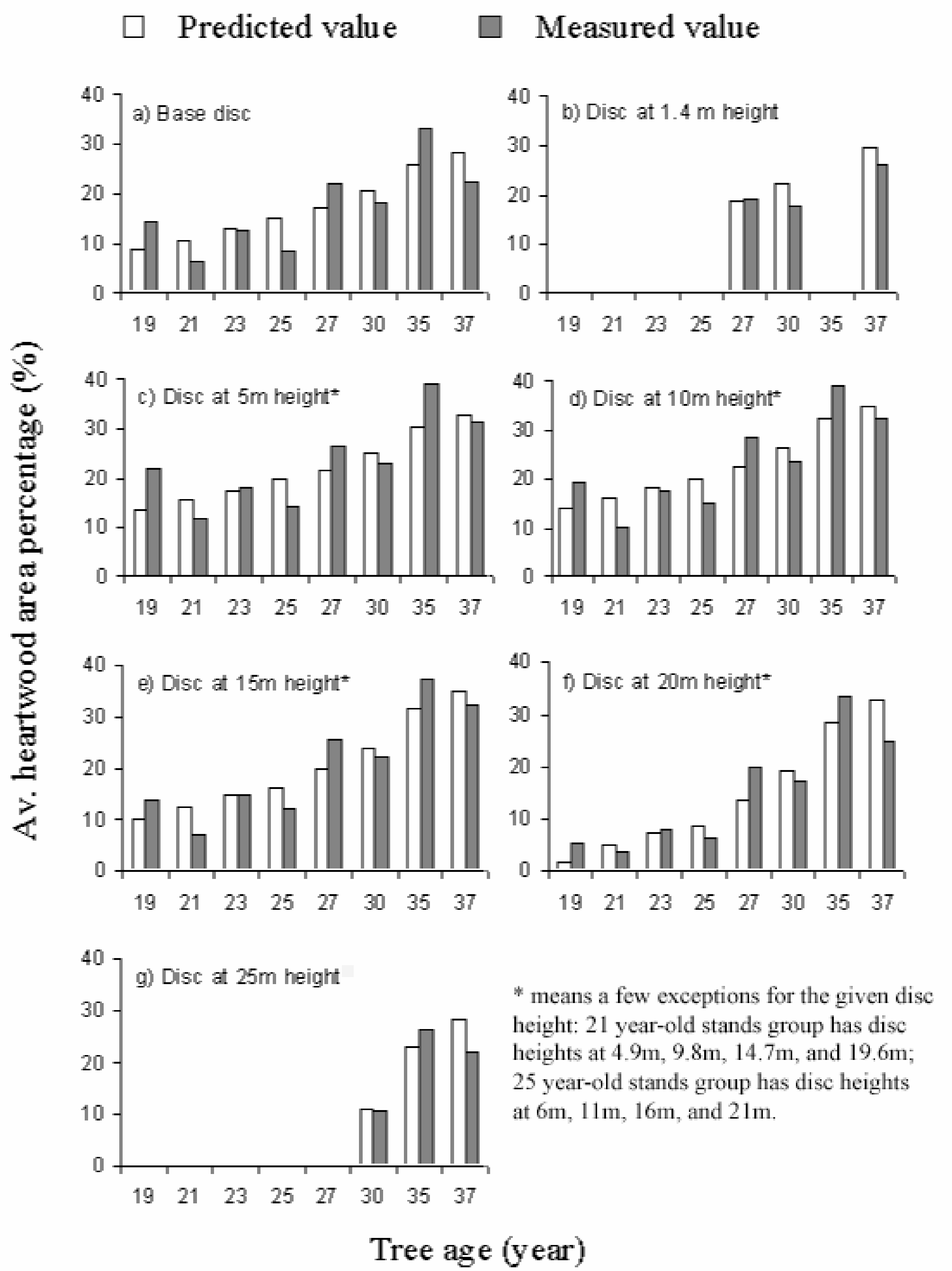
## Model applicability

Because of the limitation of available datasets, the models (Eqs. 2a-d and 3a-d).have their valid ranges in applicability. The valid ranges are shown below:

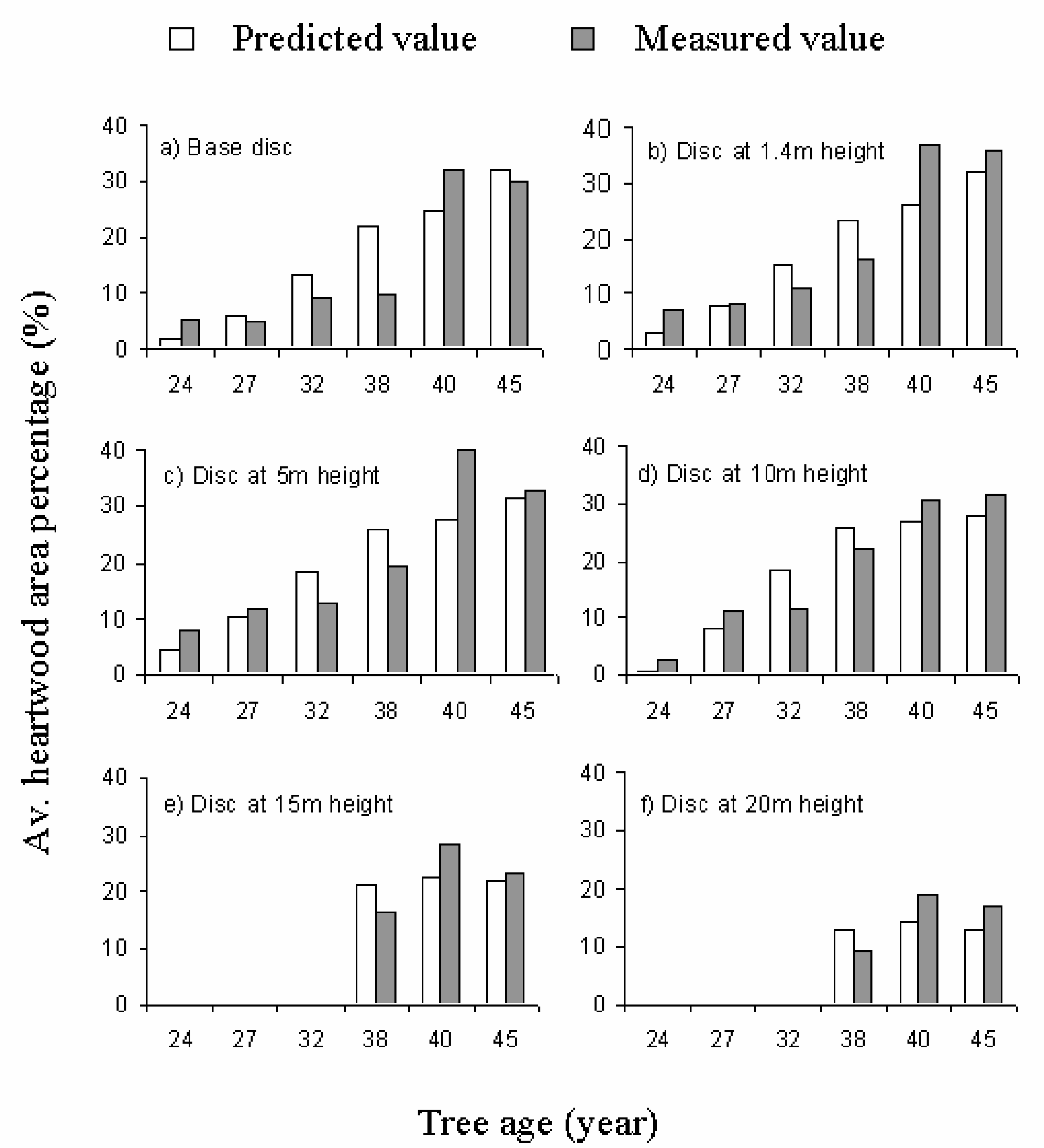
- For North Island sites, the valid age range is 19 – 37, and the valid range of vertical position in the stem is 0 – 25 m.
- For South Island sites, the valid age range is 24 – 45, and the valid range of vertical position in the stem is 0 – 20 m.

## Wrongful Predictions

The models (Eqs. 2a-d and 3a-d) will predict heartwood area percentage values less than zero (negative value) at the extremes of disc height (vertical position) in stems. When this happens predictions should be set to zero or marked as undefined.




Figures 3a-g The predicted and the measured values of heartwood area percentage (North Island sites).




Figures 4a-f The predicted and the measured values of heartwood area percentage (South Island sites).

Table 5 t-test: Paired predicted and measured heartwood area percentages for means for North Island sites

| | Predicted heartwood area percentage (%) | Measured heartwood area percentage (%) |
|---|---|---|
| Mean | 20.08604 | 19.95681 |
| Variance | 69.4302 | 88.52366 |
| Observations | 45 | 45 |
| Pearson Correlation | 0.868957 | |
| Hypothesized Mean Difference | 0 | |
| df | 44 | |
| t Stat | 0.186081 | |
| P(T<=t) one-tail | 0.426618 | |
| t Critical one-tail | 1.68023 | |
| P(T<=t) two-tail | 0.853236 | |
| t Critical two-tail | 2.015368 | |

Table 6 t-test: Paired predicted and measured heartwood area percentages for means for South Island sites

| | Predicted heartwood area percentage (%) | Measured heartwood area percentage *(%)* |
|---|---|---|
| Mean | 18.51048 | 18.90829 |
| Variance | 84.14071 | 119.2833 |
| Observations | 29 | 29 |
| Pearson Correlation | 0.862504 | |
| Hypothesized Mean Difference | 0 | |
| df | 28 | |
| t Stat | 0.38721 | |
| P(T<=t) one-tail | 0.350763 | |
| t Critical one-tail | 1.701131 | |
| P(T<=t) two-tail | 0.701525 | |
| t Critical two-tail | 2.048407 | |

## II: Predicting Heartwood Ring Number by Tree Age at Breast Height

### Model Development

There is a strong relationship ($R^2$ = 0.9185) between tree age and average heartwood ring number at breast height (Fig. 5). The function of average heartwood ring number with respect to tree age at breast height is shown below:

$$HR(a) = 0.0053a^2 + 0.0476a + 0.8241 \qquad (R^2 = 0.9185;\ 16 \le a \le 47;\ BH) \qquad (4)$$

where *HR (a)* is a function of heartwood ring number with respect to tree age at breast height; *a* is tree age, year.

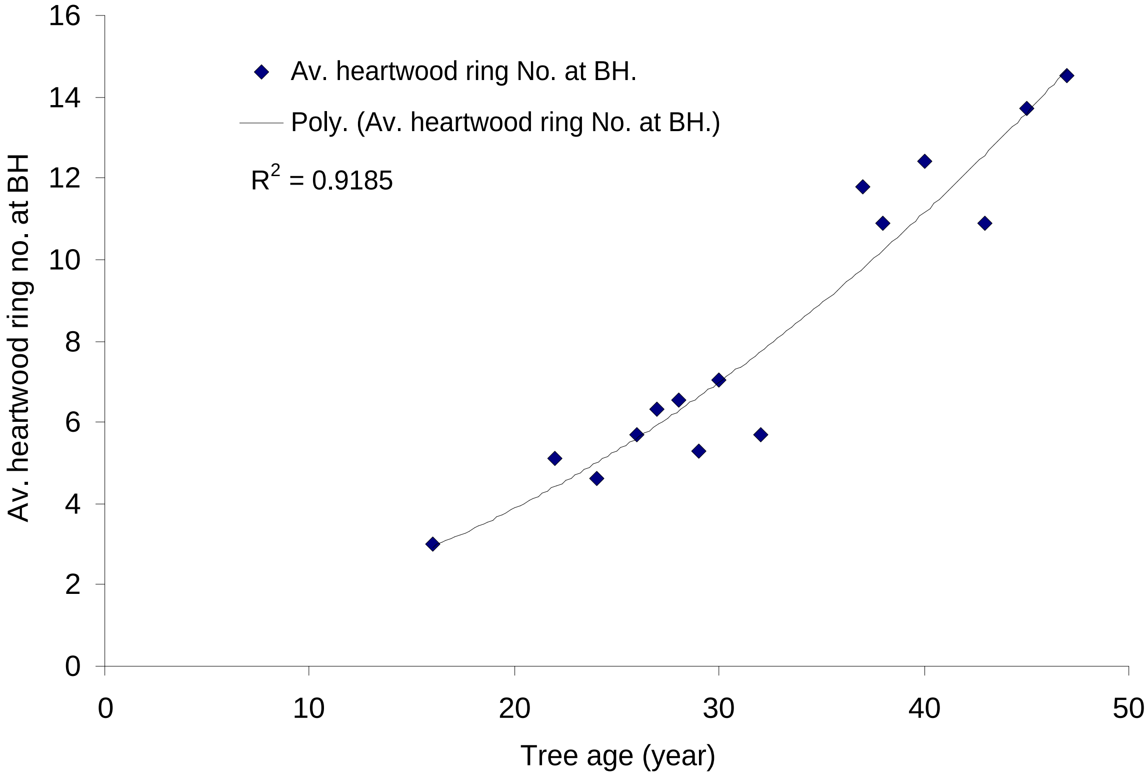



Fig. 5. Relationship between tree age and average heartwood ring number at breast height

## Model Validation

Figure 6 shows the distributions of predicted and measured heartwood ring at breast height within the investigated tree age range.

The developed function (Eq. 4) was validated using a t-test at 95% confidence level, and the difference between the predicted and the measured mean values was proved to be insignificant (Table 7).

Table 7 t-test: Paired predicted and measured values of average heartwood ring for means

| | Predicted value | Measured value |
|---|---|---|
| Mean | 8.665514 | 8.611071 |
| Variance | 11.51552 | 12.62414 |
| Observations | 14 | 14 |
| Pearson Correlation | 0.950779 | |
| Hypothesized Mean Difference | 0 | |
| df | 13 | |
| t Stat | 0.185005 | |
| P(T<=t) one-tail | 0.42804 | |
| t Critical one-tail | 1.770933 | |
| P(T<=t) two-tail | 0.85608 | |
| t Critical two-tail | 2.160369 | |

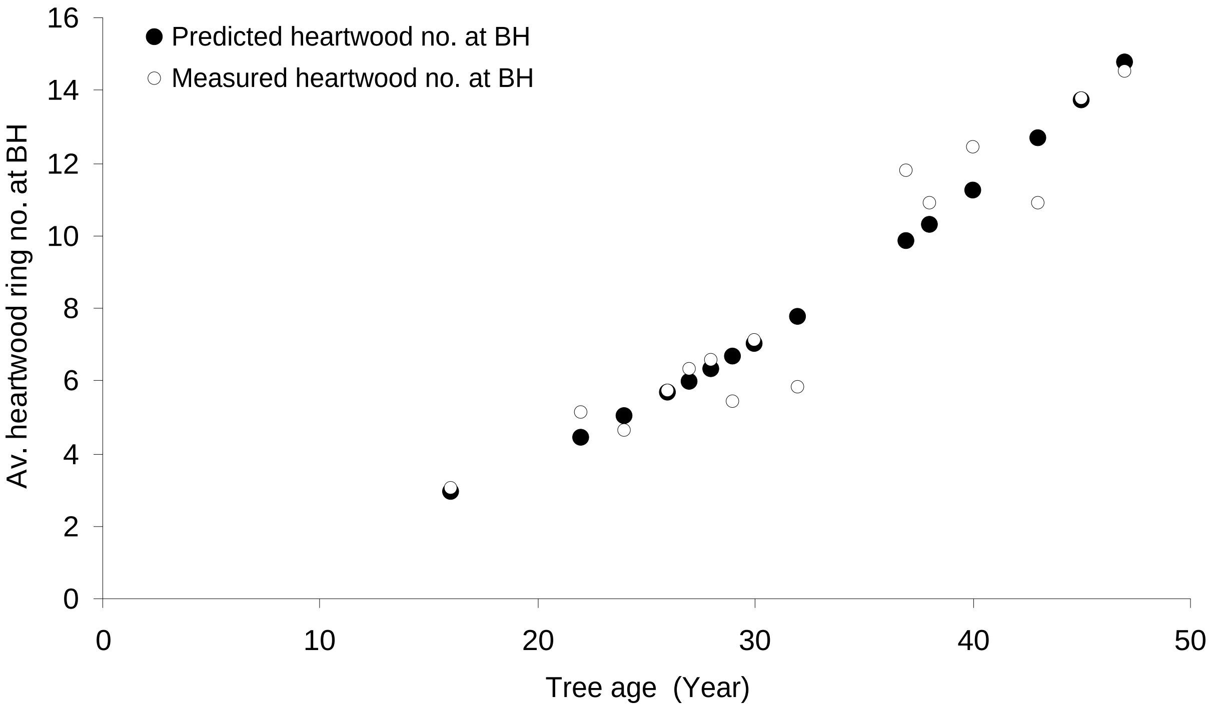



Fig. 6. Predicted and measured average heartwood ring number at breast height.

