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WORK PLAN NO.: **FIELD EXPERIMENT(S):****TITLE:** VALIDATION OF GROWTH MODEL 'EARLY' FOR SEEDLINGS AND CUTTINGS GROWN ON FARM AND FOREST SITES**AUTHOR(S):** D.G. HOLDEN, R.L. KNOWLES**DATE:** 15.5.92**KEYWORDS:** SEEDLINGS / CUTTINGS / FARM / GROWTH MODEL / EARLY / VALIDATION**ABSTRACT***

Data from trials comparing growth of cuttings and seedlings of *P. radiata* on 5 farm sites and 5 forest sites in the North Island was available for validating growth model EARLY between stand ages 4 years and 7 years. The trees were established at 400 stems/ha, and pruned in two lifts to 4 m. The cuttings were collected from parent material aged between 1 and 4 years - GF rating for both seedlings and cuttings varied between 12 and 17.

Predicted site index was about 28 m on average, with the cuttings showing a consistent trend of about a metre increase over seedlings. Individual sites showed errors in height prediction within $\pm 10\%$. When averaged over all forest sites, local height age curves resulted in error of height prediction over the 3 yr study period of about $\pm 1\%$. On farm sites, average height prediction was underestimated by about 5%. On both sites the 1 yr cuttings were the most accurately predicted.

Basal area increment was predicted for individual sites within $\pm 15\%$. A trend of slightly lower basal area growth with older cuttings resulted in EARLY overpredicting this material by about 4%, when averaged over all the sites. A similar trend occurred with seedlings when GF rating increased from 12 to 17.

This study will be extended in the future when more data is available.

Note: This material is unpublished and must not be cited as a literature reference.

VALIDATION OF THE GROWTH MODEL EARLY USING DATA FROM SEEDLING/CUTTING TRIALS UP TO 7 YEARS OF AGE

INTRODUCTION

Growth model EARLY (West *et al.* 1982) has an important role within the STANDPAK system, predicting stand growth up to height 18 m as a consequence of initial values, tree stocking, and pruning and thinning effects. It also predicts diameter over stubs (DOS) and the size of the largest branch at the time of pruning.

The functions in EARLY were initially derived from data collected from silvicultural trials on a range of sites in the central North Island. Most of the data came from genetically unimproved stands, however some plots had been planted with first generation seed orchard seedlings.

The model has since been improved and extended to predict basal area growth at low, medium and high levels of increment, the latter generally relating to fertile farm sites (Knowles and West, 1986).

Previous validation exercises have concluded that the model should be used with caution at site indices below 20 m (Knowles *et al.* 1984), the high basal area function is accurate for predicting growth on farm sites where annual rainfall is in excess of 1000 mm, and that when adequate data was available, the basal area growth for a range of forest sites can be predicted to within an overall level of error of $\pm 15\%$ (West *et al.* 1987).

Generally, the EARLY growth model will give reliable results under the following conditions:

Stand age	4-14 years
Stand height	4-18 m
Site index	22-34 m
Final crop stocking	100-1000 sph
Pruning severity	0-68% of stem pruned.

A series of trials were established in 1984 using a range of improved genetic material to compare growth and form of cuttings taken from 1- to 4-year-old trees and seedlings of the

same or similar genetic quality. Tissue culture plantlets were also included as a treatment. These trials were established on 5 farm and 5 forest sites throughout the North Island and provided an opportunity to test the EARLY growth model up to 7 years after planting using data from this improved genetic material for both seedlings and cuttings.

VALIDATION DATA

The 11 stock types in the trials include four seedling types, cuttings from 1- to 4-year-old trees and tissue culture plantlets (Table 1). Cuttings taken from 3-year-old trees and 4-year-old trees were obtained from 2 different collection sites.

