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MANAGEMENT OF EUCALYPTS COOPERATIVE

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EXECUTIVE SUMMARY

EUCALYPTUS SALIGNA NELDER GROWTH FROM AGE 2-9 YEARS

In 1980 a *Eucalyptus saligna* trial incorporating a nelder and replicated blocks was planted at Kawerau. Establishment was largely unsuccessful because of delays in getting the seedlings planted combined with very dry weather. The nelder component was retained and measured each year. The nelder is a series of concentric arcs that represent stockings from 90 to 42000 s/ha. After age 4 years a sample of arcs were measured. In these arcs all diameters and a sample of heights were measured. In the years that all diameters were measured only a sample of arcs had heights measured. The trial was abandoned at age 9 because of wind damage. Wood disc samples were taken for density analysis.

In order to provide as much information from the trial as possible basal area, mean top height, survival and volume on a per hectare basis were calculated. Trees that had all neighbouring trees successfully established were identified to ensure that in any arc, only trees that had grown at the initial spacing provided by the trial design, were included in the analysis.

Missing values for volume, basal area and mean top height were estimated by interpolation and for survival, by regression. Tables of these values from age 2 to 9 years are included.

Mean basic density was 970 kg/m^3. Basic density was not related to growth rate. Heartwood percentage was strongly correlated to growth rate as was basic density and moisture content.

Growth rates in the E. nelder compared well with a *E. nitens* nelder with higher volumes at age 8 years. Mean annual increment was over 20 m^3/ha/year at age 8 years for stockings over 1111 s/ha. At age 7 mean annual increment was over 60m^3/ha/year at stockings over 17000 s/ha which supports the interest in the species for biomass production. If the absence of a relationship between basic density and growth rate continues with age then silvicultural treatments to increase growth should not lower density.

EUCALYPTUS SALIGNA NELDER - GROWTH FROM AGE 2 - 9 YEARS

A.E. Hay, Heather McKenzie, M.O. Kimberley

INTRODUCTION

As part of the silvicultural and mensuration programme for Eucalypts a series of regime trials using a number of Eucalypt species, had been established in Kaingaroa Forest since 1977. The two main objectives of these trials were:

1) to determine the influence of competition resulting from variation in initial spacing on the development of individual tree characteristics with time.

2) to examine the differences in several stand parameters as a result of imposing certain thinning regimes on stands of varying initial stockings.

A standard design was developed for these trials which incorporated a nelder component for the examination of trends in a number of characteristics as a function of initial spacing and replicated block plantings at initial spacings of 2*2m, 3*3m and 4*4m which were to be subsequently sub-divided into four different thinning and pruning treatments.

The *E delegatensis* trial was planted in Kaingaroa Forest in 1977, followed by an *E regnans* trial in 1978 (McKenzie, 1991), *E fastigata* in 1979 and *E nitens* (nelder component only), (McKenzie and Kimberley, 1990) in 1979. Kaingaroa was too cold for *E. saligna* so a warmer site was selected near Kawerau.

NELDER TRIAL DESIGN

The nelder design (Nelder, 1962) was chosen due to the successful use in forest experiments reported by Tennent, 1973. It would

i) provide the data on the basic relationship between initial spacing and individual tree characteristics,

ii) greatly reduce the area involved while still examining a wide range of spacings

iii) Be limited in providing management information because the design does not readily allow for the imposition of thinning and pruning treatments. The block plantings were intended to provide some of this information.

A major disadvantage with the nelder design is the effect of any tree mortality on the growth and form of its nearest neighbours.

The nelder design trial is a series of concentric circles. The growing space available to each tree is determined by the distance to the nearest eight neighbours and from this the equivalent square spacing and hence the corresponding s/ha can be calculated.

The range of spacings and stockings used in the nelder trial was the same as that used in the *E. nitens* nelder and is shown in Table 1.:

TABLE 1 - Range of equivalent stockings in the *E. saligna* nelder

Arc	Equivalent square spacing (m)	Stocking (stems/ha)
22	9.14	120
21	7.95	149
20	6.92	197
19	6.03	275
18	5.24	304
17	4.56	401
16	3.97	528
15	3.46	708
14	3.00	1053
13	2.62	1462
12	2.28	1923
11	1.98	2436
10	1.72	3220
9	1.50	4444
8	1.31	5588
7	1.14	7692
6	0.99	10000
5	0.86	12000
4	0.75	15455
3	0.65	23750
2	0.57	31667
1	0.49	41649

The spacings selected included those that would be considered as standard forestry regimes for the production of pulp and saw logs, including agroforestry stockings. In addition, closer than normal forest spacings were planted to provide information on whole tree production for fuelwood and energy projects and the feasibility of short rotation pulpwood crops.