## Model Applicability

Because of the limitation of available datasets, the model (Eq. 4) has its valid ranges in applicability. The valid age range is 16 – 47, and the valid height is breast height (BH).

# CONCLUSION

Tree age is the most significant influence on heartwood distribution. At a given tree age, the average heartwood area percentage varies in a strongly polynomial (quadratic) fashion with vertical position in the stems. Therefore, both tree age and vertical position in the stem should be considered as key parameters in predicting heartwood distribution. Compared to southern sites, the forest stands located at northern sites have considerably higher average heartwood percentage at any given disc height, which indicates that other factors may have an influence on heartwood formation and development. Further research is needed regarding why and how trees form heartwood, as well as the possible effect of genetics on heartwood formation and development.

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# APPENDICES

### Appendix 1
### Number of Sample Discs at Different Height Levels (North Island sites)

| Site | Tree age (year) | Disc height in stem (m) | Number of sample discs |
|---|---|---|---|
| Northland | 19 | 0 | 37 |
| Northland | 19 | 5 | 37 |
| Northland | 19 | 10 | 35 |
| Northland | 19 | 15 | 30 |
| Northland | 19 | 20 | 15 |
| Tikitere | 19 | 0 | 33 |
| Tikitere | 19 | 5 | 5 |
| Tikitere | 19 | 10 | 9 |
| Tikitere | 19 | 15 | 7 |
| Tikitere | 19 | 20 | 5 |
| Kaingaroa Forest | 21 | 0 | 28 |
| Kaingaroa Forest | 21 | 4.9 | 29 |
| Kaingaroa Forest | 21 | 9.8 | 30 |
| Kaingaroa Forest | 21 | 14.7 | 29 |
| Puruki | 21 | 0 | 13 |
| Tikitere | 23 | 0 | 20 |
| Tikitere | 23 | 5 | 20 |
| Tikitere | 23 | 10 | 20 |
| Tikitere | 23 | 15 | 20 |
| Tikitere | 23 | 20 | 19 |
| Kaingaroa Forest | 25 | 0 | 50 |
| Kaingaroa Forest | 25 | 6 | 50 |
| Kaingaroa Forest | 25 | 11 | 50 |
| Kaingaroa Forest | 25 | 16 | 49 |
| Kaingaroa Forest | 25 | 21 | 47 |
| Kaingaroa | 27 | 0 | 61 |
| Kaingaroa | 27 | 1.4 | 20 |
| Kaingaroa | 27 | 5 | 42 |
| Kaingaroa | 27 | 10 | 42 |
| Kaingaroa | 27 | 15 | 42 |
| Kaingaroa | 27 | 20 | 41 |
| Kaingaroa | 27 | 25 | 38 |
| Kaingaroa | 27 | 30 | 29 |
| Patanamu | 27 | 0 | 5 |
| Patanamu | 27 | 1.4 | 5 |
| Patanamu | 27 | 5 | 5 |
| Patanamu | 27 | 10 | 5 |
| Patanamu | 27 | 15 | 5 |
| Patanamu | 27 | 20 | 5 |
| Patanamu | 27 | 25 | 4 |
| Patanamu | 27 | 30 | 5 |
| Waitangi | 30 | 0 | 5 |
| Waitangi | 30 | 1.4 | 5 |

| | | | |
|---|---|---|---|
| Waitangi | 30 | 5 | 5 |
| Waitangi | 30 | 10 | 5 |
| Waitangi | 30 | 15 | 5 |
| Waitangi | 30 | 20 | 5 |
| Waitangi | 30 | 25 | 2 |
| Kaingaroa Forest | 30 | 0 | 34 |
| Kaingaroa Cpt.1272 | 30 | 1.4 | 5 |
| Kaingaroa Forest | 30 | 5 | 34 |
| Kaingaroa Forest | 30 | 10 | 35 |
| Kaingaroa Forest | 30 | 15 | 35 |
| Kaingaroa Forest | 30 | 20 | 35 |
| Kaingaroa Forest | 30 | 25 | 28 |
| Tarawera Forest | 35 | 0 | 29 |
| Tarawera Forest | 35 | 5 | 36 |
| Tarawera Forest | 35 | 10 | 29 |
| Tarawera Forest | 35 | 15 | 29 |
| Tarawera Forest | 35 | 20 | 29 |
| Tarawera Forest | 35 | 25 | 28 |
| Tarawera Forest | 35 | 30 | 24 |
| Tarawera Forest | 35 | 35 | 15 |
| Rotoehu | 37 | 0 | 5 |
| Rotoehu | 37 | 1.4 | 5 |
| Rotoehu | 37 | 5 | 5 |
| Rotoehu | 37 | 10 | 5 |
| Rotoehu | 37 | 15 | 5 |
| Rotoehu | 37 | 20 | 5 |
| Rotoehu | 37 | 25 | 5 |
| Rotoehu | 37 | 30 | 4 |
| Total number of discs: 1537 | | | |

## Appendix 2
## Number of Sample Discs at Different Height Levels (South Island sites)

| Site | Tree age (year) | Disc height in stem (m) | Number of sample discs |
|---|---|---|---|
| Rankleburn | 24 | 0 | 5 |
| Rankleburn | 24 | 1.4 | 4 |
| Rankleburn | 24 | 5 | 5 |
| Rankleburn | 24 | 10 | 5 |
| Herbert | 27 | 0 | 5 |
| Herbert | 27 | 1.4 | 5 |
| Herbert | 27 | 5 | 5 |
| Herbert | 27 | 10 | 4 |
| Herbert | 27 | 15 | 2 |
| Herbert | 27 | 20 | 4 |
| Berwick | 32 | 0 | 5 |
| Berwick | 32 | 1.4 | 5 |
| Berwick | 32 | 5 | 5 |
| Berwick | 32 | 10 | 5 |
| Berwick | 32 | 15 | 5 |
| Hokonui | 38 | 0 | 5 |
| Hokonui | 38 | 1.4 | 5 |
| Hokonui | 38 | 5 | 4 |
| Hokonui | 38 | 10 | 5 |
| Hokonui | 38 | 15 | 5 |
| Hokonui | 38 | 20 | 5 |
| Hokonui | 38 | 25 | 5 |
| Milton Bay | 40 | 0 | 5 |
| Milton Bay | 40 | 1.4 | 5 |
| Milton Bay | 40 | 5 | 5 |
| Milton Bay | 40 | 10 | 5 |
| Milton Bay | 40 | 15 | 5 |
| Milton Bay | 40 | 20 | 4 |
| Milton Bay | 40 | 25 | 3 |
| Dumgree | 45 | 0 | 5 |
| Dumgree | 45 | 1.4 | 4 |
| Dumgree | 45 | 5 | 5 |
| Dumgree | 45 | 10 | 5 |
| Dumgree | 45 | 15 | 5 |
| Dumgree | 45 | 20 | 5 |
| Dumgree | 45 | 25 | 2 |
| Total number of discs: 166 | | | |

**Appendix 3**

**Heartwood Diameter and Disc Diameter Inside Bark (North Island sites)**

| Site | Tree age (year) | Disc height (m) | DIB (mm) | Heartwood diameter (mm) |
|---|---|---|---|---|
| Tikitere | 19 | 0 | 650 | 180 |
| Tikitere | 19 | 0 | 660 | 200 |
| Tikitere | 19 | 0 | 670 | 210 |
| Tikitere | 19 | 0 | 840 | 350 |
| Tikitere | 19 | 0 | 487 | 200 |
| Tikitere | 19 | 0 | 620 | 120 |
| Tikitere | 19 | 0 | 780 | 170 |
| Tikitere | 19 | 0 | 620 | 170 |
| Tikitere | 19 | 0 | 780 | 190 |
| Tikitere | 19 | 0 | 650 | 210 |
| Tikitere | 19 | 0 | 577 | 136 |
| Tikitere | 19 | 0 | 750 | 240 |
| Tikitere | 19 | 0 | 561 | 165 |
| Tikitere | 19 | 0 | 528 | 155 |
| Tikitere | 19 | 0 | 430 | 160 |
| Tikitere | 19 | 0 | 573 | 210 |
| Tikitere | 19 | 0 | 457 | 140 |
| Tikitere | 19 | 0 | 584 | 139 |
| Tikitere | 19 | 0 | 524 | 179 |
| Tikitere | 19 | 0 | 708 | 275 |
| Tikitere | 19 | 0 | 660 | 240 |
| Tikitere | 19 | 0 | 455 | 145 |
| Tikitere | 19 | 0 | 442 | 130 |
| Tikitere | 19 | 0 | 504 | 165 |
| Tikitere | 19 | 0 | 550 | 160 |
| Tikitere | 19 | 0 | 377 | 140 |
| Tikitere | 19 | 0 | 455 | 173 |
| Tikitere | 19 | 0 | 425 | 160 |
| Tikitere | 19 | 0 | 450 | 120 |
| Tikitere | 19 | 0 | 535 | 145 |
| Tikitere | 19 | 0 | 640 | 189 |
| Tikitere | 19 | 0 | 480 | 180 |
| Tikitere | 19 | 0 | 622 | 168 |
| Northland | 19 | 0 | 425 | 245 |
| Northland | 19 | 0 | 375 | 180 |
| Northland | 19 | 0 | 435 | 170 |
| Northland | 19 | 0 | 365 | 205 |
| Northland | 19 | 0 | 285 | 185 |
| Northland | 19 | 0 | 460 | 155 |
| Northland | 19 | 0 | 515 | 265 |
| Northland | 19 | 0 | 368 | 155 |
| Northland | 19 | 0 | 465 | 305 |
| Northland | 19 | 0 | 390 | 170 |
| Northland | 19 | 0 | 370 | 150 |
| Northland | 19 | 0 | 380 | 265 |
| Northland | 19 | 0 | 360 | 120 |

| | | | | |
|---|---|---|---|---|
| Northland | 19 | 0 | 260 | 110 |
| Northland | 19 | 0 | 385 | 330 |
| Northland | 19 | 0 | 450 | 240 |
| Northland | 19 | 0 | 445 | 355 |
| Northland | 19 | 0 | 345 | 145 |
| Northland | 19 | 0 | 475 | 185 |
| Northland | 19 | 0 | 430 | 220 |
| Northland | 19 | 0 | 325 | 160 |
| Northland | 19 | 0 | 470 | 210 |
| Northland | 19 | 0 | 325 | 160 |
| Northland | 19 | 0 | 375 | 220 |
| Northland | 19 | 0 | 310 | 150 |
| Northland | 19 | 0 | 495 | 150 |
| Northland | 19 | 0 | 435 | 220 |
| Northland | 19 | 0 | 360 | 160 |
| Northland | 19 | 0 | 570 | 200 |
| Northland | 19 | 0 | 495 | 250 |
| Northland | 19 | 0 | 515 | 210 |
| Northland | 19 | 0 | 425 | 130 |
| Northland | 19 | 0 | 450 | 150 |
| Northland | 19 | 0 | 490 | 150 |
| Northland | 19 | 0 | 385 | 170 |
| Northland | 19 | 0 | 415 | 170 |
| Northland | 19 | 0 | 610 | 150 |
| Tikitere | 19 | 5 | 538 | 190 |
| Tikitere | 19 | 5 | 632 | 240 |
| Tikitere | 19 | 5 | 388 | 163 |
| Tikitere | 19 | 5 | 587 | 275 |
| Tikitere | 19 | 5 | 354 | 153 |
| Northland | 19 | 5 | 350 | 210 |
| Northland | 19 | 5 | 335 | 155 |
| Northland | 19 | 5 | 330 | 165 |
| Northland | 19 | 5 | 300 | 160 |
| Northland | 19 | 5 | 245 | 160 |
| Northland | 19 | 5 | 400 | 130 |
| Northland | 19 | 5 | 465 | 250 |
| Northland | 19 | 5 | 310 | 140 |
| Northland | 19 | 5 | 370 | 260 |
| Northland | 19 | 5 | 325 | 120 |
| Northland | 19 | 5 | 310 | 150 |
| Northland | 19 | 5 | 335 | 230 |
| Northland | 19 | 5 | 330 | 110 |
| Northland | 19 | 5 | 240 | 95 |
| Northland | 19 | 5 | 305 | 235 |
| Northland | 19 | 5 | 405 | 205 |
| Northland | 19 | 5 | 370 | 280 |
| Northland | 19 | 5 | 300 | 130 |
| Northland | 19 | 5 | 420 | 195 |
| Northland | 19 | 5 | 370 | 180 |
| Northland | 19 | 5 | 275 | 160 |

| | | | | |
|---|---|---|---|---|
| Northland | 19 | 5 | 365 | 170 |
| Northland | 19 | 5 | 280 | 160 |
| Northland | 19 | 5 | 305 | 180 |
| Northland | 19 | 5 | 270 | 145 |
| Northland | 19 | 5 | 440 | 130 |
| Northland | 19 | 5 | 345 | 180 |
| Northland | 19 | 5 | 315 | 160 |
| Northland | 19 | 5 | 505 | 200 |
| Northland | 19 | 5 | 385 | 170 |
| Northland | 19 | 5 | 465 | 190 |
| Northland | 19 | 5 | 410 | 140 |
| Northland | 19 | 5 | 425 | 140 |
| Northland | 19 | 5 | 470 | 180 |
| Northland | 19 | 5 | 305 | 110 |
| Northland | 19 | 5 | 335 | 170 |
| Northland | 19 | 5 | 515 | 160 |
| Tikitere | 19 | 10 | 459 | 180 |
| Tikitere | 19 | 10 | 502 | 145 |
| Tikitere | 19 | 10 | 420 | 100 |
| Tikitere | 19 | 10 | 414 | 135 |
| Tikitere | 19 | 10 | 427 | 150 |
| Tikitere | 19 | 10 | 375 | 160 |
| Tikitere | 19 | 10 | 311 | 139 |
| Tikitere | 19 | 10 | 293 | 90 |
| Tikitere | 19 | 10 | 367 | 110 |
| Northland | 19 | 10 | 305 | 140 |
| Northland | 19 | 10 | 300 | 150 |
| Northland | 19 | 10 | 225 | 130 |
| Northland | 19 | 10 | 335 | 110 |
| Northland | 19 | 10 | 410 | 195 |
| Northland | 19 | 10 | 285 | 140 |
| Northland | 19 | 10 | 305 | 190 |
| Northland | 19 | 10 | 275 | 110 |
| Northland | 19 | 10 | 305 | 110 |
| Northland | 19 | 10 | 280 | 180 |
| Northland | 19 | 10 | 300 | 90 |
| Northland | 19 | 10 | 210 | 70 |
| Northland | 19 | 10 | 265 | 240 |
| Northland | 19 | 10 | 335 | 180 |
| Northland | 19 | 10 | 325 | 235 |
| Northland | 19 | 10 | 320 | 270 |
| Northland | 19 | 10 | 250 | 90 |
| Northland | 19 | 10 | 350 | 150 |
| Northland | 19 | 10 | 265 | 100 |
| Northland | 19 | 10 | 245 | 140 |
| Northland | 19 | 10 | 310 | 160 |
| Northland | 19 | 10 | 245 | 130 |
| Northland | 19 | 10 | 265 | 150 |
| Northland | 19 | 10 | 230 | 110 |
| Northland | 19 | 10 | 350 | 130 |

| | | | | |
|---|---|---|---|---|
| Northland | 19 | 10 | 295 | 160 |
| Northland | 19 | 10 | 270 | 135 |
| Northland | 19 | 10 | 405 | 150 |
| Northland | 19 | 10 | 340 | 160 |
| Northland | 19 | 10 | 400 | 140 |
| Northland | 19 | 10 | 375 | 140 |
| Northland | 19 | 10 | 335 | 90 |
| Northland | 19 | 10 | 380 | 170 |
| Northland | 19 | 10 | 350 | 160 |
| Northland | 19 | 10 | 430 | 145 |
| Tikitere | 19 | 15 | 281 | 62 |
| Tikitere | 19 | 15 | 247 | 60 |
| Tikitere | 19 | 15 | 347 | 109 |
| Tikitere | 19 | 15 | 285 | 90 |
| Tikitere | 19 | 15 | 266 | 85 |
| Tikitere | 19 | 15 | 233 | 56 |
| Tikitere | 19 | 15 | 353 | 128 |
| Northland | 19 | 15 | 240 | 100 |
| Northland | 19 | 15 | 260 | 90 |
| Northland | 19 | 15 | 190 | 95 |
| Northland | 19 | 15 | 305 | 60 |
| Northland | 19 | 15 | 360 | 150 |
| Northland | 19 | 15 | 225 | 75 |
| Northland | 19 | 15 | 235 | 90 |
| Northland | 19 | 15 | 225 | 120 |
| Northland | 19 | 15 | 275 | 75 |
| Northland | 19 | 15 | 210 | 155 |
| Northland | 19 | 15 | 290 | 150 |
| Northland | 19 | 15 | 235 | 95 |
| Northland | 19 | 15 | 235 | 165 |
| Northland | 19 | 15 | 210 | 70 |
| Northland | 19 | 15 | 275 | 95 |
| Northland | 19 | 15 | 200 | 100 |
| Northland | 19 | 15 | 235 | 90 |
| Northland | 19 | 15 | 200 | 100 |
| Northland | 19 | 15 | 235 | 105 |
| Northland | 19 | 15 | 270 | 95 |
| Northland | 19 | 15 | 225 | 110 |
| Northland | 19 | 15 | 245 | 110 |
| Northland | 19 | 15 | 370 | 110 |
| Northland | 19 | 15 | 300 | 130 |
| Northland | 19 | 15 | 325 | 100 |
| Northland | 19 | 15 | 280 | 90 |
| Northland | 19 | 15 | 260 | 45 |
| Northland | 19 | 15 | 295 | 100 |
| Northland | 19 | 15 | 270 | 90 |
| Northland | 19 | 15 | 370 | 130 |
| Tikitere | 19 | 20 | 200 | 0 |
| Tikitere | 19 | 20 | 110 | 20 |
| Tikitere | 19 | 20 | 168 | 0 |