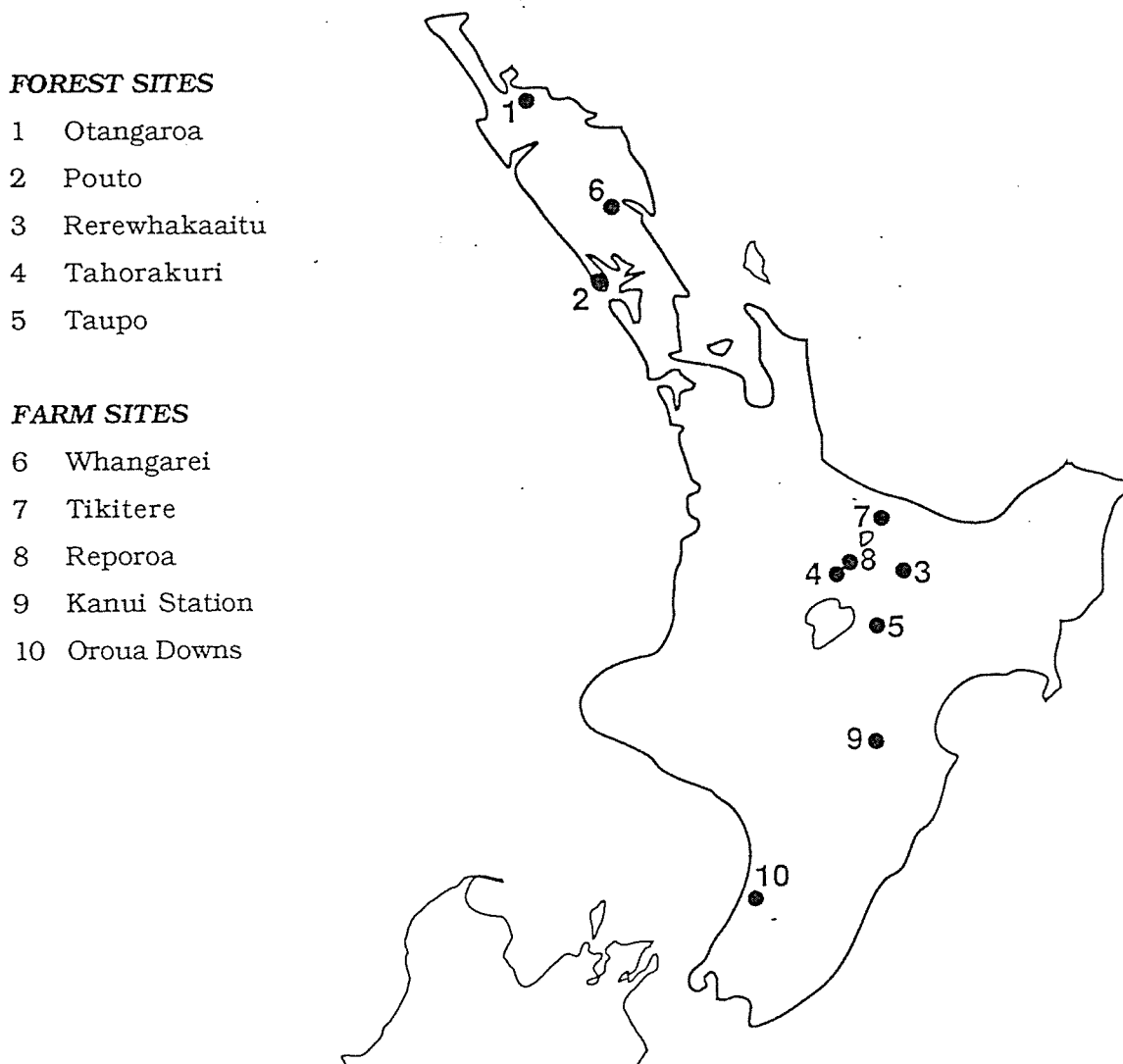
TABLE 1 - Stock types

Trt No.	Seed source	Seedlot No.	Material age	Collection site	GF rating
1	Bulked "880" op seedlings	9/0/84/080	1/0	-	12
2	Bulked "875" cross seedlings	9/0/83/081	1/0	-	17
3	"268" special seedlings	9/0/83/082	1/0	-	15
4	Gwavas seed orchard seedlings	5/3/82/002/3	1/0	-	14
5	Tissue cultured plantlets Gwavas seed orchard "850"	3/3/82/002/3	0/1	Lined out 1983	14
6	"880" op progeny test ex 1-yr ortets		0/1	FRI nursery	12
7	"850" seed orchard ex 2-yr ortets		0/1	FRI nursery	14
8	"880" op progeny test ex 3-yr ortets		0/1	Lake Taupo forest	12
9	"875" x "268" ESSO ex 3-yr ortets		0/1	Cpt 1132 Kaingaroa	16
10	"875" progeny test ex 4-yr ortets		0/1	Cpt 327 Kaingaroa	17
11	"875" progeny test ex 4-yr ortets		0/1	Onepu, Tasman	17

Trial locations are shown in Figure 1.