TRIAL HISTORY

A site at Green's Farm, Tasman Forestry Ltd, Onepu Springs Rd, Kawerau was selected as being suitable for the *E saligna* trial because the site was flat, easily accessible and was regarded as having a suitable climate for *E saligna*, being warm with only light frosts.

During November 1980 the grass was grazed short and pre-plant sprayed with Roundup at 6 l/ha. No cultivation was carried out other than a spade cultivation at time of planting when the holes were pre-dug to assist in planting of the container grown stock.

Three replications of three one hectare blocks of each spacing (2 x 2m, 3 x 3m and 4 x 4m) were planted as for the other species trials. Similarly a spacing trial laid out in a nelder design was included. Because of space contraints in laying out the plots the nelder was not planted as complete circles but was split in half and planted as two adjacent semicircles. For the half identified as nelder 1 there was sufficient space to plant complete circles in the inner arcs. In one half nelder the spacing extended out to the equivalent of 10.5m.

The seedling provenance was Kangaroo Valley, New South Wales, Australia (seedlot 8/0/80/5). This provenance had shown up as fast growing and a good performer on three New Zealand sites at age 3 years. (Wilcox et al., 1980) The seed was sown in 'Jack Pots' (a brand of peat pots) in the FRI nursery in August 1980 and the seedlings were ready for planting after twelve weeks. Planting was originally scheduled for mid to late November to benefit from the late spring rains and avoid the summer drought. However due to the late cancellation of the existing grazing lease and problems with stock removal and consequent delays in pre-plant spraying, planting was delayed until early December 1980. This delay meant that the trees were larger than desired as well as having vigorous root growth coming through the peat pot walls which were susceptible to damage during planting. The trees were transported daily to Kawerau from Rotorua and planted into the pre-dug holes. The weather at time of planting (December 1980) was fine and hot with light winds. The temperatures, ranging from 20 - 28 C, produced very dry conditions which resulted in many of the trees requiring frequent watering from a water truck. Subsequently all block plantings required blanking with left over container stock in January 1981. In May 1981, due to the severe summer drought and animal damage, a further blanking of all areas (blocks and nelders) was required using bare-rooted seedlings grown from the same seed source.

A post plant spray of Chlorothal and Simizine was undertaken during January 1981. Subsequent applications of Roundup by spraying and weed wand was undertaken during the summer 1981 to control the vigorous grass growth. Additional control was applied to the small trees throughout 1981 and 1982 and the summer of 1983 to try and encourage a more uniform crop. A paraquat/simizine mixture was pre-plant sprayed on the blanked areas during May 1981.

Urea fertiliser was applied March/April 1981 at the rate of 60 g/tree in a spade slit on one side of the tree. In addition over the next year 1982 the small trees also received an additional boost of fertiliser to try and make the stand more uniform. However in 1982 one complete replication of the block plantings was been abandoned because of extremely irregular growth and survival.

At the beginning of 1985 the remaining two replications of the block plantings were also abandoned as the non-uniform crop and mortality due to the drought at establishment had compromised the initial trial objectives. The nelders were retained because although there were still missing trees after the blanking there were sufficient trees left with all neighbours present for the trial to be analysed.

Unfortunately the assault of the elements was not over. The remaining two half nelders suffered significant wind damage during the period 1986-1989 which resulted in broken tree tops and crowns (Nicholas and Calderon, 1989). Therefore growth data could no longer be collected as height was either not available or at closer spacings the trees crowns were growing into the spaces left by adjacent broken tops. It was decided to abandon the nelder plantings. The final measurement of diameters and heights were taken in 1989, along with a biomass sampling and wood property determination across the range of spacings.

NELDER MEASUREMENT

Growth and yield

In 1982 tree measurement commenced with all diameters and heights recorded. The measurements taken are shown below.

Age 2 and 3: All diameters and heights measured

Age 4: All diameters measured. Heights taken in all arcs except the close spacing arcs in nelder 1 and the wide spacing uneven numbered arcs in nelder 2.

Age 5: Alternate arcs measured - diameters and a sample of heights in each arc.