| | | | | |
|---|---|---|---|---|
| Tikitere | 19 | 20 | 215 | 48 |
| Tikitere | 19 | 20 | 246 | 39 |
| Northland | 19 | 20 | 200 | 50 |
| Northland | 19 | 20 | 275 | 95 |
| Northland | 19 | 20 | 175 | 35 |
| Northland | 19 | 20 | 200 | 55 |
| Northland | 19 | 20 | 195 | 70 |
| Northland | 19 | 20 | 200 | 35 |
| Northland | 19 | 20 | 225 | 80 |
| Northland | 19 | 20 | 170 | 90 |
| Northland | 19 | 20 | 205 | 60 |
| Northland | 19 | 20 | 180 | 50 |
| Northland | 19 | 20 | 265 | 60 |
| Northland | 19 | 20 | 280 | 70 |
| Northland | 19 | 20 | 215 | 40 |
| Northland | 19 | 20 | 210 | 35 |
| Northland | 19 | 20 | 300 | 60 |
| Puruki | 21 | 0 | 327 | 115 |
| Puruki | 21 | 0 | 387 | 70 |
| Puruki | 21 | 0 | 393 | 91 |
| Puruki | 21 | 0 | 480 | 125 |
| Puruki | 21 | 0 | 531 | 113 |
| Puruki | 21 | 0 | 396 | 75 |
| Puruki | 21 | 0 | 509 | 160 |
| Puruki | 21 | 0 | 519 | 132 |
| Puruki | 21 | 0 | 515 | 135 |
| Puruki | 21 | 0 | 643 | 160 |
| Puruki | 21 | 0 | 459 | 128 |
| Puruki | 21 | 0 | 510 | 146 |
| Puruki | 21 | 0 | 468 | 120 |
| Kaingaroa Forest | 21 | 0 | 513 | 90 |
| Kaingaroa Forest | 21 | 0 | 438 | 95 |
| Kaingaroa Forest | 21 | 0 | 522 | 130 |
| Kaingaroa Forest | 21 | 0 | 488 | 160 |
| Kaingaroa Forest | 21 | 0 | 448 | 120 |
| Kaingaroa Forest | 21 | 0 | 547 | 120 |
| Kaingaroa Forest | 21 | 0 | 535 | 105 |
| Kaingaroa Forest | 21 | 0 | 430 | 125 |
| Kaingaroa Forest | 21 | 0 | 481 | 90 |
| Kaingaroa Forest | 21 | 0 | 508 | 160 |
| Kaingaroa Forest | 21 | 0 | 332 | 55 |
| Kaingaroa Forest | 21 | 0 | 442 | 100 |
| Kaingaroa Forest | 21 | 0 | 441 | 75 |
| Kaingaroa Forest | 21 | 0 | 518 | 110 |
| Kaingaroa Forest | 21 | 0 | 513 | 175 |
| Kaingaroa Forest | 21 | 0 | 501 | 130 |
| Kaingaroa Forest | 21 | 0 | 498 | 195 |
| Kaingaroa Forest | 21 | 0 | 448 | 100 |
| Kaingaroa Forest | 21 | 0 | 489 | 80 |
| Kaingaroa Forest | 21 | 0 | 484 | 185 |

| | | | | |
|---|---|---|---|---|
| Kaingaroa Forest | 21 | 0 | 507 | 110 |
| Kaingaroa Forest | 21 | 0 | 497 | 120 |
| Kaingaroa Forest | 21 | 0 | 457 | 130 |
| Kaingaroa Forest | 21 | 0 | 508 | 120 |
| Kaingaroa Forest | 21 | 0 | 592 | 100 |
| Kaingaroa Forest | 21 | 0 | 471 | 98 |
| Kaingaroa Forest | 21 | 0 | 499 | 170 |
| Kaingaroa Forest | 21 | 0 | 503 | 115 |
| Kaingaroa Forest | 21 | 4.9 | 411 | 145 |
| Kaingaroa Forest | 21 | 4.9 | 370 | 95 |
| Kaingaroa Forest | 21 | 4.9 | 397 | 110 |
| Kaingaroa Forest | 21 | 4.9 | 386 | 170 |
| Kaingaroa Forest | 21 | 4.9 | 369 | 140 |
| Kaingaroa Forest | 21 | 4.9 | 407 | 130 |
| Kaingaroa Forest | 21 | 4.9 | 430 | 175 |
| Kaingaroa Forest | 21 | 4.9 | 419 | 120 |
| Kaingaroa Forest | 21 | 4.9 | 327 | 100 |
| Kaingaroa Forest | 21 | 4.9 | 362 | 145 |
| Kaingaroa Forest | 21 | 4.9 | 268 | 85 |
| Kaingaroa Forest | 21 | 4.9 | 360 | 100 |
| Kaingaroa Forest | 21 | 4.9 | 358 | 90 |
| Kaingaroa Forest | 21 | 4.9 | 412 | 180 |
| Kaingaroa Forest | 21 | 4.9 | 420 | 165 |
| Kaingaroa Forest | 21 | 4.9 | 402 | 160 |
| Kaingaroa Forest | 21 | 4.9 | 408 | 185 |
| Kaingaroa Forest | 21 | 4.9 | 371 | 155 |
| Kaingaroa Forest | 21 | 4.9 | 388 | 120 |
| Kaingaroa Forest | 21 | 4.9 | 382 | 110 |
| Kaingaroa Forest | 21 | 4.9 | 407 | 90 |
| Kaingaroa Forest | 21 | 4.9 | 419 | 140 |
| Kaingaroa Forest | 21 | 4.9 | 354 | 135 |
| Kaingaroa Forest | 21 | 4.9 | 405 | 120 |
| Kaingaroa Forest | 21 | 4.9 | 461 | 120 |
| Kaingaroa Forest | 21 | 4.9 | 311 | 110 |
| Kaingaroa Forest | 21 | 4.9 | 369 | 150 |
| Kaingaroa Forest | 21 | 4.9 | 423 | 140 |
| Kaingaroa Forest | 21 | 4.9 | 407 | 135 |
| Kaingaroa Forest | 21 | 9.8 | 360 | 130 |
| Kaingaroa Forest | 21 | 9.8 | 308 | 70 |
| Kaingaroa Forest | 21 | 9.8 | 349 | 105 |
| Kaingaroa Forest | 21 | 9.8 | 335 | 140 |
| Kaingaroa Forest | 21 | 9.8 | 320 | 135 |
| Kaingaroa Forest | 21 | 9.8 | 370 | 105 |
| Kaingaroa Forest | 21 | 9.8 | 358 | 120 |
| Kaingaroa Forest | 21 | 9.8 | 372 | 85 |
| Kaingaroa Forest | 21 | 9.8 | 294 | 60 |
| Kaingaroa Forest | 21 | 9.8 | 323 | 130 |
| Kaingaroa Forest | 21 | 9.8 | 359 | 150 |
| Kaingaroa Forest | 21 | 9.8 | 245 | 80 |
| Kaingaroa Forest | 21 | 9.8 | 327 | 95 |

| | | | | |
|---|---|---|---|---|
| Kaingaroa Forest | 21 | 9.8 | 304 | 75 |
| Kaingaroa Forest | 21 | 9.8 | 375 | 130 |
| Kaingaroa Forest | 21 | 9.8 | 359 | 130 |
| Kaingaroa Forest | 21 | 9.8 | 342 | 130 |
| Kaingaroa Forest | 21 | 9.8 | 355 | 145 |
| Kaingaroa Forest | 21 | 9.8 | 307 | 105 |
| Kaingaroa Forest | 21 | 9.8 | 351 | 100 |
| Kaingaroa Forest | 21 | 9.8 | 347 | 60 |
| Kaingaroa Forest | 21 | 9.8 | 353 | 80 |
| Kaingaroa Forest | 21 | 9.8 | 381 | 120 |
| Kaingaroa Forest | 21 | 9.8 | 329 | 120 |
| Kaingaroa Forest | 21 | 9.8 | 362 | 130 |
| Kaingaroa Forest | 21 | 9.8 | 408 | 100 |
| Kaingaroa Forest | 21 | 9.8 | 270 | 90 |
| Kaingaroa Forest | 21 | 9.8 | 318 | 120 |
| Kaingaroa Forest | 21 | 9.8 | 354 | 95 |
| Kaingaroa Forest | 21 | 9.8 | 375 | 140 |
| Kaingaroa Forest | 21 | 14.7 | 298 | 75 |
| Kaingaroa Forest | 21 | 14.7 | 258 | 40 |
| Kaingaroa Forest | 21 | 14.7 | 294 | 90 |
| Kaingaroa Forest | 21 | 14.7 | 300 | 80 |
| Kaingaroa Forest | 21 | 14.7 | 275 | 90 |
| Kaingaroa Forest | 21 | 14.7 | 317 | 80 |
| Kaingaroa Forest | 21 | 14.7 | 324 | 85 |
| Kaingaroa Forest | 21 | 14.7 | 318 | 80 |
| Kaingaroa Forest | 21 | 14.7 | 275 | 90 |
| Kaingaroa Forest | 21 | 14.7 | 276 | 95 |
| Kaingaroa Forest | 21 | 14.7 | 215 | 60 |
| Kaingaroa Forest | 21 | 14.7 | 256 | 60 |
| Kaingaroa Forest | 21 | 14.7 | 235 | 45 |
| Kaingaroa Forest | 21 | 14.7 | 299 | 95 |
| Kaingaroa Forest | 21 | 14.7 | 309 | 80 |
| Kaingaroa Forest | 21 | 14.7 | 296 | 90 |
| Kaingaroa Forest | 21 | 14.7 | 298 | 100 |
| Kaingaroa Forest | 21 | 14.7 | 278 | 65 |
| Kaingaroa Forest | 21 | 14.7 | 290 | 60 |
| Kaingaroa Forest | 21 | 14.7 | 277 | 55 |
| Kaingaroa Forest | 21 | 14.7 | 279 | 80 |
| Kaingaroa Forest | 21 | 14.7 | 317 | 85 |
| Kaingaroa Forest | 21 | 14.7 | 277 | 80 |
| Kaingaroa Forest | 21 | 14.7 | 310 | 85 |
| Kaingaroa Forest | 21 | 14.7 | 359 | 70 |
| Kaingaroa Forest | 21 | 14.7 | 224 | 55 |
| Kaingaroa Forest | 21 | 14.7 | 264 | 80 |
| Kaingaroa Forest | 21 | 14.7 | 299 | 70 |
| Kaingaroa Forest | 21 | 14.7 | 292 | 85 |
| Tikitere | 23 | 0 | 517 | 185 |
| Tikitere | 23 | 0 | 483 | 220 |
| Tikitere | 23 | 0 | 531 | 180 |
| Tikitere | 23 | 0 | 491 | 140 |

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| Tikitere | 23 | 0 | 435 | 155 |
| Tikitere | 23 | 0 | 488 | 150 |
| Tikitere | 23 | 0 | 451 | 210 |
| Tikitere | 23 | 0 | 490 | 200 |
| Tikitere | 23 | 0 | 569 | 240 |
| Tikitere | 23 | 0 | 521 | 210 |
| Tikitere | 23 | 0 | 401 | 190 |
| Tikitere | 23 | 0 | 509 | 205 |
| Tikitere | 23 | 0 | 770 | 275 |
| Tikitere | 23 | 0 | 770 | 280 |
| Tikitere | 23 | 0 | 755 | 250 |
| Tikitere | 23 | 0 | 720 | 300 |
| Tikitere | 23 | 0 | 719 | 210 |
| Tikitere | 23 | 0 | 695 | 170 |
| Tikitere | 23 | 0 | 660 | 175 |
| Tikitere | 23 | 0 | 750 | 255 |
| Tikitere | 23 | 5 | 467 | 225 |
| Tikitere | 23 | 5 | 425 | 242 |
| Tikitere | 23 | 5 | 447 | 146 |
| Tikitere | 23 | 5 | 394 | 120 |
| Tikitere | 23 | 5 | 382 | 175 |
| Tikitere | 23 | 5 | 416 | 173 |
| Tikitere | 23 | 5 | 372 | 205 |
| Tikitere | 23 | 5 | 397 | 205 |
| Tikitere | 23 | 5 | 467 | 230 |
| Tikitere | 23 | 5 | 437 | 200 |
| Tikitere | 23 | 5 | 331 | 190 |
| Tikitere | 23 | 5 | 414 | 180 |
| Tikitere | 23 | 5 | 655 | 295 |
| Tikitere | 23 | 5 | 640 | 240 |
| Tikitere | 23 | 5 | 625 | 225 |
| Tikitere | 23 | 5 | 615 | 260 |
| Tikitere | 23 | 5 | 580 | 195 |
| Tikitere | 23 | 5 | 661 | 160 |
| Tikitere | 23 | 5 | 564 | 160 |
| Tikitere | 23 | 5 | 625 | 415 |
| Tikitere | 23 | 10 | 428 | 230 |
| Tikitere | 23 | 10 | 386 | 225 |
| Tikitere | 23 | 10 | 432 | 140 |
| Tikitere | 23 | 10 | 367 | 105 |
| Tikitere | 23 | 10 | 374 | 150 |
| Tikitere | 23 | 10 | 390 | 165 |
| Tikitere | 23 | 10 | 337 | 180 |
| Tikitere | 23 | 10 | 358 | 185 |
| Tikitere | 23 | 10 | 432 | 205 |
| Tikitere | 23 | 10 | 402 | 165 |
| Tikitere | 23 | 10 | 296 | 105 |
| Tikitere | 23 | 10 | 407 | 190 |
| Tikitere | 23 | 10 | 610 | 280 |
| Tikitere | 23 | 10 | 602 | 215 |

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| Tikitere | 23 | 10 | 572 | 150 |
| Tikitere | 23 | 10 | 610 | 270 |
| Tikitere | 23 | 10 | 531 | 170 |
| Tikitere | 23 | 10 | 551 | 175 |
| Tikitere | 23 | 10 | 522 | 140 |
| Tikitere | 23 | 10 | 604 | 400 |
| Tikitere | 23 | 15 | 342 | 185 |
| Tikitere | 23 | 15 | 341 | 180 |
| Tikitere | 23 | 15 | 372 | 125 |
| Tikitere | 23 | 15 | 306 | 85 |
| Tikitere | 23 | 15 | 303 | 105 |
| Tikitere | 23 | 15 | 336 | 125 |
| Tikitere | 23 | 15 | 288 | 110 |
| Tikitere | 23 | 15 | 340 | 175 |
| Tikitere | 23 | 15 | 360 | 135 |
| Tikitere | 23 | 15 | 328 | 150 |
| Tikitere | 23 | 15 | 221 | 95 |
| Tikitere | 23 | 15 | 322 | 125 |
| Tikitere | 23 | 15 | 494 | 205 |
| Tikitere | 23 | 15 | 479 | 180 |
| Tikitere | 23 | 15 | 282 | 70 |
| Tikitere | 23 | 15 | 455 | 162 |
| Tikitere | 23 | 15 | 308 | 75 |
| Tikitere | 23 | 15 | 345 | 70 |
| Tikitere | 23 | 15 | 382 | 70 |
| Tikitere | 23 | 15 | 402 | 260 |
| Tikitere | 23 | 20 | 261 | 115 |
| Tikitere | 23 | 20 | 278 | 125 |
| Tikitere | 23 | 20 | 294 | 60 |
| Tikitere | 23 | 20 | 187 | 40 |
| Tikitere | 23 | 20 | 247 | 65 |
| Tikitere | 23 | 20 | 278 | 75 |
| Tikitere | 23 | 20 | 238 | 75 |
| Tikitere | 23 | 20 | 278 | 100 |
| Tikitere | 23 | 20 | 287 | 70 |
| Tikitere | 23 | 20 | 266 | 90 |
| Tikitere | 23 | 20 | 263 | 75 |
| Tikitere | 23 | 20 | 385 | 110 |
| Tikitere | 23 | 20 | 347 | 97 |
| Tikitere | 23 | 20 | 209 | 45 |
| Tikitere | 23 | 20 | 329 | 80 |
| Tikitere | 23 | 20 | 207 | 30 |
| Tikitere | 23 | 20 | 159 | 40 |
| Tikitere | 23 | 20 | 220 | 20 |
| Tikitere | 23 | 20 | 143 | 75 |
| Kaingaroa Forest | 25 | 0 | 655 | 194 |
| Kaingaroa Forest | 25 | 0 | 587 | 164 |
| Kaingaroa Forest | 25 | 0 | 490 | 130 |
| Kaingaroa Forest | 25 | 0 | 620 | 54 |
| Kaingaroa Forest | 25 | 0 | 608 | 187 |