On each site the total trial area varies from 2.2 ha to 2.6 ha depending upon the number of replications. Each trial is laid out in a randomised complete block design with the 11 stock types replicated in 10 to 12 blocks. Each block measures 0.22 ha and trees were established at 400 stems/ha. Stock types are represented by a single row of eight trees per block. All sites were pruned to half height between ages 4-5 years, and unpruned trees were thinned to waste. A second pruning to about 4 m ht was applied to all sites between ages 5-6 years. Most unpruned trees were left as followers. Currently stocking varies between 200 and 280 stems/ha.

FIGURE 1 - Map of trial locations

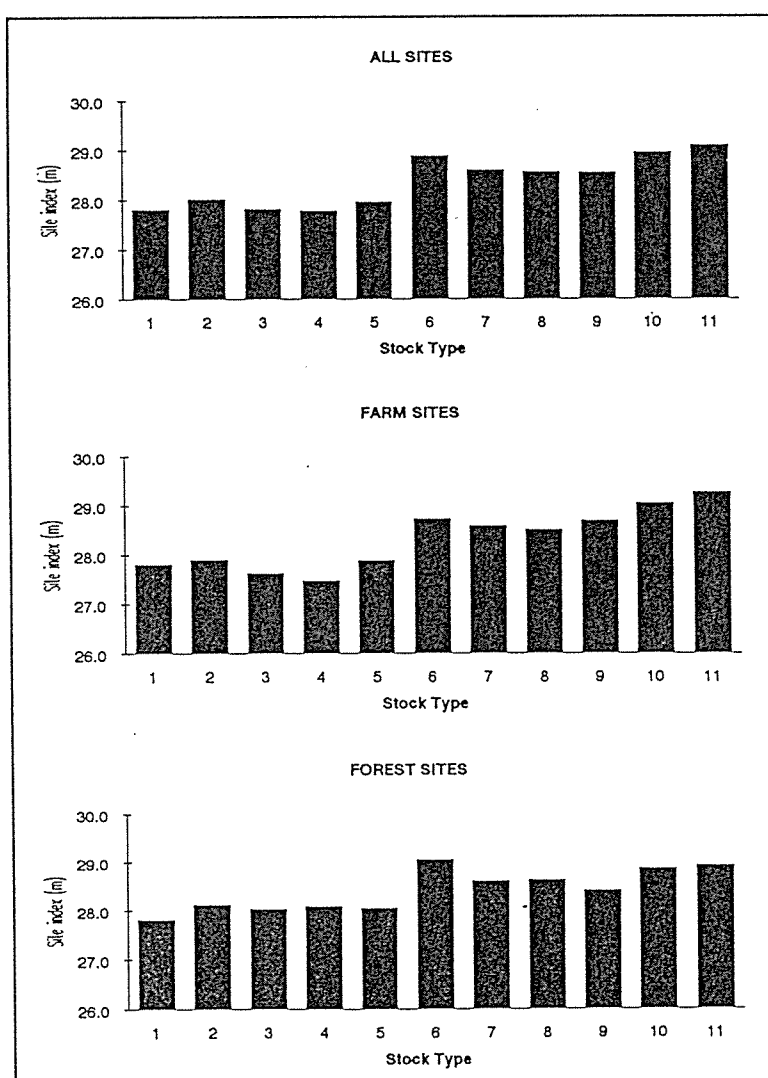


GENERAL METHOD

The model was tested from age $3\frac{1}{2}$ years using residual analysis in a similar manner to Knowles and Koehler (1984), Manley (1986) and West *et al* (1987). This method involves initialising the model with measurement data of dbh, height, and stocking. An estimate of site index was calculated by using the latest height measurement at age 7 years. Regional height/age curves were chosen on the basis of location, and where several were available, best fit. Site indices as entered in the model are shown in Fig. 2 and in Appendices II - XII. Estimates of site index for the different tree stock types averaged around 28 m for both farm and forest sites, however cuttings showed a slightly higher site index than seedlings on both farm and forest sites (Fig. 2).