Age 6: All arcs up to arc 17 in nelder 1 measured and then alternate uneven numbered arcs. In nelder 2 the close spaced arcs were not measured and from arc 7 uneven numbered arcs. A sample of heights was measured in those arcs where diameter was measured

Age 7: All diameters measured and a height sample in alternate uneven numbered arcs.

Age 8: All diameters measured and a height sample in uneven numberered arcs from arc 9 out.

Age 9: All diameters measured. A sample of heights across the nelder 1 was measured.

Wood density

The clear felling of the nelder provided the opportunity to investigate the effect of growth rate on basic density. At age 9 years 42 trees where felled in nelder 1. They were selected from arcs 7, 8, 11, 15 18 (three trees in each) and arcs 9 and 16 (13 trees in each). Diameter inside bark was recorded. From each tree felled a breast height sample disc was cross cut and analysed to determine heartwood percentage, green and basic wood densities and green moisture content.

METHODS

Calculation of volume, basal area, mean top height, and survival

In order to summarize the data so that the information could be used for predictive or comparative purposes it was necessary to firstly extract the data for those trees in each arc that had in fact grown at the correct initial spacing. This entailed removing data for trees that had grown next to a gap recorded at age 2. The number of trees out of a possible 21 in each nelder 1 and 20 in nelder 2 that were included in the analysis is shown in Table 2.

TABLE 2: Number of trees used in the analysis in each nelder and arc.

Arc	nelder 1	nelder 2
1	16	13
2	13	9
3	14	7
4	12	7
5	11	10
6	9	15
7	14	17
8	12	17
9	13	14
10	13	16
11	13	16
12	11	14
13	12	12
14	15	10
15	15	8
16	12	5
17	8	5
18	12	7
19	13	7
20	15	10
21	11	10
22	10	14
23	13	

The data were collected separately for nelder 1 and 2. Because the closest spacing arcs were complete in only one of the half nelders and there were different levels of mortality in parts of the nelders the data were analysed separately initially so that any unusual growth pattern could be checked before combining the data.

Volumes were calculated for trees with height measured using the function derived for the Cooperative (Gordon and Hay, 1990). Data from the corresponding arcs of the two nelders were combined to calculate a regression of volume on tree diameter (dbh^2) and the regression was used to calculate volume for all trees in the arc in each nelder. In order to calculate a height parameter for each arc a height/diameter regression of the form $\ln(H-1.4)=a+b/D$ was derived for each arc. Because trees had been removed from the dataset collected, some arcs had insufficient height trees to derive a regression. Combined arcs with fewer than 6 height trees were excluded. The height measurement at age 9 was not included because a regression across the entire nelder or at least several arcs was required to provide sufficient trees. This may have masked arc differences. However if required, heights in the adjacent two or three arcs could be used if the volume of a particular arc was required.

The calculation of mean top diameter (MTD) was made on the basis of the proportion of a hectare occupied by the trees included in the analysis of any arc. The area occupied by the trees in the close spaced arcs was very small so that only one tree represented the top 100 s/ha. The number of trees used increased gradually, reaching 6 or 7 trees for arc 21 (depending on the nelder). The height corresponding to this diameter was used to calculate mean top height (MTH). The sample of trees is not representive of a stand situation. Mean height was also calculated but the results were so variable, because of the effect of small trees, that the data was not included in any summary. The mean tree volume and basal area data were converted to volume and basal area per hectare. Stocking per hectare was calculated from the survival of trees in each arc.

Interpolation of data and smoothing of curves

The same procedure as that used for the *E. nitens* nelder (McKenzie and Kimberley, 1990) was applied to each nelder separately. However in those arcs that had only had heights measured in the first two years no attempt was made to estimate height or volume for these arcs. These were the even numbered arcs. In the uneven numbered arcs interpolated values were obtained for any missing measurements. To ensure that interpolated values followed the same trends as measured values, the data was transformed by dividing by the average of those arcs measured every year, before applying linear interpolation. It was considered undesirable to smooth across ages which could have masked out yearly perturbations in growth rate which might be of interest. Obvious irregularities across stockings were removed by fitting smoothed curves through all stockings for each year's measurements (using spline functions). Note that this smoothing was only carried out across stockings, not across ages. For heights and volumes, polynomial curves were used to interpolate results for even numbered arcs.

The smoothing procedure did not work satisfactorily for survival which was therefore smoothed across both age and stocking (using a logistic regression).