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| Kaingaroa Forest | 25 | 0 | 660 | 182 |
| Kaingaroa Forest | 25 | 0 | 510 | 105 |
| Kaingaroa Forest | 25 | 0 | 570 | 90 |
| Kaingaroa Forest | 25 | 0 | 574 | 160 |
| Kaingaroa Forest | 25 | 0 | 610 | 165 |
| Kaingaroa Forest | 25 | 0 | 560 | 200 |
| Kaingaroa Forest | 25 | 0 | 409 | 130 |
| Kaingaroa Forest | 25 | 0 | 623 | 150 |
| Kaingaroa Forest | 25 | 0 | 416 | 150 |
| Kaingaroa Forest | 25 | 0 | 506 | 110 |
| Kaingaroa Forest | 25 | 0 | 545 | 155 |
| Kaingaroa Forest | 25 | 0 | 588 | 170 |
| Kaingaroa Forest | 25 | 0 | 588 | 80 |
| Kaingaroa Forest | 25 | 0 | 517 | 180 |
| Kaingaroa Forest | 25 | 0 | 540 | 150 |
| Kaingaroa Forest | 25 | 0 | 520 | 120 |
| Kaingaroa Forest | 25 | 0 | 480 | 150 |
| Kaingaroa Forest | 25 | 0 | 725 | 180 |
| Kaingaroa Forest | 25 | 0 | 410 | 90 |
| Kaingaroa Forest | 25 | 0 | 580 | 160 |
| Kaingaroa Forest | 25 | 0 | 377 | 110 |
| Kaingaroa Forest | 25 | 0 | 633 | 125 |
| Kaingaroa Forest | 25 | 0 | 522 | 180 |
| Kaingaroa Forest | 25 | 0 | 538 | 220 |
| Kaingaroa Forest | 25 | 0 | 430 | 140 |
| Kaingaroa Forest | 25 | 0 | 487 | 85 |
| Kaingaroa Forest | 25 | 0 | 577 | 240 |
| Kaingaroa Forest | 25 | 0 | 580 | 180 |
| Kaingaroa Forest | 25 | 0 | 480 | 180 |
| Kaingaroa Forest | 25 | 0 | 592 | 145 |
| Kaingaroa Forest | 25 | 0 | 614 | 205 |
| Kaingaroa Forest | 25 | 0 | 460 | 150 |
| Kaingaroa Forest | 25 | 0 | 575 | 140 |
| Kaingaroa Forest | 25 | 0 | 557 | 175 |
| Kaingaroa Forest | 25 | 0 | 638 | 195 |
| Kaingaroa Forest | 25 | 0 | 535 | 140 |
| Kaingaroa Forest | 25 | 0 | 630 | 245 |
| Kaingaroa Forest | 25 | 0 | 608 | 250 |
| Kaingaroa Forest | 25 | 0 | 569 | 160 |
| Kaingaroa Forest | 25 | 0 | 640 | 205 |
| Kaingaroa Forest | 25 | 0 | 568 | 175 |
| Kaingaroa Forest | 25 | 0 | 407 | 80 |
| Kaingaroa Forest | 25 | 0 | 609 | 193 |
| Kaingaroa Forest | 25 | 0 | 632 | 220 |
| Kaingaroa Forest | 25 | 0 | 569 | 220 |
| Kaingaroa Forest | 25 | 6 | 526 | 202 |
| Kaingaroa Forest | 25 | 6 | 457 | 198 |
| Kaingaroa Forest | 25 | 6 | 386 | 151 |
| Kaingaroa Forest | 25 | 6 | 464 | 100 |
| Kaingaroa Forest | 25 | 6 | 488 | 175 |

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| Kaingaroa Forest | 25 | 6 | 502 | 153 |
| Kaingaroa Forest | 25 | 6 | 413 | 110 |
| Kaingaroa Forest | 25 | 6 | 397 | 120 |
| Kaingaroa Forest | 25 | 6 | 424 | 175 |
| Kaingaroa Forest | 25 | 6 | 482 | 170 |
| Kaingaroa Forest | 25 | 6 | 420 | 200 |
| Kaingaroa Forest | 25 | 6 | 309 | 145 |
| Kaingaroa Forest | 25 | 6 | 521 | 130 |
| Kaingaroa Forest | 25 | 6 | 335 | 105 |
| Kaingaroa Forest | 25 | 6 | 417 | 130 |
| Kaingaroa Forest | 25 | 6 | 464 | 185 |
| Kaingaroa Forest | 25 | 6 | 478 | 180 |
| Kaingaroa Forest | 25 | 6 | 470 | 120 |
| Kaingaroa Forest | 25 | 6 | 432 | 200 |
| Kaingaroa Forest | 25 | 6 | 387 | 170 |
| Kaingaroa Forest | 25 | 6 | 430 | 180 |
| Kaingaroa Forest | 25 | 6 | 377 | 150 |
| Kaingaroa Forest | 25 | 6 | 595 | 140 |
| Kaingaroa Forest | 25 | 6 | 314 | 110 |
| Kaingaroa Forest | 25 | 6 | 441 | 120 |
| Kaingaroa Forest | 25 | 6 | 316 | 120 |
| Kaingaroa Forest | 25 | 6 | 478 | 190 |
| Kaingaroa Forest | 25 | 6 | 477 | 220 |
| Kaingaroa Forest | 25 | 6 | 409 | 220 |
| Kaingaroa Forest | 25 | 6 | 316 | 130 |
| Kaingaroa Forest | 25 | 6 | 398 | 100 |
| Kaingaroa Forest | 25 | 6 | 434 | 190 |
| Kaingaroa Forest | 25 | 6 | 444 | 230 |
| Kaingaroa Forest | 25 | 6 | 371 | 160 |
| Kaingaroa Forest | 25 | 6 | 456 | 155 |
| Kaingaroa Forest | 25 | 6 | 488 | 170 |
| Kaingaroa Forest | 25 | 6 | 367 | 160 |
| Kaingaroa Forest | 25 | 6 | 446 | 150 |
| Kaingaroa Forest | 25 | 6 | 418 | 145 |
| Kaingaroa Forest | 25 | 6 | 484 | 200 |
| Kaingaroa Forest | 25 | 6 | 430 | 150 |
| Kaingaroa Forest | 25 | 6 | 431 | 185 |
| Kaingaroa Forest | 25 | 6 | 538 | 240 |
| Kaingaroa Forest | 25 | 6 | 452 | 190 |
| Kaingaroa Forest | 25 | 6 | 506 | 215 |
| Kaingaroa Forest | 25 | 6 | 456 | 205 |
| Kaingaroa Forest | 25 | 6 | 325 | 80 |
| Kaingaroa Forest | 25 | 6 | 463 | 184 |
| Kaingaroa Forest | 25 | 6 | 480 | 190 |
| Kaingaroa Forest | 25 | 6 | 464 | 196 |
| Kaingaroa Forest | 25 | 11 | 488 | 145 |
| Kaingaroa Forest | 25 | 11 | 413 | 187 |
| Kaingaroa Forest | 25 | 11 | 390 | 130 |
| Kaingaroa Forest | 25 | 11 | 435 | 152 |
| Kaingaroa Forest | 25 | 11 | 451 | 175 |

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| Kaingaroa Forest | 25 | 11 | 472 | 152 |
| Kaingaroa Forest | 25 | 11 | 387 | 120 |
| Kaingaroa Forest | 25 | 11 | 340 | 120 |
| Kaingaroa Forest | 25 | 11 | 391 | 165 |
| Kaingaroa Forest | 25 | 11 | 443 | 180 |
| Kaingaroa Forest | 25 | 11 | 395 | 210 |
| Kaingaroa Forest | 25 | 11 | 308 | 130 |
| Kaingaroa Forest | 25 | 11 | 485 | 110 |
| Kaingaroa Forest | 25 | 11 | 305 | 120 |
| Kaingaroa Forest | 25 | 11 | 420 | 115 |
| Kaingaroa Forest | 25 | 11 | 429 | 170 |
| Kaingaroa Forest | 25 | 11 | 434 | 170 |
| Kaingaroa Forest | 25 | 11 | 419 | 120 |
| Kaingaroa Forest | 25 | 11 | 373 | 190 |
| Kaingaroa Forest | 25 | 11 | 355 | 170 |
| Kaingaroa Forest | 25 | 11 | 394 | 170 |
| Kaingaroa Forest | 25 | 11 | 340 | 140 |
| Kaingaroa Forest | 25 | 11 | 511 | 110 |
| Kaingaroa Forest | 25 | 11 | 297 | 105 |
| Kaingaroa Forest | 25 | 11 | 420 | 125 |
| Kaingaroa Forest | 25 | 11 | 268 | 135 |
| Kaingaroa Forest | 25 | 11 | 437 | 170 |
| Kaingaroa Forest | 25 | 11 | 382 | 180 |
| Kaingaroa Forest | 25 | 11 | 369 | 190 |
| Kaingaroa Forest | 25 | 11 | 296 | 120 |
| Kaingaroa Forest | 25 | 11 | 355 | 90 |
| Kaingaroa Forest | 25 | 11 | 385 | 190 |
| Kaingaroa Forest | 25 | 11 | 412 | 190 |
| Kaingaroa Forest | 25 | 11 | 312 | 160 |
| Kaingaroa Forest | 25 | 11 | 420 | 160 |
| Kaingaroa Forest | 25 | 11 | 490 | 115 |
| Kaingaroa Forest | 25 | 11 | 329 | 150 |
| Kaingaroa Forest | 25 | 11 | 400 | 115 |
| Kaingaroa Forest | 25 | 11 | 376 | 120 |
| Kaingaroa Forest | 25 | 11 | 446 | 200 |
| Kaingaroa Forest | 25 | 11 | 393 | 160 |
| Kaingaroa Forest | 25 | 11 | 429 | 140 |
| Kaingaroa Forest | 25 | 11 | 433 | 190 |
| Kaingaroa Forest | 25 | 11 | 402 | 175 |
| Kaingaroa Forest | 25 | 11 | 461 | 210 |
| Kaingaroa Forest | 25 | 11 | 403 | 190 |
| Kaingaroa Forest | 25 | 11 | 292 | 80 |
| Kaingaroa Forest | 25 | 11 | 426 | 192 |
| Kaingaroa Forest | 25 | 11 | 442 | 180 |
| Kaingaroa Forest | 25 | 11 | 430 | 160 |
| Kaingaroa Forest | 25 | 16 | 419 | 115 |
| Kaingaroa Forest | 25 | 16 | 366 | 130 |
| Kaingaroa Forest | 25 | 16 | 299 | 108 |
| Kaingaroa Forest | 25 | 16 | 360 | 108 |
| Kaingaroa Forest | 25 | 16 | 356 | 130 |

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| Kaingaroa Forest | 25 | 16 | 406 | 145 |
| Kaingaroa Forest | 25 | 16 | 340 | 115 |
| Kaingaroa Forest | 25 | 16 | 305 | 110 |
| Kaingaroa Forest | 25 | 16 | 379 | 150 |
| Kaingaroa Forest | 25 | 16 | 390 | 160 |
| Kaingaroa Forest | 25 | 16 | 358 | 180 |
| Kaingaroa Forest | 25 | 16 | 252 | 95 |
| Kaingaroa Forest | 25 | 16 | 442 | 95 |
| Kaingaroa Forest | 25 | 16 | 265 | 75 |
| Kaingaroa Forest | 25 | 16 | 343 | 100 |
| Kaingaroa Forest | 25 | 16 | 341 | 100 |
| Kaingaroa Forest | 25 | 16 | 410 | 125 |
| Kaingaroa Forest | 25 | 16 | 371 | 100 |
| Kaingaroa Forest | 25 | 16 | 346 | 140 |
| Kaingaroa Forest | 25 | 16 | 316 | 120 |
| Kaingaroa Forest | 25 | 16 | 348 | 110 |
| Kaingaroa Forest | 25 | 16 | 289 | 125 |
| Kaingaroa Forest | 25 | 16 | 385 | 85 |
| Kaingaroa Forest | 25 | 16 | 288 | 80 |
| Kaingaroa Forest | 25 | 16 | 366 | 100 |
| Kaingaroa Forest | 25 | 16 | 382 | 130 |
| Kaingaroa Forest | 25 | 16 | 331 | 110 |
| Kaingaroa Forest | 25 | 16 | 313 | 150 |
| Kaingaroa Forest | 25 | 16 | 282 | 105 |
| Kaingaroa Forest | 25 | 16 | 306 | 80 |
| Kaingaroa Forest | 25 | 16 | 346 | 160 |
| Kaingaroa Forest | 25 | 16 | 340 | 120 |
| Kaingaroa Forest | 25 | 16 | 269 | 130 |
| Kaingaroa Forest | 25 | 16 | 374 | 110 |
| Kaingaroa Forest | 25 | 16 | 408 | 115 |
| Kaingaroa Forest | 25 | 16 | 300 | 115 |
| Kaingaroa Forest | 25 | 16 | 341 | 110 |
| Kaingaroa Forest | 25 | 16 | 322 | 90 |
| Kaingaroa Forest | 25 | 16 | 392 | 160 |
| Kaingaroa Forest | 25 | 16 | 350 | 145 |
| Kaingaroa Forest | 25 | 16 | 420 | 150 |
| Kaingaroa Forest | 25 | 16 | 415 | 160 |
| Kaingaroa Forest | 25 | 16 | 348 | 145 |
| Kaingaroa Forest | 25 | 16 | 389 | 155 |
| Kaingaroa Forest | 25 | 16 | 342 | 150 |
| Kaingaroa Forest | 25 | 16 | 255 | 45 |
| Kaingaroa Forest | 25 | 16 | 357 | 137 |
| Kaingaroa Forest | 25 | 16 | 386 | 140 |
| Kaingaroa Forest | 25 | 16 | 384 | 117 |
| Kaingaroa Forest | 25 | 21 | 337 | 101 |
| Kaingaroa Forest | 25 | 21 | 279 | 62 |
| Kaingaroa Forest | 25 | 21 | 294 | 55 |
| Kaingaroa Forest | 25 | 21 | 290 | 80 |
| Kaingaroa Forest | 25 | 21 | 335 | 78 |
| Kaingaroa Forest | 25 | 21 | 284 | 70 |