FIG. 2

PREDICTED SITE INDEX



The ratio of DBH/Ht at the time of first measurement at age 4-5 years can be used in EARLY as an indicator of the appropriate basal area level (West *et al.* 1987). Table 2 shows that the farm sites generally have a higher ratio than forest sites, however on one forest site (Otangaroa) the trees were relatively slender and on one farm site (Whangarei) the DBH/Ht ratio was similar to the forest sites. Table 3 shows the DBH/Ht ratios for each treatment and site. These values are considerably higher than those calculated from data that went into constructing EARLY (G. West, pers. comm. see Table 4). An explanation is that at a young age, at low stockings either diameters are enhanced or heights are reduced, or both are affected.

TABLE 2 - Dbh/ht ratio at initial measurement

	Dbh (cm)/ ht (m)	Mean
FARM SITES		
Whangarei	2.00	
Tikitere	2.27	
Reporoa	2.22	
Kanui Station	2.49	
Oroua Downs	2.33	2.29
FOREST SITES		
Otangaroa	1.75	
Pouto	1.99	
Rerewhakaaitu	1.97	
Tahorakuri	1.92	
Taupo	2.12	1.96

Preliminary runs of the model showed that there were only small differences in basal area prediction when using either the 'medium' or 'high' levels in EARLY. This was presumably because of the low levels of crown in these trials due to the low initial stockings and timely pruning. Basal area increment on all sites was predicted using the 'medium' level in EARLY, with the exception of Otangaroa and Pouto, where the 'low' level was used.

TABLE 3 - Indicative dbh/ht ratios at age 4-5 years

Trt	1	2	3	4	5	6	7	8	9	10	11
Forest											
Otagaroa	5	5	5	5	5	5	5	6	6	5	6
Pouto	2	3	3	3	3	2	2	3	4	4	4
Rerewhakaaitu	3	4	3	3	4	4	3	4	4	4	5
Tahorakuri	3	4	3	3	5	3	4	5	4	5	6
Taupo	2	2	2	2	3	3	2	3	3	3	5
Farm											
Whangarei	2	2	2	1	1	2	2	2	3	4	4
Tikitere	1	1	1	1	1	1	1	2	2	3	3
Reporoa	1	1	1	1	1	1	1	1	1	2	3
Kanui Station	1	1	1	1	1	1	1	1	1	1	2
Oroua Downs	1	2	1	1	1	1	1	2	2	2	4

KEY:

Basal area level

1	High	+ 20%	5	Medium	+ 20%	10	Low	+ 10%
2	High	+ 10%	6	Medium	+ 10%	11	Low	
3	High		7	Medium		12	Low	- 10%
4	High	- 10%	8	Medium	- 10%	13	Low	- 20%
			9	Medium	- 20%			

TABLE 4 - EARLY growth model - DBH/Ht ratios

Month	Years	BASAL AREA LEVEL												
		1	2	3	4	5	6	7	8	9	10	11	12	13
			10%	High	-10%	20%	10%	Med	-10%	20%	10%	Low	-10%	-20%
Jul	4	NA	2.04	1.92	1.79	1.67	1.54	1.42	1.37	1.32	1.27	1.22	1.17	1.12
Aug	4	"	2.06	1.93	1.81	1.68	1.56	1.43	1.38	1.33	1.28	1.23	1.18	1.13
Sep	4	"	2.07	1.95	1.82	1.70	1.57	1.45	1.40	1.35	1.30	1.25	1.20	1.15
Oct	4	"	2.09	1.97	1.84	1.72	1.59	1.47	1.42	1.37	1.32	1.27	1.22	1.17
Nov	4	"	2.11	1.98	1.86	1.73	1.61	1.48	1.43	1.38	1.33	1.28	1.23	1.18
Dec	4	"	2.12	2.00	1.87	1.75	1.62	1.50	1.45	1.40	1.35	1.30	1.25	1.20
Jan	4	"	2.14	2.02	1.89	1.77	1.64	1.52	1.47	1.42	1.37	1.32	1.27	1.22
Feb	4	"	2.16	2.03	1.91	1.78	1.66	1.53	1.48	1.43	1.38	1.33	1.28	1.23
Mar	4	"	2.17	2.05	1.92	1.80	1.67	1.55	1.50	1.45	1.40	1.35	1.30	1.25
Apr	4	"	2.19	2.07	1.94	1.82	1.69	1.57	1.52	1.47	1.42	1.37	1.32	1.27
May	4	"	2.21	2.08	1.96	1.83	1.71	1.58	1.53	1.48	1.43	1.38	1.33	1.28
Jun	4	"	2.23	2.10	1.98	1.85	1.73	1.60	1.55	1.50	1.43	1.40	1.35	1.30
Jul	5	"	2.24	2.12	1.99	1.87	1.74	1.62	1.57	1.52	1.47	1.42	1.37	1.32