The two nelders had measurements for the first 7 arcs completely at variance with each other. Mortality was negligible and growth rates much higher than expected (up to 290 m^3/ha/year mean annual increment!). The lack of an adequate surround and high initial mortality before age 2 in these arcs are the most likely explanations. In fact growth oscillated between very high and relatively low for several arcs. Presumably this was because of an interaction between arcs. The strong growth in the first arc may be explained by the arc planted as a surround not being effective. This was followed by a suppressed arc and then one which grew better than expected presumably because of its supressed neighbour and so on. This only applied to the very high stockings and was much more pronounced in nelder 2. In the Appendix the results are based on nelder 1 only for stockings greater than 7000 s/ha.

GROWTH RESULTS

The MTH was very similar in both nelders, but basal area growth was greater in nelder 2. Because the height growth was consistent and the nelders were adjoining each other it was decided that an average of the two nelders was the most useful way to present the information for forest managers. The average basal area and stocking (ages 2-9), volume, mean top height (age 2-8) for the two nelders were summarised in Appendix 1. The mean annual increment and current annual increment of volume were also included.

WOOD DENSITY RESULTS

Simple linear regression analyses showed significant relationships between growth rate (represented by dbhib) and heartwood percentage, moisture content and basic density.

Heartwood percentage (expressed as the percentage of heartwood of the total cross-sectional area sampled) increased with growth rate which accounted for 70% of the variation. Heartwood percentage varied from 0 to 62% with a mean of 29%.

Heart percentage and growth rate were significantly related to green density but not sufficiently to be useful relationships. Basic density and moisture content were strongly correlated (r^2 = 99.6). Mean green density was 970 kg/m^3 with a range of 862 to 1173 kg/m^3. Mean moisture content was 122 % (range 98 to 150%).

The most important result was that there was no relationship between basic density and growth rate. The mean basic density was 451 kg/m$_3$ with a range of 399 to 505 kg/m$_3$.

DISCUSSION

The analysis of the *E. saligna* nelder was undertaken to salvage as much information as possible from a trial which had a disappointing history leading to its being terminated. Compared to the *E. nitens* nelder, basal area was initially much less at all spacings. However by age 5 years it was greater at about 1111 s/ha in the *E. saligna* nelder and by age 6 or 7 generally higher. This faster growth was reflected in a higher volume in the *E. saligna* nelder at age 8 years. By contrast the height of the *E. nitens* was greater at each age.

MAIs of over 20 m^3/ha/year at age 8 years for stockings over 1111 s/ha indicate acceptable growth rates for the species are possible. Despite problems with the implementation of the trial design and establishment problems, the very high MAI figures at high stockings support the interest in the species for biomass production. A biomass study has been undertaken and results of that will be made available to Cooperative members when analysis is complete.

The relationship between heartwood percentage and growth rate, if it continues to hold true, could be a distinct advantage as any silvicultural regimes designed to produce sawlogs will favour fast grown trees.

The fact that no relationship was found between basic density and growth rate was not entirely unexpected as E. saligna is a diffouse porous hardwood. However it is encouraging in that increased growth rate gained by silvicultural manipulations should not affect wood density.

ACKNOWLEDGEMENT

G.D. Young did the wood density analysis.

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APPENDIX 1: Smoothed data for the *E.saligna* nelder

1 Basal area (m2/ha)

stocking (age 2)	Arc Number	Age (years)							
		2.3	3.0	4.0	5.0	6.0	7.0	8.0	9.3
91	23	0.0	0.3	0.8	2.0	3.4	5.0	6.8	.
120	22	0.1	0.4	1.2	2.5	4.1	6.2	8.4	11.2
158	21	0.1	0.4	1.2	2.9	4.8	7.4	10.1	12.7
209	20	0.1	0.4	1.4	3.5	5.8	8.8	11.9	14.5
275	19	0.1	0.5	1.7	4.2	7.1	10.5	14.0	16.6
364	18	0.1	0.6	2.2	5.3	8.7	12.5	16.2	19.2
481	17	0.1	0.8	2.9	6.7	10.6	14.8	18.8	22.0
634	16	0.2	1.0	3.9	8.4	13.0	17.5	21.6	25.2
835	15	0.3	1.4	5.0	10.5	15.7	20.5	24.8	28.6
1111	14	0.4	1.9	6.5	13.0	18.9	24.1	28.6	32.3
1457	13	0.7	2.6	8.3	15.7	22.2	27.8	32.4	36.0
1924	12	1.0	3.5	10.4	18.8	25.9	31.8	36.6	40.0
2551	11	1.5	4.8	12.8	22.1	29.5	35.8	41.0	44.3
3380	10	2.2	6.4	15.4	25.4	33.0	39.6	45.3	48.7
4444	9	3.2	8.1	18.0	28.5	36.1	42.8	48.9	52.5
5827	8	4.2	10.1	20.5	31.4	38.9	45.6	51.3	55.3
7694	7	5.4	10.2	20.9	30.7	36.9	42.8	46.9	49.8
10202	6	7.9	13.2	24.0	34.4	40.9	46.7	50.7	53.2
13519	5	10.9	16.3	26.9	37.9	44.6	50.4	54.3	56.5
17776	4	13.7	18.9	29.1	40.6	47.4	53.4	57.3	59.6
23665	3	15.6	20.4	30.4	42.2	49.0	55.2	59.8	62.7
30773	2	15.4	19.9	30.3	42.2	48.6	55.3	61.0	65.3
41640	1	12.5	16.9	28.7	40.1	45.6	53.3	60.9	67.9