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| Kaingaroa Forest | 25 | 21 | 255 | 40 |
| Kaingaroa Forest | 25 | 21 | 292 | 80 |
| Kaingaroa Forest | 25 | 21 | 347 | 130 |
| Kaingaroa Forest | 25 | 21 | 315 | 125 |
| Kaingaroa Forest | 25 | 21 | 215 | 55 |
| Kaingaroa Forest | 25 | 21 | 365 | 60 |
| Kaingaroa Forest | 25 | 21 | 222 | 40 |
| Kaingaroa Forest | 25 | 21 | 234 | 30 |
| Kaingaroa Forest | 25 | 21 | 282 | 50 |
| Kaingaroa Forest | 25 | 21 | 353 | 100 |
| Kaingaroa Forest | 25 | 21 | 310 | 60 |
| Kaingaroa Forest | 25 | 21 | 268 | 90 |
| Kaingaroa Forest | 25 | 21 | 267 | 90 |
| Kaingaroa Forest | 25 | 21 | 225 | 60 |
| Kaingaroa Forest | 25 | 21 | 254 | 50 |
| Kaingaroa Forest | 25 | 21 | 222 | 65 |
| Kaingaroa Forest | 25 | 21 | 356 | 80 |
| Kaingaroa Forest | 25 | 21 | 340 | 100 |
| Kaingaroa Forest | 25 | 21 | 246 | 50 |
| Kaingaroa Forest | 25 | 21 | 260 | 90 |
| Kaingaroa Forest | 25 | 21 | 230 | 60 |
| Kaingaroa Forest | 25 | 21 | 263 | 50 |
| Kaingaroa Forest | 25 | 21 | 278 | 110 |
| Kaingaroa Forest | 25 | 21 | 277 | 65 |
| Kaingaroa Forest | 25 | 21 | 236 | 0 |
| Kaingaroa Forest | 25 | 21 | 286 | 60 |
| Kaingaroa Forest | 25 | 21 | 320 | 50 |
| Kaingaroa Forest | 25 | 21 | 253 | 75 |
| Kaingaroa Forest | 25 | 21 | 288 | 60 |
| Kaingaroa Forest | 25 | 21 | 269 | 45 |
| Kaingaroa Forest | 25 | 21 | 305 | 100 |
| Kaingaroa Forest | 25 | 21 | 306 | 80 |
| Kaingaroa Forest | 25 | 21 | 311 | 100 |
| Kaingaroa Forest | 25 | 21 | 323 | 110 |
| Kaingaroa Forest | 25 | 21 | 284 | 85 |
| Kaingaroa Forest | 25 | 21 | 305 | 90 |
| Kaingaroa Forest | 25 | 21 | 308 | 105 |
| Kaingaroa Forest | 25 | 21 | 209 | 30 |
| Kaingaroa Forest | 25 | 21 | 301 | 84 |
| Kaingaroa Forest | 25 | 21 | 333 | 100 |
| Kaingaroa Forest | 25 | 21 | 329 | 75 |
| Kaingaroa | 27 | 0 | 592 | 305 |
| Kaingaroa | 27 | 0 | 501 | 175 |
| Kaingaroa | 27 | 0 | 465 | 235 |
| Kaingaroa | 27 | 0 | 420 | 250 |
| Kaingaroa | 27 | 0 | 470 | 180 |
| Kaingaroa | 27 | 0 | 455 | 252 |
| Kaingaroa | 27 | 0 | 559 | 210 |
| Kaingaroa | 27 | 0 | 388 | 233 |
| Kaingaroa | 27 | 0 | 423 | 205 |

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| Kaingaroa | 27 | 0 | 334 | 233 |
| Kaingaroa | 27 | 0 | 532 | 210 |
| Kaingaroa | 27 | 0 | 462 | 165 |
| Kaingaroa | 27 | 0 | 306 | 200 |
| Kaingaroa | 27 | 0 | 461 | 243 |
| Kaingaroa | 27 | 0 | 430 | 210 |
| Kaingaroa | 27 | 0 | 412 | 233 |
| Kaingaroa | 27 | 0 | 605 | 300 |
| Kaingaroa | 27 | 0 | 564 | 235 |
| Kaingaroa | 27 | 0 | 366 | 200 |
| Kaingaroa | 27 | 0 | 427 | 240 |
| Kaingaroa | 27 | 0 | 507 | 195 |
| Kaingaroa | 27 | 0 | 654 | 310 |
| Kaingaroa | 27 | 0 | 417 | 265 |
| Kaingaroa | 27 | 0 | 491 | 255 |
| Kaingaroa | 27 | 0 | 431 | 260 |
| Kaingaroa | 27 | 0 | 557 | 215 |
| Kaingaroa | 27 | 0 | 465 | 270 |
| Kaingaroa | 27 | 0 | 332 | 175 |
| Kaingaroa | 27 | 0 | 440 | 260 |
| Kaingaroa | 27 | 0 | 500 | 185 |
| Kaingaroa | 27 | 0 | 505 | 305 |
| Kaingaroa | 27 | 0 | 485 | 255 |
| Kaingaroa | 27 | 0 | 436 | 285 |
| Kaingaroa | 27 | 0 | 512 | 195 |
| Kaingaroa | 27 | 0 | 665 | 240 |
| Kaingaroa | 27 | 0 | 457 | 255 |
| Kaingaroa | 27 | 0 | 529 | 235 |
| Kaingaroa | 27 | 0 | 505 | 190 |
| Kaingaroa | 27 | 0 | 567 | 270 |
| Kaingaroa | 27 | 0 | 466 | 265 |
| Kaingaroa | 27 | 0 | 500 | 270 |
| Kaingaroa | 27 | 0 | 612 | 300 |
| Kaingaroa | 27 | 0 | 542 | 185 |
| Kaingaroa | 27 | 0 | 555 | 250 |
| Kaingaroa | 27 | 0 | 573 | 215 |
| Kaingaroa | 27 | 0 | 636 | 325 |
| Kaingaroa | 27 | 0 | 495 | 180 |
| Kaingaroa | 27 | 0 | 567 | 225 |
| Kaingaroa | 27 | 0 | 508 | 165 |
| Kaingaroa | 27 | 0 | 539 | 240 |
| Kaingaroa | 27 | 0 | 560 | 205 |
| Kaingaroa | 27 | 0 | 479 | 225 |
| Kaingaroa | 27 | 0 | 594 | 260 |
| Kaingaroa | 27 | 0 | 516 | 265 |
| Kaingaroa | 27 | 0 | 408 | 230 |
| Kaingaroa | 27 | 0 | 620 | 320 |
| Kaingaroa | 27 | 0 | 466 | 235 |
| Kaingaroa | 27 | 0 | 441 | 245 |
| Kaingaroa | 27 | 0 | 543 | 255 |

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| Kaingaroa | 27 | 0 | 436 | 250 |
| Kaingaroa | 27 | 0 | 502 | 205 |
| Patanamu | 27 | 0 | 611 | 200 |
| Patanamu | 27 | 0 | 596 | 230 |
| Patanamu | 27 | 0 | 618 | 190 |
| Patanamu | 27 | 0 | 543 | 270 |
| Patanamu | 27 | 0 | 571 | 155 |
| Kaingaroa | 27 | 1.4 | 500 | 210 |
| Kaingaroa | 27 | 1.4 | 536 | 250 |
| Kaingaroa | 27 | 1.4 | 536 | 225 |
| Kaingaroa | 27 | 1.4 | 587 | 303 |
| Kaingaroa | 27 | 1.4 | 458 | 195 |
| Kaingaroa | 27 | 1.4 | 530 | 225 |
| Kaingaroa | 27 | 1.4 | 470 | 170 |
| Kaingaroa | 27 | 1.4 | 482 | 208 |
| Kaingaroa | 27 | 1.4 | 508 | 210 |
| Kaingaroa | 27 | 1.4 | 440 | 205 |
| Kaingaroa | 27 | 1.4 | 553 | 235 |
| Kaingaroa | 27 | 1.4 | 499 | 255 |
| Kaingaroa | 27 | 1.4 | 385 | 205 |
| Kaingaroa | 27 | 1.4 | 576 | 300 |
| Kaingaroa | 27 | 1.4 | 471 | 185 |
| Kaingaroa | 27 | 1.4 | 434 | 230 |
| Kaingaroa | 27 | 1.4 | 386 | 215 |
| Kaingaroa | 27 | 1.4 | 485 | 220 |
| Kaingaroa | 27 | 1.4 | 400 | 235 |
| Kaingaroa | 27 | 1.4 | 460 | 205 |
| Patanamu | 27 | 1.4 | 557 | 220 |
| Patanamu | 27 | 1.4 | 540 | 230 |
| Patanamu | 27 | 1.4 | 570 | 210 |
| Patanamu | 27 | 1.4 | 505 | 140 |
| Patanamu | 27 | 1.4 | 536 | 150 |
| Kaingaroa | 27 | 5 | 438 | 206 |
| Kaingaroa | 27 | 5 | 570 | 340 |
| Kaingaroa | 27 | 5 | 349 | 230 |
| Kaingaroa | 27 | 5 | 396 | 240 |
| Kaingaroa | 27 | 5 | 363 | 240 |
| Kaingaroa | 27 | 5 | 495 | 215 |
| Kaingaroa | 27 | 5 | 445 | 280 |
| Kaingaroa | 27 | 5 | 293 | 185 |
| Kaingaroa | 27 | 5 | 397 | 220 |
| Kaingaroa | 27 | 5 | 435 | 220 |
| Kaingaroa | 27 | 5 | 433 | 270 |
| Kaingaroa | 27 | 5 | 450 | 280 |
| Kaingaroa | 27 | 5 | 384 | 240 |
| Kaingaroa | 27 | 5 | 454 | 220 |
| Kaingaroa | 27 | 5 | 550 | 335 |
| Kaingaroa | 27 | 5 | 395 | 235 |
| Kaingaroa | 27 | 5 | 468 | 265 |
| Kaingaroa | 27 | 5 | 479 | 235 |

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| Kaingaroa | 27 | 5 | 500 | 240 |
| Kaingaroa | 27 | 5 | 406 | 250 |
| Kaingaroa | 27 | 5 | 442 | 250 |
| Kaingaroa | 27 | 5 | 540 | 310 |
| Kaingaroa | 27 | 5 | 448 | 190 |
| Kaingaroa | 27 | 5 | 500 | 230 |
| Kaingaroa | 27 | 5 | 506 | 235 |
| Kaingaroa | 27 | 5 | 538 | 315 |
| Kaingaroa | 27 | 5 | 407 | 200 |
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| Kaingaroa | 27 | 5 | 414 | 170 |
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| Kaingaroa | 27 | 5 | 477 | 215 |
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| Kaingaroa | 27 | 5 | 327 | 190 |
| Kaingaroa | 27 | 5 | 526 | 290 |
| Kaingaroa | 27 | 5 | 426 | 183 |
| Kaingaroa | 27 | 5 | 384 | 215 |
| Kaingaroa | 27 | 5 | 361 | 205 |
| Kaingaroa | 27 | 5 | 430 | 220 |
| Kaingaroa | 27 | 5 | 381 | 233 |
| Kaingaroa | 27 | 5 | 418 | 190 |
| Patanamu | 27 | 5 | 532 | 200 |
| Patanamu | 27 | 5 | 489 | 240 |
| Patanamu | 27 | 5 | 522 | 210 |
| Patanamu | 27 | 5 | 460 | 125 |
| Patanamu | 27 | 5 | 486 | 155 |
| Kaingaroa | 27 | 10 | 394 | 195 |
| Kaingaroa | 27 | 10 | 531 | 323 |
| Kaingaroa | 27 | 10 | 327 | 210 |
| Kaingaroa | 27 | 10 | 368 | 240 |
| Kaingaroa | 27 | 10 | 340 | 220 |
| Kaingaroa | 27 | 10 | 470 | 205 |
| Kaingaroa | 27 | 10 | 416 | 250 |
| Kaingaroa | 27 | 10 | 260 | 170 |
| Kaingaroa | 27 | 10 | 374 | 225 |
| Kaingaroa | 27 | 10 | 386 | 215 |
| Kaingaroa | 27 | 10 | 394 | 260 |
| Kaingaroa | 27 | 10 | 438 | 260 |
| Kaingaroa | 27 | 10 | 350 | 215 |
| Kaingaroa | 27 | 10 | 399 | 205 |
| Kaingaroa | 27 | 10 | 514 | 320 |
| Kaingaroa | 27 | 10 | 365 | 230 |
| Kaingaroa | 27 | 10 | 428 | 255 |
| Kaingaroa | 27 | 10 | 400 | 225 |
| Kaingaroa | 27 | 10 | 452 | 235 |
| Kaingaroa | 27 | 10 | 372 | 230 |
| Kaingaroa | 27 | 10 | 400 | 230 |

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| Kaingaroa | 27 | 10 | 514 | 315 |
| Kaingaroa | 27 | 10 | 424 | 165 |
| Kaingaroa | 27 | 10 | 469 | 215 |
| Kaingaroa | 27 | 10 | 452 | 220 |
| Kaingaroa | 27 | 10 | 477 | 300 |
| Kaingaroa | 27 | 10 | 380 | 185 |
| Kaingaroa | 27 | 10 | 445 | 210 |
| Kaingaroa | 27 | 10 | 374 | 175 |
| Kaingaroa | 27 | 10 | 405 | 205 |
| Kaingaroa | 27 | 10 | 413 | 180 |
| Kaingaroa | 27 | 10 | 375 | 200 |
| Kaingaroa | 27 | 10 | 425 | 208 |
| Kaingaroa | 27 | 10 | 417 | 210 |
| Kaingaroa | 27 | 10 | 305 | 178 |
| Kaingaroa | 27 | 10 | 463 | 265 |
| Kaingaroa | 27 | 10 | 388 | 178 |
| Kaingaroa | 27 | 10 | 345 | 185 |
| Kaingaroa | 27 | 10 | 328 | 195 |
| Kaingaroa | 27 | 10 | 394 | 225 |
| Kaingaroa | 27 | 10 | 349 | 200 |
| Kaingaroa | 27 | 10 | 384 | 175 |
| Patanamu | 27 | 10 | 474 | 210 |
| Patanamu | 27 | 10 | 448 | 244 |
| Patanamu | 27 | 10 | 469 | 210 |
| Patanamu | 27 | 10 | 417 | 110 |
| Patanamu | 27 | 10 | 434 | 150 |
| Kaingaroa | 27 | 15 | 354 | 160 |
| Kaingaroa | 27 | 15 | 492 | 270 |
| Kaingaroa | 27 | 15 | 281 | 165 |
| Kaingaroa | 27 | 15 | 318 | 215 |
| Kaingaroa | 27 | 15 | 308 | 185 |
| Kaingaroa | 27 | 15 | 397 | 170 |
| Kaingaroa | 27 | 15 | 365 | 215 |
| Kaingaroa | 27 | 15 | 234 | 135 |
| Kaingaroa | 27 | 15 | 328 | 190 |
| Kaingaroa | 27 | 15 | 355 | 195 |
| Kaingaroa | 27 | 15 | 355 | 220 |
| Kaingaroa | 27 | 15 | 378 | 220 |
| Kaingaroa | 27 | 15 | 320 | 185 |
| Kaingaroa | 27 | 15 | 363 | 180 |
| Kaingaroa | 27 | 15 | 463 | 270 |
| Kaingaroa | 27 | 15 | 324 | 185 |
| Kaingaroa | 27 | 15 | 394 | 220 |
| Kaingaroa | 27 | 15 | 381 | 205 |
| Kaingaroa | 27 | 15 | 406 | 195 |
| Kaingaroa | 27 | 15 | 335 | 195 |
| Kaingaroa | 27 | 15 | 355 | 200 |
| Kaingaroa | 27 | 15 | 460 | 265 |
| Kaingaroa | 27 | 15 | 380 | 155 |
| Kaingaroa | 27 | 15 | 418 | 165 |

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| Kaingaroa | 27 | 15 | 398 | 152 |
| Kaingaroa | 27 | 15 | 448 | 278 |
| Kaingaroa | 27 | 15 | 350 | 160 |
| Kaingaroa | 27 | 15 | 401 | 165 |
| Kaingaroa | 27 | 15 | 331 | 130 |
| Kaingaroa | 27 | 15 | 371 | 175 |
| Kaingaroa | 27 | 15 | 373 | 150 |
| Kaingaroa | 27 | 15 | 335 | 178 |
| Kaingaroa | 27 | 15 | 383 | 185 |
| Kaingaroa | 27 | 15 | 368 | 170 |
| Kaingaroa | 27 | 15 | 278 | 145 |
| Kaingaroa | 27 | 15 | 416 | 220 |
| Kaingaroa | 27 | 15 | 364 | 155 |
| Kaingaroa | 27 | 15 | 305 | 160 |
| Kaingaroa | 27 | 15 | 303 | 165 |
| Kaingaroa | 27 | 15 | 367 | 200 |
| Kaingaroa | 27 | 15 | 308 | 175 |
| Kaingaroa | 27 | 15 | 264 | 75 |
| Patanamu | 27 | 15 | 433 | 165 |
| Patanamu | 27 | 15 | 404 | 230 |
| Patanamu | 27 | 15 | 433 | 200 |
| Patanamu | 27 | 15 | 378 | 125 |
| Patanamu | 27 | 15 | 386 | 145 |
| Kaingaroa | 27 | 20 | 318 | 130 |
| Kaingaroa | 27 | 20 | 429 | 210 |
| Kaingaroa | 27 | 20 | 248 | 130 |
| Kaingaroa | 27 | 20 | 283 | 180 |
| Kaingaroa | 27 | 20 | 275 | 145 |
| Kaingaroa | 27 | 20 | 345 | 140 |
| Kaingaroa | 27 | 20 | 327 | 170 |
| Kaingaroa | 27 | 20 | 200 | 110 |
| Kaingaroa | 27 | 20 | 276 | 145 |
| Kaingaroa | 27 | 20 | 319 | 150 |
| Kaingaroa | 27 | 20 | 312 | 185 |
| Kaingaroa | 27 | 20 | 351 | 185 |
| Kaingaroa | 27 | 20 | 269 | 125 |
| Kaingaroa | 27 | 20 | 328 | 135 |
| Kaingaroa | 27 | 20 | 416 | 200 |
| Kaingaroa | 27 | 20 | 298 | 155 |
| Kaingaroa | 27 | 20 | 356 | 190 |
| Kaingaroa | 27 | 20 | 318 | 140 |
| Kaingaroa | 27 | 20 | 360 | 155 |
| Kaingaroa | 27 | 20 | 290 | 150 |
| Kaingaroa | 27 | 20 | 326 | 155 |
| Kaingaroa | 27 | 20 | 341 | 110 |
| Kaingaroa | 27 | 20 | 362 | 120 |
| Kaingaroa | 27 | 20 | 338 | 105 |
| Kaingaroa | 27 | 20 | 395 | 210 |
| Kaingaroa | 27 | 20 | 324 | 140 |
| Kaingaroa | 27 | 20 | 349 | 140 |