Silvicultural measurements (pruning date, pruned height and stocking) which would effect the growth prediction in EARLY were input from actual data.

Percentage error for both mean height and mean basal area were calculated for each stock type on each site, as: $(\text{actual value} - \text{predicted value}) / \text{predicted value} \times 100$. A positive value indicates an underprediction by the model and a negative value indicates an overprediction by the model.

RESULTS

Tables of actual and predicted values, percentage error, estimated site index for each stock type and basal area level for each site are shown in Appendices II - XII. Error trends for farm and forest sites are shown in Figures 3 and 4.

COMPARISON OF ERRORS IN HEIGHT PREDICTION BY SITE

Farm sites

Generally height growth on farm sites is underpredicted. Tikitere, Whangarei and Kanui Station showed less than 5% error at age 7 years and a maximum error of less than 10% over the simulation period of 3 years. At Reporoa, errors of between 5% and 10% at age 7 years occur and there is a trend of increasing underprediction over time. Height growth at Oroua Downs is considerably less than the other sites and allowed only a 2-year simulation. Errors on this site range from 10% to 15% and also show a tendency of increasing underprediction over time.

Height growth of juvenile cuttings (from 1-year-old trees) is accurately predicted at Reporoa compared with other stock types, however there is no clear trend evident on other farm sites.

Forest sites

Pouto, Tahorakuri and Taupo show overall errors of 6% or less. Initially, Rerewhakaaitu is underpredicted by up to 15%, however there is a trend of decreasing error over time. Height growth at Otangaroa is generally overpredicted although the data is quite spread and ranges from +5% to -13%. Problems with nutrient deficiency on this site may have had a confounding effect on the prediction.

Figure 3 COMPARISON OF ERRORS IN HEIGHT PREDICTION ON 10 SITES.