Shaded areas include data from nelder 1 only

2 STOCKING (s/ha)

stocking (age 2)	Arc Number	Age (years)							
		2.3	3	4	5	6	7	8	9.3
91	23	91	91	91	91	90	90	90	90
120	22	120	120	120	120	119	119	119	119
158	21	158	158	158	158	158	157	157	156
209	20	209	209	209	208	208	207	206	206
275	19	275	275	275	274	273	272	271	270
364	18	364	364	364	363	362	359	357	357
481	17	481	481	481	479	477	473	470	469
634	16	634	634	634	632	628	622	618	616
835	15	835	835	835	832	825	816	809	806
1111	14	1111	1111	1110	1105	1094	1080	1068	1064
1457	13	1457	1457	1455	1447	1430	1408	1390	1383
1924	12	1924	1923	1920	1908	1881	1846	1818	1807
2551	11	2551	2550	2545	2525	2483	2427	2383	2366
3380	10	3380	3379	3371	3339	3271	3184	3115	3088
4444	9	4444	4443	4430	4380	4272	4137	4031	3990
5827	8	5827	5825	5805	5724	5557	5349	5188	5127
7694	7	7694	7688	7628	7424	7066	6671	6369	6206
10202	6	10202	10192	10094	9765	9194	8579	8119	7874
13519	5	13519	13503	13344	12812	11910	10963	10272	9909
17776	4	17776	17749	17493	16649	15251	13825	12812	12289
23665	3	23665	23622	23202	21837	19643	17486	15998	15245
30773	2	30773	30705	30044	27931	24641	21527	19447	18414
41640	1	41640	41525	40412	36936	31749	27079	24082	22627

Shaded areas indicate values derived from nelder 1 only

3 MEAN TOP HEIGHT (m)

stocking (age 2)	Arc Number	Age (years)						
		2.3	3	4	5	6	7	8
91	23	2.9	3.8	5.9	7.9	9.8	12.5	13.8
120	22	3.1	4.1	6.6	8.7	11	12.8	14.1
158	21	3.1	4.2	6.7	8.9	11.2	12.9	14.2
209	20	3.2	4.3	6.9	9.2	11.6	13.1	14.4
275	19	3.3	4.5	7.1	9.6	12	13.6	14.9
364	18	3.5	4.7	7.4	10	12.5	14.1	15.4
481	17	3.6	4.9	7.7	10.5	13.1	14.8	16
634	16	3.8	5.1	8	11	13.6	15.4	16.7
835	15	4	5.2	8.3	11.4	14.1	16	17.3
1111	14	4.2	5.4	8.6	11.8	14.6	16.6	17.8
1457	13	4.3	5.6	8.8	12.2	15	17.1	18.3
1924	12	4.4	5.7	9	12.5	15.3	17.6	18.8
2551	11	4.5	5.8	9.2	12.7	15.6	17.9	19.1
3380	10	4.6	5.9	9.3	12.9	15.8	18.2	19.4
4444	9	4.7	5.9	9.3	13	15.9	18.3	19.6
5827	8	4.7	5.9	9.4	13	15.9	18.4	
7694	7	4.9	5.8	8.9	13	15.8	17.9	
10202	6	5	5.8	8.9	13	15.9	17.9	
13519	5	5	5.9	8.9	13	15.9	17.9	
17776	4	5	5.9	8.9	13	15.8	17.9	
23665	3	5	5.9	8.9	13	15.8	17.9	
30773	2	5	5.9	8.9	13	15.8	17.9	
41640	1	5	5.9	8.9	13	15.8	17.9	