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| Kaingaroa | 27 | 20 | 287 | 105 |
| Kaingaroa | 27 | 20 | 331 | 147 |
| Kaingaroa | 27 | 20 | 339 | 110 |
| Kaingaroa | 27 | 20 | 285 | 145 |
| Kaingaroa | 27 | 20 | 342 | 160 |
| Kaingaroa | 27 | 20 | 325 | 130 |
| Kaingaroa | 27 | 20 | 247 | 110 |
| Kaingaroa | 27 | 20 | 365 | 180 |
| Kaingaroa | 27 | 20 | 323 | 125 |
| Kaingaroa | 27 | 20 | 265 | 115 |
| Kaingaroa | 27 | 20 | 267 | 135 |
| Kaingaroa | 27 | 20 | 314 | 145 |
| Kaingaroa | 27 | 20 | 272 | 130 |
| Kaingaroa | 27 | 20 | 220 | 68 |
| Patanamu | 27 | 20 | 360 | 120 |
| Patanamu | 27 | 20 | 356 | 180 |
| Patanamu | 27 | 20 | 377 | 135 |
| Patanamu | 27 | 20 | 319 | 95 |
| Patanamu | 27 | 20 | 343 | 118 |
| Kaingaroa | 27 | 25 | 208 | 45 |
| Kaingaroa | 27 | 25 | 375 | 160 |
| Kaingaroa | 27 | 25 | 170 | 50 |
| Kaingaroa | 27 | 25 | 239 | 105 |
| Kaingaroa | 27 | 25 | 281 | 70 |
| Kaingaroa | 27 | 25 | 159 | 60 |
| Kaingaroa | 27 | 25 | 241 | 100 |
| Kaingaroa | 27 | 25 | 274 | 100 |
| Kaingaroa | 27 | 25 | 261 | 130 |
| Kaingaroa | 27 | 25 | 294 | 130 |
| Kaingaroa | 27 | 25 | 252 | 55 |
| Kaingaroa | 27 | 25 | 361 | 150 |
| Kaingaroa | 27 | 25 | 244 | 105 |
| Kaingaroa | 27 | 25 | 306 | 145 |
| Kaingaroa | 27 | 25 | 275 | 90 |
| Kaingaroa | 27 | 25 | 287 | 95 |
| Kaingaroa | 27 | 25 | 249 | 110 |
| Kaingaroa | 27 | 25 | 286 | 115 |
| Kaingaroa | 27 | 25 | 280 | 65 |
| Kaingaroa | 27 | 25 | 295 | 100 |
| Kaingaroa | 27 | 25 | 269 | 63 |
| Kaingaroa | 27 | 25 | 340 | 155 |
| Kaingaroa | 27 | 25 | 271 | 95 |
| Kaingaroa | 27 | 25 | 282 | 95 |
| Kaingaroa | 27 | 25 | 239 | 60 |
| Kaingaroa | 27 | 25 | 275 | 110 |
| Kaingaroa | 27 | 25 | 280 | 75 |
| Kaingaroa | 27 | 25 | 238 | 100 |
| Kaingaroa | 27 | 25 | 315 | 110 |
| Kaingaroa | 27 | 25 | 260 | 80 |
| Kaingaroa | 27 | 25 | 200 | 70 |

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| Kaingaroa | 27 | 25 | 292 | 120 |
| Kaingaroa | 27 | 25 | 266 | 90 |
| Kaingaroa | 27 | 25 | 220 | 43 |
| Kaingaroa | 27 | 25 | 218 | 95 |
| Kaingaroa | 27 | 25 | 263 | 105 |
| Kaingaroa | 27 | 25 | 170 | 45 |
| Kaingaroa | 27 | 25 | 179 | 40 |
| Patanamu | 27 | 25 | 289 | 100 |
| Patanamu | 27 | 25 | 252 | 120 |
| Patanamu | 27 | 25 | 313 | 110 |
| Patanamu | 27 | 25 | 288 | 85 |
| Kaingaroa | 27 | 30 | 147 | 30 |
| Kaingaroa | 27 | 30 | 305 | 105 |
| Kaingaroa | 27 | 30 | 231 | 50 |
| Kaingaroa | 27 | 30 | 238 | 75 |
| Kaingaroa | 27 | 30 | 201 | 35 |
| Kaingaroa | 27 | 30 | 304 | 95 |
| Kaingaroa | 27 | 30 | 233 | 60 |
| Kaingaroa | 27 | 30 | 210 | 40 |
| Kaingaroa | 27 | 30 | 257 | 70 |
| Kaingaroa | 27 | 30 | 215 | 30 |
| Kaingaroa | 27 | 30 | 240 | 50 |
| Kaingaroa | 27 | 30 | 197 | 50 |
| Kaingaroa | 27 | 30 | 273 | 75 |
| Kaingaroa | 27 | 30 | 211 | 45 |
| Kaingaroa | 27 | 30 | 229 | 60 |
| Kaingaroa | 27 | 30 | 177 | 30 |
| Kaingaroa | 27 | 30 | 221 | 60 |
| Kaingaroa | 27 | 30 | 222 | 30 |
| Kaingaroa | 27 | 30 | 188 | 50 |
| Kaingaroa | 27 | 30 | 248 | 70 |
| Kaingaroa | 27 | 30 | 194 | 25 |
| Kaingaroa | 27 | 30 | 148 | 30 |
| Kaingaroa | 27 | 30 | 235 | 85 |
| Kaingaroa | 27 | 30 | 196 | 40 |
| Kaingaroa | 27 | 30 | 149 | 45 |
| Kaingaroa | 27 | 30 | 165 | 45 |
| Kaingaroa | 27 | 30 | 218 | 55 |
| Kaingaroa | 27 | 30 | 112 | 40 |
| Kaingaroa | 27 | 30 | 90 | 15 |
| Patanamu | 27 | 30 | 204 | 40 |
| Patanamu | 27 | 30 | 211 | 60 |
| Patanamu | 27 | 30 | 243 | 55 |
| Patanamu | 27 | 30 | 216 | 45 |
| Patanamu | 27 | 30 | 213 | 50 |
| Kaingaroa Forest | 30 | 0 | 600 | 175 |
| Kaingaroa Forest | 30 | 0 | 565 | 240 |
| Kaingaroa Forest | 30 | 0 | 640 | 350 |
| Kaingaroa Forest | 30 | 0 | 690 | 260 |
| Kaingaroa Forest | 30 | 0 | 560 | 250 |

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| Kaingaroa Forest | 30 | 0 | 465 | 240 |
| Kaingaroa Forest | 30 | 0 | 560 | 295 |
| Kaingaroa Forest | 30 | 0 | 620 | 340 |
| Kaingaroa Forest | 30 | 0 | 475 | 270 |
| Kaingaroa Forest | 30 | 0 | 660 | 350 |
| Kaingaroa Forest | 30 | 0 | 655 | 240 |
| Kaingaroa Forest | 30 | 0 | 465 | 230 |
| Kaingaroa Forest | 30 | 0 | 580 | 300 |
| Kaingaroa Forest | 30 | 0 | 595 | 240 |
| Kaingaroa Forest | 30 | 0 | 590 | 190 |
| Kaingaroa Forest | 30 | 0 | 595 | 260 |
| Kaingaroa Forest | 30 | 0 | 755 | 365 |
| Kaingaroa Forest | 30 | 0 | 480 | 185 |
| Kaingaroa Forest | 30 | 0 | 543 | 240 |
| Kaingaroa Forest | 30 | 0 | 600 | 300 |
| Kaingaroa Forest | 30 | 0 | 630 | 210 |
| Kaingaroa Forest | 30 | 0 | 680 | 335 |
| Kaingaroa Forest | 30 | 0 | 710 | 320 |
| Kaingaroa Forest | 30 | 0 | 670 | 265 |
| Kaingaroa Forest | 30 | 0 | 560 | 190 |
| Kaingaroa Forest | 30 | 0 | 530 | 220 |
| Kaingaroa Forest | 30 | 0 | 470 | 230 |
| Kaingaroa Forest | 30 | 0 | 585 | 180 |
| Kaingaroa Forest | 30 | 0 | 575 | 250 |
| Waitangi | 30 | 0 | 365 | 165 |
| Waitangi | 30 | 0 | 374 | 171 |
| Waitangi | 30 | 0 | 408 | 195 |
| Waitangi | 30 | 0 | 350 | 125 |
| Waitangi | 30 | 0 | 380 | 165 |
| Kaingaroa Cpt.1272 | 30 | 0 | 423 | 150 |
| Kaingaroa Cpt.1272 | 30 | 0 | 475 | 180 |
| Kaingaroa Cpt.1272 | 30 | 0 | 410 | 80 |
| Kaingaroa Cpt.1272 | 30 | 0 | 376 | 120 |
| Kaingaroa Cpt.1272 | 30 | 0 | 358 | 160 |
| Waitangi | 30 | 1.4 | 331 | 160 |
| Waitangi | 30 | 1.4 | 332 | 165 |
| Waitangi | 30 | 1.4 | 364 | 150 |
| Waitangi | 30 | 1.4 | 326 | 125 |
| Waitangi | 30 | 1.4 | 346 | 190 |
| Kaingaroa Cpt.1272 | 30 | 1.4 | 393 | 145 |
| Kaingaroa Cpt.1272 | 30 | 1.4 | 444 | 200 |
| Kaingaroa Cpt.1272 | 30 | 1.4 | 387 | 100 |
| Kaingaroa Cpt.1272 | 30 | 1.4 | 356 | 130 |
| Kaingaroa Cpt.1272 | 30 | 1.4 | 358 | 150 |
| Kaingaroa Forest | 30 | 5 | 474 | 210 |
| Kaingaroa Forest | 30 | 5 | 315 | 170 |
| Kaingaroa Forest | 30 | 5 | 553 | 315 |
| Kaingaroa Forest | 30 | 5 | 585 | 250 |
| Kaingaroa Forest | 30 | 5 | 520 | 210 |
| Kaingaroa Forest | 30 | 5 | 415 | 175 |

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| Kaingaroa Forest | 30 | 5 | 465 | 250 |
| Kaingaroa Forest | 30 | 5 | 560 | 310 |
| Kaingaroa Forest | 30 | 5 | 375 | 210 |
| Kaingaroa Forest | 30 | 5 | 532 | 320 |
| Kaingaroa Forest | 30 | 5 | 570 | 220 |
| Kaingaroa Forest | 30 | 5 | 368 | 210 |
| Kaingaroa Forest | 30 | 5 | 470 | 265 |
| Kaingaroa Forest | 30 | 5 | 475 | 195 |
| Kaingaroa Forest | 30 | 5 | 518 | 170 |
| Kaingaroa Forest | 30 | 5 | 515 | 235 |
| Kaingaroa Forest | 30 | 5 | 620 | 335 |
| Kaingaroa Forest | 30 | 5 | 460 | 190 |
| Kaingaroa Forest | 30 | 5 | 425 | 210 |
| Kaingaroa Forest | 30 | 5 | 500 | 280 |
| Kaingaroa Forest | 30 | 5 | 508 | 205 |
| Kaingaroa Forest | 30 | 5 | 575 | 290 |
| Kaingaroa Forest | 30 | 5 | 590 | 340 |
| Kaingaroa Forest | 30 | 5 | 570 | 230 |
| Kaingaroa Forest | 30 | 5 | 500 | 190 |
| Kaingaroa Forest | 30 | 5 | 457 | 240 |
| Kaingaroa Forest | 30 | 5 | 400 | 190 |
| Kaingaroa Forest | 30 | 5 | 505 | 270 |
| Kaingaroa Forest | 30 | 5 | 505 | 250 |
| Waitangi | 30 | 5 | 314 | 140 |
| Waitangi | 30 | 5 | 308 | 163 |
| Waitangi | 30 | 5 | 318 | 128 |
| Waitangi | 30 | 5 | 285 | 123 |
| Waitangi | 30 | 5 | 298 | 170 |
| Kaingaroa Cpt.1272 | 30 | 5 | 352 | 150 |
| Kaingaroa Cpt.1272 | 30 | 5 | 408 | 170 |
| Kaingaroa Cpt.1272 | 30 | 5 | 365 | 135 |
| Kaingaroa Cpt.1272 | 30 | 5 | 352 | 165 |
| Kaingaroa Cpt.1272 | 30 | 5 | 325 | 145 |
| Kaingaroa Forest | 30 | 10 | 482 | 160 |
| Kaingaroa Forest | 30 | 10 | 482 | 200 |
| Kaingaroa Forest | 30 | 10 | 292 | 160 |
| Kaingaroa Forest | 30 | 10 | 496 | 265 |
| Kaingaroa Forest | 30 | 10 | 541 | 260 |
| Kaingaroa Forest | 30 | 10 | 510 | 240 |
| Kaingaroa Forest | 30 | 10 | 384 | 190 |
| Kaingaroa Forest | 30 | 10 | 450 | 240 |
| Kaingaroa Forest | 30 | 10 | 504 | 270 |
| Kaingaroa Forest | 30 | 10 | 365 | 205 |
| Kaingaroa Forest | 30 | 10 | 480 | 290 |
| Kaingaroa Forest | 30 | 10 | 520 | 225 |
| Kaingaroa Forest | 30 | 10 | 351 | 200 |
| Kaingaroa Forest | 30 | 10 | 440 | 250 |
| Kaingaroa Forest | 30 | 10 | 430 | 200 |
| Kaingaroa Forest | 30 | 10 | 460 | 145 |
| Kaingaroa Forest | 30 | 10 | 476 | 240 |

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| Kaingaroa Forest | 30 | 10 | 625 | 315 |
| Kaingaroa Forest | 30 | 10 | 430 | 195 |
| Kaingaroa Forest | 30 | 10 | 395 | 210 |
| Kaingaroa Forest | 30 | 10 | 477 | 285 |
| Kaingaroa Forest | 30 | 10 | 464 | 210 |
| Kaingaroa Forest | 30 | 10 | 548 | 285 |
| Kaingaroa Forest | 30 | 10 | 536 | 305 |
| Kaingaroa Forest | 30 | 10 | 525 | 230 |
| Kaingaroa Forest | 30 | 10 | 457 | 180 |
| Kaingaroa Forest | 30 | 10 | 420 | 225 |
| Kaingaroa Forest | 30 | 10 | 368 | 175 |
| Kaingaroa Forest | 30 | 10 | 455 | 245 |
| Kaingaroa Forest | 30 | 10 | 468 | 235 |
| Waitangi | 30 | 10 | 280 | 130 |
| Waitangi | 30 | 10 | 269 | 135 |
| Waitangi | 30 | 10 | 290 | 107 |
| Waitangi | 30 | 10 | 242 | 90 |
| Waitangi | 30 | 10 | 261 | 125 |
| Kaingaroa Cpt.1272 | 30 | 10 | 314 | 140 |
| Kaingaroa Cpt.1272 | 30 | 10 | 367 | 160 |
| Kaingaroa Cpt.1272 | 30 | 10 | 324 | 125 |
| Kaingaroa Cpt.1272 | 30 | 10 | 290 | 135 |
| Kaingaroa Cpt.1272 | 30 | 10 | 295 | 130 |
| Kaingaroa Forest | 30 | 15 | 423 | 160 |
| Kaingaroa Forest | 30 | 15 | 390 | 150 |
| Kaingaroa Forest | 30 | 15 | 252 | 125 |
| Kaingaroa Forest | 30 | 15 | 458 | 250 |
| Kaingaroa Forest | 30 | 15 | 469 | 210 |
| Kaingaroa Forest | 30 | 15 | 446 | 190 |
| Kaingaroa Forest | 30 | 15 | 351 | 175 |
| Kaingaroa Forest | 30 | 15 | 405 | 225 |
| Kaingaroa Forest | 30 | 15 | 465 | 220 |
| Kaingaroa Forest | 30 | 15 | 315 | 180 |
| Kaingaroa Forest | 30 | 15 | 443 | 255 |
| Kaingaroa Forest | 30 | 15 | 450 | 200 |
| Kaingaroa Forest | 30 | 15 | 308 | 160 |
| Kaingaroa Forest | 30 | 15 | 397 | 215 |
| Kaingaroa Forest | 30 | 15 | 405 | 190 |
| Kaingaroa Forest | 30 | 15 | 405 | 145 |
| Kaingaroa Forest | 30 | 15 | 417 | 210 |
| Kaingaroa Forest | 30 | 15 | 531 | 300 |
| Kaingaroa Forest | 30 | 15 | 408 | 180 |
| Kaingaroa Forest | 30 | 15 | 370 | 200 |
| Kaingaroa Forest | 30 | 15 | 457 | 285 |
| Kaingaroa Forest | 30 | 15 | 431 | 185 |
| Kaingaroa Forest | 30 | 15 | 500 | 260 |
| Kaingaroa Forest | 30 | 15 | 494 | 260 |
| Kaingaroa Forest | 30 | 15 | 478 | 210 |
| Kaingaroa Forest | 30 | 15 | 400 | 160 |
| Kaingaroa Forest | 30 | 15 | 395 | 195 |