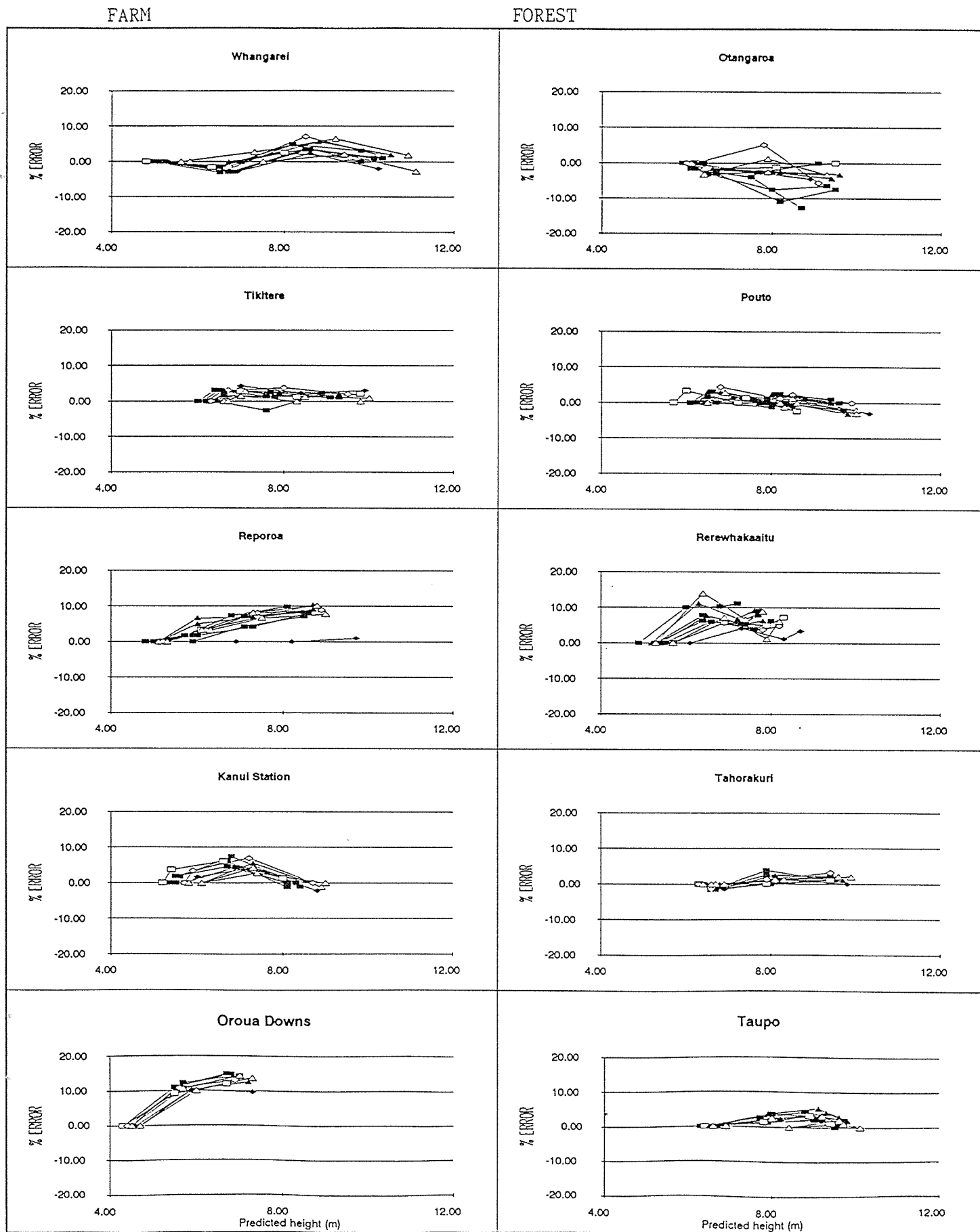
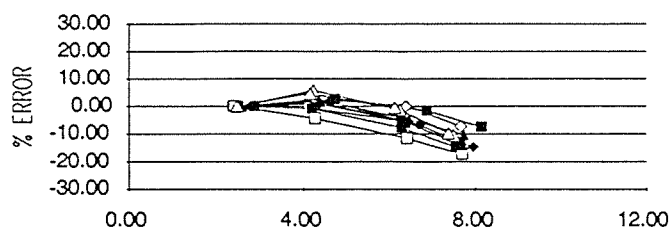


Figure 4 COMPARISON OF ERRORS IN BASAL AREA PREDICTION ON 10 SITES.