Shaded areas indicate values derived from nelder 1 only

4 VOLUME (m^3/ha)

stocking (age 2)	Arc Number	Age (years)						
		2.3	3	4	5	6	7	8
91	23	0	1	2	7	13	20	31
120	22	0	2	6	15	26	33	53
158	21	0	2	5	14	25	40	60
209	20	0	2	6	15	27	47	69
275	19	0	2	6	18	32	57	79
364	18	0	2	8	22	40	69	91
481	17	1	3	10	29	51	83	106
634	16	1	4	14	39	67	99	124
835	15	1	5	18	51	86	119	144
1111	14	2	7	24	66	109	142	169
1457	13	3	9	31	84	135	168	198
1924	12	4	12	39	103	161	197	231
2551	11	6	16	48	122	185	230	271
3380	10	8	20	56	139	206	266	317
4444	9	10	24	64	155	223	306	370
5827	8	13	29	72	168	238	351	
7694	7	18	32	74	175	246	329	
10202	6	24	40	87	195	268	362	
13519	5	31	49	99	215	287	397	
17776	4	38	57	110	233	301	437	
23665	3	45	64	119	249	311	481	
30773	2	48	68	123	262	316	532	
41640	1	48	66	122	273	315	590	

Shaded areas indicate values derived from nelder 1 only

5 MEAN ANNUAL INCREMENT (m^3/ha/year)

stocking (age 2)	Arc Number	Age (years)						
		2.3	3	4	5	6	7	8
91	23	0.0	0.3	0.5	1.4	2.2	2.9	3.9
120	22	0.0	0.7	1.5	3.0	4.3	4.7	6.6
158	21	0.0	0.7	1.3	2.8	4.2	5.7	7.5
209	20	0.0	0.7	1.5	3.0	4.5	6.7	8.6
275	19	0.0	0.7	1.5	3.6	5.3	8.1	9.9
364	18	0.0	0.7	2.0	4.4	6.7	9.9	11.4
481	17	0.4	1.0	2.5	5.8	8.5	11.9	13.3
634	16	0.4	1.3	3.5	7.8	11.2	14.1	15.5
835	15	0.4	1.7	4.5	10.2	14.3	17.0	18.0
1111	14	0.9	2.3	6.0	13.2	18.2	20.3	21.1
1457	13	1.3	3.0	7.8	16.8	22.5	24.0	24.8
1924	12	1.7	4.0	9.8	20.6	26.8	28.1	28.9
2551	11	2.6	5.3	12.0	24.4	30.8	32.9	33.9
3380	10	3.5	6.7	14.0	27.8	34.3	38.0	39.6
4444	9	4.3	8.0	16.0	31.0	37.2	43.7	46.3
5827	8	5.7	9.7	18.0	33.6	39.7	50.1	
7694	7	7.8	10.7	18.5	35.0	41.0	47.0	
10202	6	10.4	13.3	21.8	39.0	44.7	51.7	
13519	5	13.5	16.3	24.8	43.0	47.8	56.7	
17776	4	16.5	19.0	27.5	46.6	50.2	62.4	
23665	3	19.6	21.3	29.8	49.8	51.8	68.7	
30773	2	20.9	22.7	30.8	52.4	52.7	76.0	
41640	1	20.9	22.0	30.5	54.6	52.5	84.3	

6 CURRENT ANNUAL INCREMENT (m^3/ha)

stocking (age 2)	Arc Number	Age (years)						
			3	4	5	6	7	8
91	23		1	1	5	6	7	11
120	22		2	4	9	11	7	20
158	21		2	3	9	11	15	20
209	20		2	4	9	12	20	22
275	19		2	4	12	14	25	22
364	18		2	6	14	18	29	22
481	17		2	7	19	22	32	23
634	16		3	10	25	28	32	25
835	15		4	13	33	35	33	25
1111	14		5	17	42	43	33	27
1457	13		6	22	53	51	33	30
1924	12		8	27	64	58	36	34
2551	11		10	32	74	63	45	41
3380	10		12	36	83	67	60	51
4444	9		14	40	91	68	83	64
5827	8		16	43	96	70	113	
7694	7		14	42	101	71	83	
10202	6		16	47	108	73	94	
13519	5		18	50	116	72	110	
17776	4		19	53	123	68	136	
23665	3		19	55	130	62	170	
30773	2		20	55	139	54	216	
41640	1		18	56	151	42	275	