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| Kaingaroa Forest | 30 | 15 | 318 | 140 |
| Kaingaroa Forest | 30 | 15 | 417 | 225 |
| Kaingaroa Forest | 30 | 15 | 423 | 180 |
| Waitangi | 30 | 15 | 245 | 90 |
| Waitangi | 30 | 15 | 229 | 107 |
| Waitangi | 30 | 15 | 246 | 80 |
| Waitangi | 30 | 15 | 210 | 80 |
| Waitangi | 30 | 15 | 228 | 95 |
| Kaingaroa Cpt.1272 | 30 | 15 | 269 | 110 |
| Kaingaroa Cpt.1272 | 30 | 15 | 321 | 150 |
| Kaingaroa Cpt.1272 | 30 | 15 | 295 | 110 |
| Kaingaroa Cpt.1272 | 30 | 15 | 258 | 90 |
| Kaingaroa Cpt.1272 | 30 | 15 | 272 | 115 |
| Kaingaroa Forest | 30 | 20 | 366 | 120 |
| Kaingaroa Forest | 30 | 20 | 365 | 140 |
| Kaingaroa Forest | 30 | 20 | 198 | 85 |
| Kaingaroa Forest | 30 | 20 | 392 | 180 |
| Kaingaroa Forest | 30 | 20 | 400 | 165 |
| Kaingaroa Forest | 30 | 20 | 392 | 145 |
| Kaingaroa Forest | 30 | 20 | 306 | 145 |
| Kaingaroa Forest | 30 | 20 | 352 | 190 |
| Kaingaroa Forest | 30 | 20 | 402 | 165 |
| Kaingaroa Forest | 30 | 20 | 280 | 140 |
| Kaingaroa Forest | 30 | 20 | 404 | 220 |
| Kaingaroa Forest | 30 | 20 | 405 | 140 |
| Kaingaroa Forest | 30 | 20 | 255 | 100 |
| Kaingaroa Forest | 30 | 20 | 363 | 165 |
| Kaingaroa Forest | 30 | 20 | 346 | 160 |
| Kaingaroa Forest | 30 | 20 | 370 | 140 |
| Kaingaroa Forest | 30 | 20 | 392 | 175 |
| Kaingaroa Forest | 30 | 20 | 480 | 245 |
| Kaingaroa Forest | 30 | 20 | 366 | 130 |
| Kaingaroa Forest | 30 | 20 | 335 | 155 |
| Kaingaroa Forest | 30 | 20 | 382 | 215 |
| Kaingaroa Forest | 30 | 20 | 378 | 160 |
| Kaingaroa Forest | 30 | 20 | 437 | 200 |
| Kaingaroa Forest | 30 | 20 | 426 | 210 |
| Kaingaroa Forest | 30 | 20 | 462 | 165 |
| Kaingaroa Forest | 30 | 20 | 380 | 140 |
| Kaingaroa Forest | 30 | 20 | 350 | 140 |
| Kaingaroa Forest | 30 | 20 | 275 | 100 |
| Kaingaroa Forest | 30 | 20 | 370 | 180 |
| Kaingaroa Forest | 30 | 20 | 328 | 110 |
| Waitangi | 30 | 20 | 208 | 53 |
| Waitangi | 30 | 20 | 196 | 75 |
| Waitangi | 30 | 20 | 207 | 50 |
| Waitangi | 30 | 20 | 171 | 35 |
| Waitangi | 30 | 20 | 194 | 70 |
| Kaingaroa Cpt.1272 | 30 | 20 | 224 | 75 |
| Kaingaroa Cpt.1272 | 30 | 20 | 282 | 115 |

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| Kaingaroa Cpt.1272 | 30 | 20 | 237 | 72 |
| Kaingaroa Cpt.1272 | 30 | 20 | 224 | 95 |
| Kaingaroa Cpt.1272 | 30 | 20 | 234 | 75 |
| Kaingaroa Forest | 30 | 25 | 311 | 75 |
| Kaingaroa Forest | 30 | 25 | 278 | 75 |
| Kaingaroa Forest | 30 | 25 | 294 | 95 |
| Kaingaroa Forest | 30 | 25 | 303 | 95 |
| Kaingaroa Forest | 30 | 25 | 338 | 100 |
| Kaingaroa Forest | 30 | 25 | 260 | 100 |
| Kaingaroa Forest | 30 | 25 | 296 | 135 |
| Kaingaroa Forest | 30 | 25 | 236 | 100 |
| Kaingaroa Forest | 30 | 25 | 335 | 145 |
| Kaingaroa Forest | 30 | 25 | 322 | 100 |
| Kaingaroa Forest | 30 | 25 | 316 | 110 |
| Kaingaroa Forest | 30 | 25 | 330 | 100 |
| Kaingaroa Forest | 30 | 25 | 323 | 130 |
| Kaingaroa Forest | 30 | 25 | 290 | 110 |
| Kaingaroa Forest | 30 | 25 | 340 | 165 |
| Kaingaroa Forest | 30 | 25 | 325 | 80 |
| Kaingaroa Forest | 30 | 25 | 384 | 150 |
| Kaingaroa Forest | 30 | 25 | 336 | 130 |
| Kaingaroa Forest | 30 | 25 | 340 | 85 |
| Kaingaroa Forest | 30 | 25 | 300 | 85 |
| Kaingaroa Forest | 30 | 25 | 283 | 95 |
| Kaingaroa Forest | 30 | 25 | 335 | 110 |
| Kaingaroa Forest | 30 | 25 | 262 | 45 |
| Waitangi | 30 | 25 | 156 | 30 |
| Waitangi | 30 | 25 | 141 | 28 |
| Kaingaroa Cpt.1272 | 30 | 25 | 174 | 45 |
| Kaingaroa Cpt.1272 | 30 | 25 | 238 | 82 |
| Kaingaroa Cpt.1272 | 30 | 25 | 168 | 25 |
| Kaingaroa Cpt.1272 | 30 | 25 | 181 | 38 |
| Kaingaroa Cpt.1272 | 30 | 25 | 204 | 55 |
| Tarawera Forest | 35 | 0 | 322 | 142 |
| Tarawera Forest | 35 | 0 | 263 | 175 |
| Tarawera Forest | 35 | 0 | 546 | 229 |
| Tarawera Forest | 35 | 0 | 278 | 174 |
| Tarawera Forest | 35 | 0 | 317 | 190 |
| Tarawera Forest | 35 | 0 | 440 | 240 |
| Tarawera Forest | 35 | 0 | 290 | 152 |
| Tarawera Forest | 35 | 0 | 389 | 237 |
| Tarawera Forest | 35 | 0 | 430 | 240 |
| Tarawera Forest | 35 | 0 | 284 | 167 |
| Tarawera Forest | 35 | 0 | 740 | 405 |
| Tarawera Forest | 35 | 0 | 637 | 365 |
| Tarawera Forest | 35 | 0 | 322 | 225 |
| Tarawera Forest | 35 | 0 | 540 | 315 |
| Tarawera Forest | 35 | 0 | 675 | 387 |
| Tarawera Forest | 35 | 0 | 438 | 305 |
| Tarawera Forest | 35 | 0 | 532 | 324 |

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| Tarawera Forest | 35 | 0 | 475 | 260 |
| Tarawera Forest | 35 | 0 | 651 | 336 |
| Tarawera Forest | 35 | 0 | 437 | 250 |
| Tarawera Forest | 35 | 0 | 351 | 200 |
| Tarawera Forest | 35 | 0 | 312 | 254 |
| Tarawera Forest | 35 | 0 | 605 | 279 |
| Tarawera Forest | 35 | 0 | 449 | 295 |
| Tarawera Forest | 35 | 0 | 341 | 170 |
| Tarawera Forest | 35 | 0 | 433 | 267 |
| Tarawera Forest | 35 | 0 | 346 | 220 |
| Tarawera Forest | 35 | 0 | 334 | 210 |
| Tarawera Forest | 35 | 0 | 338 | 170 |
| Tarawera Forest | 35 | 5 | 272 | 138 |
| Tarawera Forest | 35 | 5 | 212 | 137 |
| Tarawera Forest | 35 | 5 | 437 | 214 |
| Tarawera Forest | 35 | 5 | 224 | 145 |
| Tarawera Forest | 35 | 5 | 281 | 163 |
| Tarawera Forest | 35 | 5 | 378 | 220 |
| Tarawera Forest | 35 | 5 | 252 | 131 |
| Tarawera Forest | 35 | 5 | 320 | 206 |
| Tarawera Forest | 35 | 5 | 350 | 203 |
| Tarawera Forest | 35 | 5 | 226 | 139 |
| Tarawera Forest | 35 | 5 | 591 | 368 |
| Tarawera Forest | 35 | 5 | 543 | 333 |
| Tarawera Forest | 35 | 5 | 264 | 177 |
| Tarawera Forest | 35 | 5 | 467 | 290 |
| Tarawera Forest | 35 | 5 | 543 | 360 |
| Tarawera Forest | 35 | 5 | 360 | 273 |
| Tarawera Forest | 35 | 5 | 438 | 305 |
| Tarawera Forest | 35 | 5 | 452 | 289 |
| Tarawera Forest | 35 | 5 | 571 | 343 |
| Tarawera Forest | 35 | 5 | 360 | 225 |
| Tarawera Forest | 35 | 5 | 295 | 191 |
| Tarawera Forest | 35 | 5 | 247 | 202 |
| Tarawera Forest | 35 | 5 | 522 | 279 |
| Tarawera Forest | 35 | 5 | 358 | 237 |
| Tarawera Forest | 35 | 5 | 280 | 167 |
| Tarawera Forest | 35 | 5 | 371 | 255 |
| Tarawera Forest | 35 | 5 | 290 | 185 |
| Tarawera Forest | 35 | 5 | 272 | 180 |
| Tarawera Forest | 35 | 5 | 269 | 155 |
| Tarawera Forest | 35 | 5 | 537 | 355 |
| Tarawera Forest | 35 | 5 | 381 | 265 |
| Tarawera Forest | 35 | 5 | 444 | 308 |
| Tarawera Forest | 35 | 5 | 633 | 362 |
| Tarawera Forest | 35 | 5 | 437 | 295 |
| Tarawera Forest | 35 | 5 | 505 | 303 |
| Tarawera Forest | 35 | 5 | 493 | 268 |
| Tarawera Forest | 35 | 10 | 242 | 126 |
| Tarawera Forest | 35 | 10 | 185 | 105 |

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|---|---|---|---|---|
| Tarawera Forest | 35 | 10 | 398 | 205 |
| Tarawera Forest | 35 | 10 | 202 | 116 |
| Tarawera Forest | 35 | 10 | 262 | 145 |
| Tarawera Forest | 35 | 10 | 352 | 205 |
| Tarawera Forest | 35 | 10 | 227 | 117 |
| Tarawera Forest | 35 | 10 | 314 | 185 |
| Tarawera Forest | 35 | 10 | 340 | 206 |
| Tarawera Forest | 35 | 10 | 206 | 128 |
| Tarawera Forest | 35 | 10 | 541 | 351 |
| Tarawera Forest | 35 | 10 | 492 | 315 |
| Tarawera Forest | 35 | 10 | 243 | 158 |
| Tarawera Forest | 35 | 10 | 425 | 268 |
| Tarawera Forest | 35 | 10 | 504 | 326 |
| Tarawera Forest | 35 | 10 | 327 | 246 |
| Tarawera Forest | 35 | 10 | 385 | 270 |
| Tarawera Forest | 35 | 10 | 375 | 252 |
| Tarawera Forest | 35 | 10 | 523 | 328 |
| Tarawera Forest | 35 | 10 | 317 | 190 |
| Tarawera Forest | 35 | 10 | 261 | 173 |
| Tarawera Forest | 35 | 10 | 218 | 172 |
| Tarawera Forest | 35 | 10 | 475 | 273 |
| Tarawera Forest | 35 | 10 | 326 | 208 |
| Tarawera Forest | 35 | 10 | 260 | 151 |
| Tarawera Forest | 35 | 10 | 351 | 242 |
| Tarawera Forest | 35 | 10 | 263 | 162 |
| Tarawera Forest | 35 | 10 | 250 | 163 |
| Tarawera Forest | 35 | 10 | 251 | 147 |
| Tarawera Forest | 35 | 15 | 215 | 105 |
| Tarawera Forest | 35 | 15 | 164 | 90 |
| Tarawera Forest | 35 | 15 | 369 | 194 |
| Tarawera Forest | 35 | 15 | 173 | 92 |
| Tarawera Forest | 35 | 15 | 226 | 123 |
| Tarawera Forest | 35 | 15 | 317 | 194 |
| Tarawera Forest | 35 | 15 | 202 | 105 |
| Tarawera Forest | 35 | 15 | 276 | 165 |
| Tarawera Forest | 35 | 15 | 301 | 166 |
| Tarawera Forest | 35 | 15 | 187 | 108 |
| Tarawera Forest | 35 | 15 | 489 | 317 |
| Tarawera Forest | 35 | 15 | 461 | 290 |
| Tarawera Forest | 35 | 15 | 208 | 132 |
| Tarawera Forest | 35 | 15 | 394 | 258 |
| Tarawera Forest | 35 | 15 | 463 | 279 |
| Tarawera Forest | 35 | 15 | 297 | 210 |
| Tarawera Forest | 35 | 15 | 353 | 245 |
| Tarawera Forest | 35 | 15 | 350 | 210 |
| Tarawera Forest | 35 | 15 | 466 | 280 |
| Tarawera Forest | 35 | 15 | 298 | 174 |
| Tarawera Forest | 35 | 15 | 233 | 155 |
| Tarawera Forest | 35 | 15 | 189 | 148 |
| Tarawera Forest | 35 | 15 | 435 | 259 |

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|---|---|---|---|---|
| Tarawera Forest | 35 | 15 | 305 | 196 |
| Tarawera Forest | 35 | 15 | 237 | 136 |
| Tarawera Forest | 35 | 15 | 313 | 217 |
| Tarawera Forest | 35 | 15 | 232 | 134 |
| Tarawera Forest | 35 | 15 | 215 | 146 |
| Tarawera Forest | 35 | 15 | 227 | 123 |
| Tarawera Forest | 35 | 20 | 184 | 75 |
| Tarawera Forest | 35 | 20 | 137 | 64 |
| Tarawera Forest | 35 | 20 | 331 | 160 |
| Tarawera Forest | 35 | 20 | 145 | 63 |
| Tarawera Forest | 35 | 20 | 197 | 108 |
| Tarawera Forest | 35 | 20 | 282 | 155 |
| Tarawera Forest | 35 | 20 | 175 | 75 |
| Tarawera Forest | 35 | 20 | 237 | 130 |
| Tarawera Forest | 35 | 20 | 262 | 144 |
| Tarawera Forest | 35 | 20 | 159 | 83 |
| Tarawera Forest | 35 | 20 | 431 | 277 |
| Tarawera Forest | 35 | 20 | 396 | 225 |
| Tarawera Forest | 35 | 20 | 174 | 99 |
| Tarawera Forest | 35 | 20 | 347 | 228 |
| Tarawera Forest | 35 | 20 | 421 | 241 |
| Tarawera Forest | 35 | 20 | 269 | 170 |
| Tarawera Forest | 35 | 20 | 321 | 218 |
| Tarawera Forest | 35 | 20 | 311 | 192 |
| Tarawera Forest | 35 | 20 | 421 | 260 |
| Tarawera Forest | 35 | 20 | 272 | 136 |
| Tarawera Forest | 35 | 20 | 202 | 126 |
| Tarawera Forest | 35 | 20 | 155 | 110 |
| Tarawera Forest | 35 | 20 | 401 | 237 |
| Tarawera Forest | 35 | 20 | 269 | 164 |
| Tarawera Forest | 35 | 20 | 203 | 116 |
| Tarawera Forest | 35 | 20 | 289 | 197 |
| Tarawera Forest | 35 | 20 | 202 | 104 |
| Tarawera Forest | 35 | 20 | 185 | 112 |
| Tarawera Forest | 35 | 20 | 199 | 98 |
| Tarawera Forest | 35 | 25 | 150 | 42 |
| Tarawera Forest | 35 | 25 | 92 | 23 |
| Tarawera Forest | 35 | 25 | 293 | 130 |
| Tarawera Forest | 35 | 25 | 117 | 35 |
| Tarawera Forest | 35 | 25 | 157 | 75 |
| Tarawera Forest | 35 | 25 | 244 | 120 |
| Tarawera Forest | 35 | 25 | 139 | 48 |
| Tarawera Forest | 35 | 25 | 208 | 101 |
| Tarawera Forest | 35 | 25 | 228 | 115 |
| Tarawera Forest | 35 | 25 | 134 | 55 |
| Tarawera Forest | 35 | 25 | 381 | 228 |
| Tarawera Forest | 35 | 25 | 355 | 189 |
| Tarawera Forest | 35 | 25 | 296 | 180 |
| Tarawera Forest | 35 | 25 | 380 | 187 |
| Tarawera Forest | 35 | 25 | 180 | 100 |