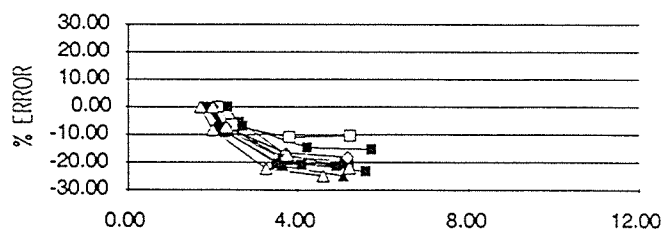
FARM

FOREST

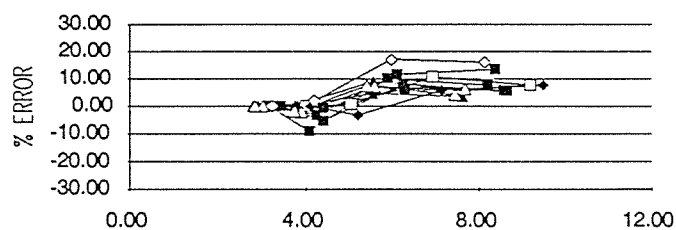
Whangarei



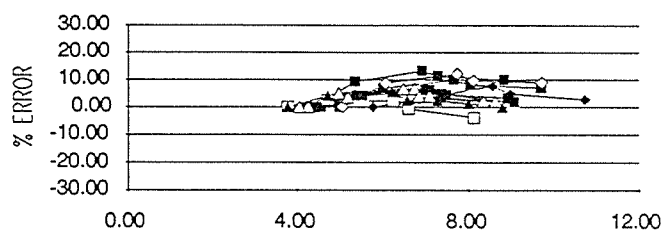
Otangaroa



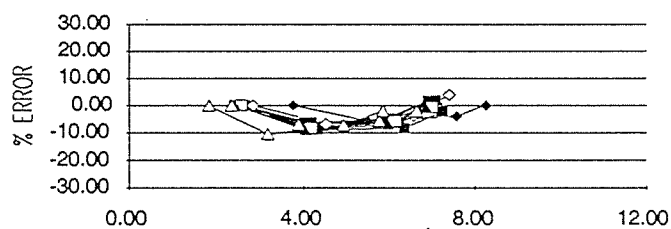
Tikitere



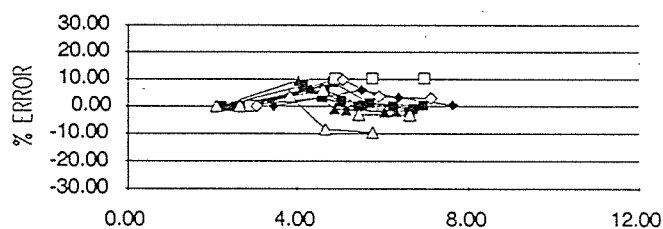
Pouto



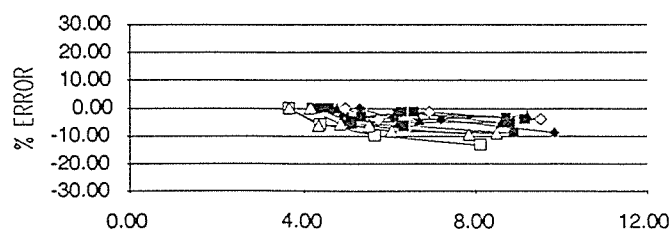
Reporoa



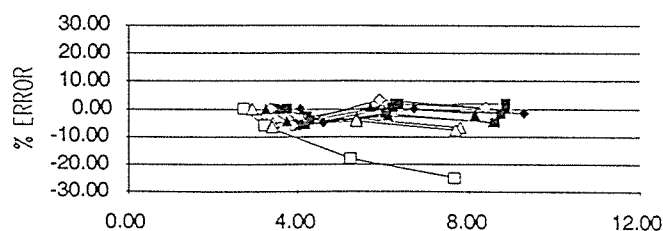
Rerewhakaaitu



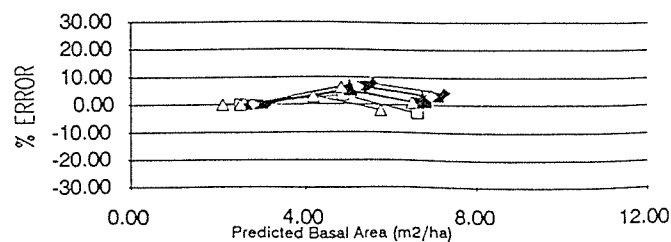
Kanui Station



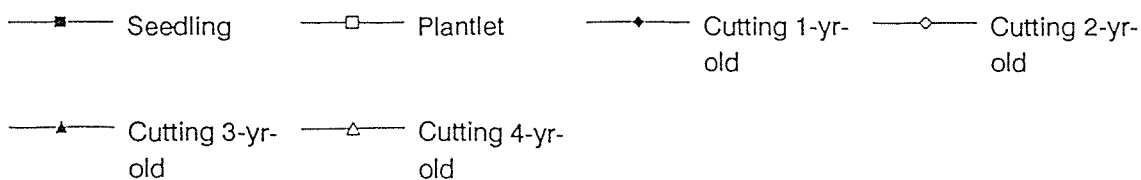
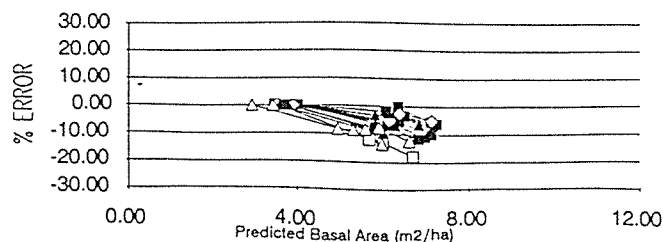
Tahorakuri