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|---|---|---|---|---|
| Tarawera Forest | 35 | 25 | 283 | 167 |
| Tarawera Forest | 35 | 25 | 268 | 147 |
| Tarawera Forest | 35 | 25 | 378 | 219 |
| Tarawera Forest | 35 | 25 | 172 | 73 |
| Tarawera Forest | 35 | 25 | 174 | 84 |
| Tarawera Forest | 35 | 25 | 127 | 83 |
| Tarawera Forest | 35 | 25 | 348 | 185 |
| Tarawera Forest | 35 | 25 | 234 | 122 |
| Tarawera Forest | 35 | 25 | 158 | 87 |
| Tarawera Forest | 35 | 25 | 243 | 160 |
| Tarawera Forest | 35 | 25 | 181 | 82 |
| Tarawera Forest | 35 | 25 | 164 | 100 |
| Tarawera Forest | 35 | 25 | 171 | 67 |
| Tarawera Forest | 35 | 30 | 116 | 20 |
| Tarawera Forest | 35 | 30 | 248 | 87 |
| Tarawera Forest | 35 | 30 | 113 | 25 |
| Tarawera Forest | 35 | 30 | 209 | 84 |
| Tarawera Forest | 35 | 30 | 115 | 22 |
| Tarawera Forest | 35 | 30 | 172 | 64 |
| Tarawera Forest | 35 | 30 | 194 | 64 |
| Tarawera Forest | 35 | 30 | 107 | 30 |
| Tarawera Forest | 35 | 30 | 327 | 178 |
| Tarawera Forest | 35 | 30 | 307 | 132 |
| Tarawera Forest | 35 | 30 | 249 | 106 |
| Tarawera Forest | 35 | 30 | 328 | 148 |
| Tarawera Forest | 35 | 30 | 144 | 65 |
| Tarawera Forest | 35 | 30 | 234 | 124 |
| Tarawera Forest | 35 | 30 | 229 | 113 |
| Tarawera Forest | 35 | 30 | 334 | 177 |
| Tarawera Forest | 35 | 30 | 145 | 45 |
| Tarawera Forest | 35 | 30 | 301 | 148 |
| Tarawera Forest | 35 | 30 | 202 | 90 |
| Tarawera Forest | 35 | 30 | 133 | 50 |
| Tarawera Forest | 35 | 30 | 207 | 118 |
| Tarawera Forest | 35 | 30 | 154 | 46 |
| Tarawera Forest | 35 | 30 | 126 | 53 |
| Tarawera Forest | 35 | 30 | 135 | 29 |
| Tarawera Forest | 35 | 35 | 203 | 36 |
| Tarawera Forest | 35 | 35 | 180 | 43 |
| Tarawera Forest | 35 | 35 | 120 | 10 |
| Tarawera Forest | 35 | 35 | 100 | 7 |
| Tarawera Forest | 35 | 35 | 242 | 63 |
| Tarawera Forest | 35 | 35 | 196 | 48 |
| Tarawera Forest | 35 | 35 | 107 | 20 |
| Tarawera Forest | 35 | 35 | 183 | 65 |
| Tarawera Forest | 35 | 35 | 188 | 68 |
| Tarawera Forest | 35 | 35 | 288 | 112 |
| Tarawera Forest | 35 | 35 | 114 | 20 |
| Tarawera Forest | 35 | 35 | 157 | 60 |
| Tarawera Forest | 35 | 35 | 109 | 20 |

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|---|---|---|---|---|
| Tarawera Forest | 35 | 35 | 178 | 72 |
| Tarawera Forest | 35 | 35 | 105 | 0 |
| Rotoehu | 37 | 0 | 622 | 300 |
| Rotoehu | 37 | 0 | 525 | 270 |
| Rotoehu | 37 | 0 | 530 | 280 |
| Rotoehu | 37 | 0 | 550 | 250 |
| Rotoehu | 37 | 0 | 517 | 200 |
| Rotoehu | 37 | 1.4 | 582 | 290 |
| Rotoehu | 37 | 1.4 | 488 | 260 |
| Rotoehu | 37 | 1.4 | 470 | 290 |
| Rotoehu | 37 | 1.4 | 510 | 260 |
| Rotoehu | 37 | 1.4 | 470 | 190 |
| Rotoehu | 37 | 5 | 560 | 310 |
| Rotoehu | 37 | 5 | 452 | 260 |
| Rotoehu | 37 | 5 | 442 | 280 |
| Rotoehu | 37 | 5 | 475 | 277 |
| Rotoehu | 37 | 5 | 439 | 195 |
| Rotoehu | 37 | 10 | 516 | 280 |
| Rotoehu | 37 | 10 | 405 | 235 |
| Rotoehu | 37 | 10 | 414 | 290 |
| Rotoehu | 37 | 10 | 437 | 242 |
| Rotoehu | 37 | 10 | 398 | 185 |
| Rotoehu | 37 | 15 | 469 | 265 |
| Rotoehu | 37 | 15 | 364 | 220 |
| Rotoehu | 37 | 15 | 384 | 250 |
| Rotoehu | 37 | 15 | 403 | 220 |
| Rotoehu | 37 | 15 | 363 | 170 |
| Rotoehu | 37 | 20 | 416 | 170 |
| Rotoehu | 37 | 20 | 327 | 190 |
| Rotoehu | 37 | 20 | 360 | 230 |
| Rotoehu | 37 | 20 | 360 | 160 |
| Rotoehu | 37 | 20 | 310 | 130 |
| Rotoehu | 37 | 25 | 335 | 145 |
| Rotoehu | 37 | 25 | 287 | 150 |
| Rotoehu | 37 | 25 | 314 | 180 |
| Rotoehu | 37 | 25 | 321 | 145 |
| Rotoehu | 37 | 25 | 259 | 90 |
| Rotoehu | 37 | 30 | 285 | 100 |
| Rotoehu | 37 | 30 | 197 | 80 |
| Rotoehu | 37 | 30 | 279 | 110 |
| Rotoehu | 37 | 30 | 260 | 95 |

## Appendix 4
## Heartwood Diameter and Disc Diameter Inside Bark (South Island sites)

| Site | Tree age (year) | Disc height (m) | DIB (mm) | Heartwood Diameter (mm) |
|---|---|---|---|---|
| Rankleburn | 24 | 0 | 305 | 50 |
| Rankleburn | 24 | 0 | 425 | 95 |
| Rankleburn | 24 | 0 | 344 | 65 |
| Rankleburn | 24 | 0 | 350 | 130 |
| Rankleburn | 24 | 0 | 270 | 50 |
| Rankleburn | 24 | 1.4 | 266 | 65 |
| Rankleburn | 24 | 1.4 | 365 | 100 |
| Rankleburn | 24 | 1.4 | 296 | 70 |
| Rankleburn | 24 | 1.4 | 264 | 80 |
| Rankleburn | 24 | 5 | 248 | 60 |
| Rankleburn | 24 | 5 | 324 | 60 |
| Rankleburn | 24 | 5 | 264 | 65 |
| Rankleburn | 24 | 5 | 288 | 120 |
| Rankleburn | 24 | 5 | 220 | 70 |
| Rankleburn | 24 | 10 | 190 | 25 |
| Rankleburn | 24 | 10 | 272 | 35 |
| Rankleburn | 24 | 10 | 231 | 40 |
| Rankleburn | 24 | 10 | 237 | 48 |
| Rankleburn | 24 | 10 | 172 | 35 |
| Herbert | 27 | 0 | 506 | 120 |
| Herbert | 27 | 0 | 630 | 105 |
| Herbert | 27 | 0 | 490 | 120 |
| Herbert | 27 | 0 | 532 | 125 |
| Herbert | 27 | 0 | 530 | 140 |
| Herbert | 27 | 1.4 | 470 | 126 |
| Herbert | 27 | 1.4 | 495 | 155 |
| Herbert | 27 | 1.4 | 475 | 130 |
| Herbert | 27 | 1.4 | 445 | 145 |
| Herbert | 27 | 1.4 | 472 | 120 |
| Herbert | 27 | 5 | 415 | 113 |
| Herbert | 27 | 5 | 448 | 164 |
| Herbert | 27 | 5 | 428 | 153 |
| Herbert | 27 | 5 | 410 | 146 |
| Herbert | 27 | 5 | 412 | 150 |
| Herbert | 27 | 10 | 366 | 112 |
| Herbert | 27 | 10 | 351 | 120 |
| Herbert | 27 | 10 | 323 | 115 |
| Herbert | 27 | 10 | 340 | 110 |
| Herbert | 27 | 15 | 278 | 80 |
| Herbert | 27 | 15 | 263 | 80 |
| Herbert | 27 | 20 | 98 | 0 |
| Herbert | 27 | 20 | 135 | 0 |
| Herbert | 27 | 20 | 170 | 0 |
| Herbert | 27 | 20 | 107 | 0 |
| Berwick | 32 | 0 | 365 | 130 |
| Berwick | 32 | 0 | 475 | 130 |

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|---|---|---|---|---|
| Berwick | 32 | 0 | 425 | 120 |
| Berwick | 32 | 0 | 460 | 130 |
| Berwick | 32 | 0 | 422 | 130 |
| Berwick | 32 | 1.4 | 365 | 140 |
| Berwick | 32 | 1.4 | 412 | 125 |
| Berwick | 32 | 1.4 | 377 | 110 |
| Berwick | 32 | 1.4 | 396 | 140 |
| Berwick | 32 | 1.4 | 400 | 130 |
| Berwick | 32 | 5 | 317 | 130 |
| Berwick | 32 | 5 | 365 | 110 |
| Berwick | 32 | 5 | 335 | 115 |
| Berwick | 32 | 5 | 320 | 130 |
| Berwick | 32 | 5 | 381 | 130 |
| Berwick | 32 | 10 | 264 | 90 |
| Berwick | 32 | 10 | 307 | 95 |
| Berwick | 32 | 10 | 299 | 110 |
| Berwick | 32 | 10 | 272 | 105 |
| Berwick | 32 | 10 | 316 | 100 |
| Berwick | 32 | 15 | 205 | 45 |
| Berwick | 32 | 15 | 253 | 45 |
| Berwick | 32 | 15 | 228 | 45 |
| Berwick | 32 | 15 | 201 | 42 |
| Berwick | 32 | 15 | 251 | 65 |
| Hokonui | 38 | 0 | 440 | 150 |
| Hokonui | 38 | 0 | 505 | 260 |
| Hokonui | 38 | 0 | 485 | 105 |
| Hokonui | 38 | 0 | 375 | 65 |
| Hokonui | 38 | 0 | 430 | 130 |
| Hokonui | 38 | 1.4 | 375 | 160 |
| Hokonui | 38 | 1.4 | 444 | 260 |
| Hokonui | 38 | 1.4 | 455 | 130 |
| Hokonui | 38 | 1.4 | 338 | 85 |
| Hokonui | 38 | 1.4 | 380 | 165 |
| Hokonui | 38 | 5 | 331 | 170 |
| Hokonui | 38 | 5 | 410 | 150 |
| Hokonui | 38 | 5 | 300 | 120 |
| Hokonui | 38 | 5 | 347 | 175 |
| Hokonui | 38 | 10 | 292 | 145 |
| Hokonui | 38 | 10 | 360 | 200 |
| Hokonui | 38 | 10 | 365 | 135 |
| Hokonui | 38 | 10 | 278 | 110 |
| Hokonui | 38 | 10 | 314 | 165 |
| Hokonui | 38 | 15 | 234 | 80 |
| Hokonui | 38 | 15 | 314 | 165 |
| Hokonui | 38 | 15 | 317 | 100 |
| Hokonui | 38 | 15 | 249 | 90 |
| Hokonui | 38 | 15 | 277 | 130 |
| Hokonui | 38 | 20 | 176 | 35 |
| Hokonui | 38 | 20 | 252 | 100 |
| Hokonui | 38 | 20 | 260 | 80 |

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| Hokonui | 38 | 20 | 212 | 45 |
| Hokonui | 38 | 20 | 225 | 80 |
| Hokonui | 38 | 25 | 98 | 0 |
| Hokonui | 38 | 25 | 190 | 35 |
| Hokonui | 38 | 25 | 185 | 35 |
| Hokonui | 38 | 25 | 153 | 0 |
| Hokonui | 38 | 25 | 172 | 35 |
| Milton Bay | 40 | 0 | 455 | 230 |
| Milton Bay | 40 | 0 | 433 | 216 |
| Milton Bay | 40 | 0 | 429 | 260 |
| Milton Bay | 40 | 0 | 430 | 240 |
| Milton Bay | 40 | 0 | 435 | 290 |
| Milton Bay | 40 | 1.4 | 373 | 210 |
| Milton Bay | 40 | 1.4 | 405 | 222 |
| Milton Bay | 40 | 1.4 | 390 | 220 |
| Milton Bay | 40 | 1.4 | 355 | 260 |
| Milton Bay | 40 | 1.4 | 365 | 235 |
| Milton Bay | 40 | 5 | 307 | 180 |
| Milton Bay | 40 | 5 | 335 | 215 |
| Milton Bay | 40 | 5 | 363 | 220 |
| Milton Bay | 40 | 5 | 325 | 225 |
| Milton Bay | 40 | 5 | 347 | 220 |
| Milton Bay | 40 | 10 | 288 | 124 |
| Milton Bay | 40 | 10 | 294 | 170 |
| Milton Bay | 40 | 10 | 294 | 165 |
| Milton Bay | 40 | 10 | 298 | 200 |
| Milton Bay | 40 | 10 | 305 | 160 |
| Milton Bay | 40 | 15 | 234 | 120 |
| Milton Bay | 40 | 15 | 252 | 135 |
| Milton Bay | 40 | 15 | 270 | 125 |
| Milton Bay | 40 | 15 | 235 | 150 |
| Milton Bay | 40 | 15 | 264 | 135 |
| Milton Bay | 40 | 20 | 170 | 55 |
| Milton Bay | 40 | 20 | 222 | 100 |
| Milton Bay | 40 | 20 | 182 | 85 |
| Milton Bay | 40 | 20 | 210 | 100 |
| Milton Bay | 40 | 25 | 112 | 0 |
| Milton Bay | 40 | 25 | 135 | 25 |
| Milton Bay | 40 | 25 | 147 | 45 |
| Dumgree | 45 | 0 | 445 | 275 |
| Dumgree | 45 | 0 | 416 | 255 |
| Dumgree | 45 | 0 | 485 | 290 |
| Dumgree | 45 | 0 | 403 | 200 |
| Dumgree | 45 | 0 | 462 | 194 |
| Dumgree | 45 | 1.4 | 370 | 250 |
| Dumgree | 45 | 1.4 | 430 | 265 |
| Dumgree | 45 | 1.4 | 395 | 240 |
| Dumgree | 45 | 1.4 | 424 | 200 |
| Dumgree | 45 | 5 | 417 | 245 |
| Dumgree | 45 | 5 | 352 | 210 |

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|---|---|---|---|---|
| Dumgree | 45 | 5 | 381 | 240 |
| Dumgree | 45 | 5 | 364 | 215 |
| Dumgree | 45 | 5 | 384 | 175 |
| Dumgree | 45 | 10 | 364 | 230 |
| Dumgree | 45 | 10 | 310 | 178 |
| Dumgree | 45 | 10 | 339 | 204 |
| Dumgree | 45 | 10 | 321 | 178 |
| Dumgree | 45 | 10 | 335 | 146 |
| Dumgree | 45 | 15 | 308 | 185 |
| Dumgree | 45 | 15 | 264 | 160 |
| Dumgree | 45 | 15 | 285 | 130 |
| Dumgree | 45 | 15 | 220 | 80 |
| Dumgree | 45 | 15 | 257 | 88 |
| Dumgree | 45 | 20 | 220 | 110 |
| Dumgree | 45 | 20 | 202 | 84 |
| Dumgree | 45 | 20 | 228 | 94 |
| Dumgree | 45 | 20 | 137 | 0 |
| Dumgree | 45 | 20 | 194 | 115 |
| Dumgree | 45 | 25 | 138 | 54 |
| Dumgree | 45 | 25 | 144 | 25 |