Oroua Downs



Taupo



COMPARISON OF ERRORS IN BASAL AREA PREDICTION BY SITE

Farm sites

Basal area growth for Reporoa, Kanui Station and Oroua Downs is predicted to be within $\pm 10\%$. The Tikitere site is underpredicted by up to 15% although apart from the juvenile cuttings (from 2-year-old trees) and one seedling type, errors were 10% or less. Whangarei showed increasing overprediction with time to a maximum of approximately 15% at age 7 years.

Forest sites

All forest sites except for Otangaroa show errors of $\pm 15\%$ or less. Tahorakuri and Rerewhakaaitu are accurately predicted, however there is a trend of overprediction of Taupo and underprediction at Pouto. Otangaroa shows considerable overprediction with final values being overpredicted by up to 25%. As mentioned previously, problems of low fertility on this site may have had an effect on the prediction.

For most forest sites there is an indication that the aged cuttings (from 4-year-old trees) are overpredicted more than other stock types.

COMPARISON OF ERRORS IN HEIGHT PREDICTION FOR EACH STOCK TYPE

To determine whether all stock types are similarly predicted the mean error at age 7 years on all sites combined was calculated for each stock type and is shown in Figure 5.

The data is shown for farm and forest sites separately in Figures 6 and 7.

There is a trend for all stock types to be underpredicted although the error is less than 5%. Juvenile cuttings (from 1-year-old trees) are accurately predicted with an overall error of less than 1%.

All stock types are predicted more accurately on forest sites compared with farm sites.

Predicted height error for each stock type.

Fig 5

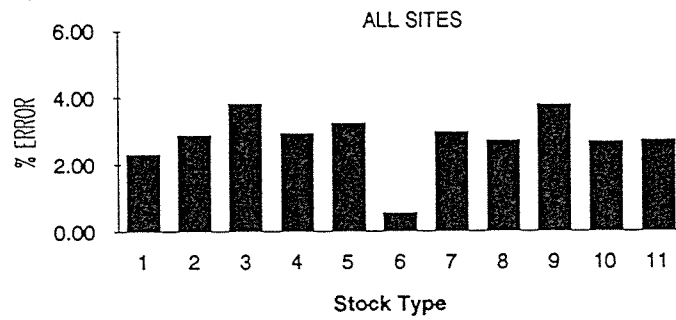


Fig 6

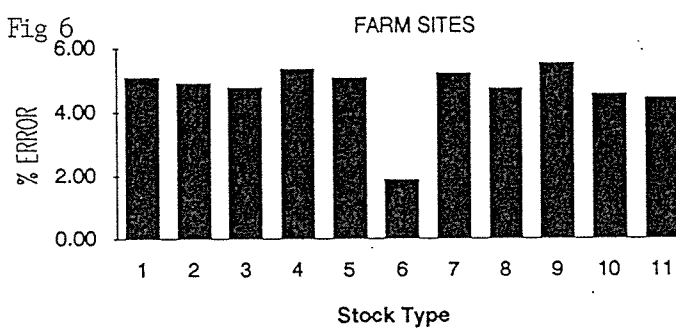
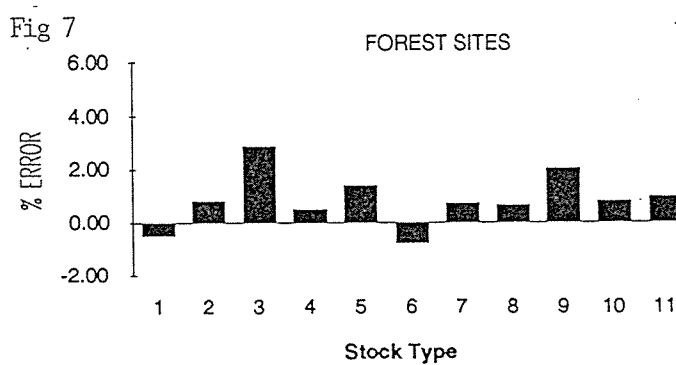


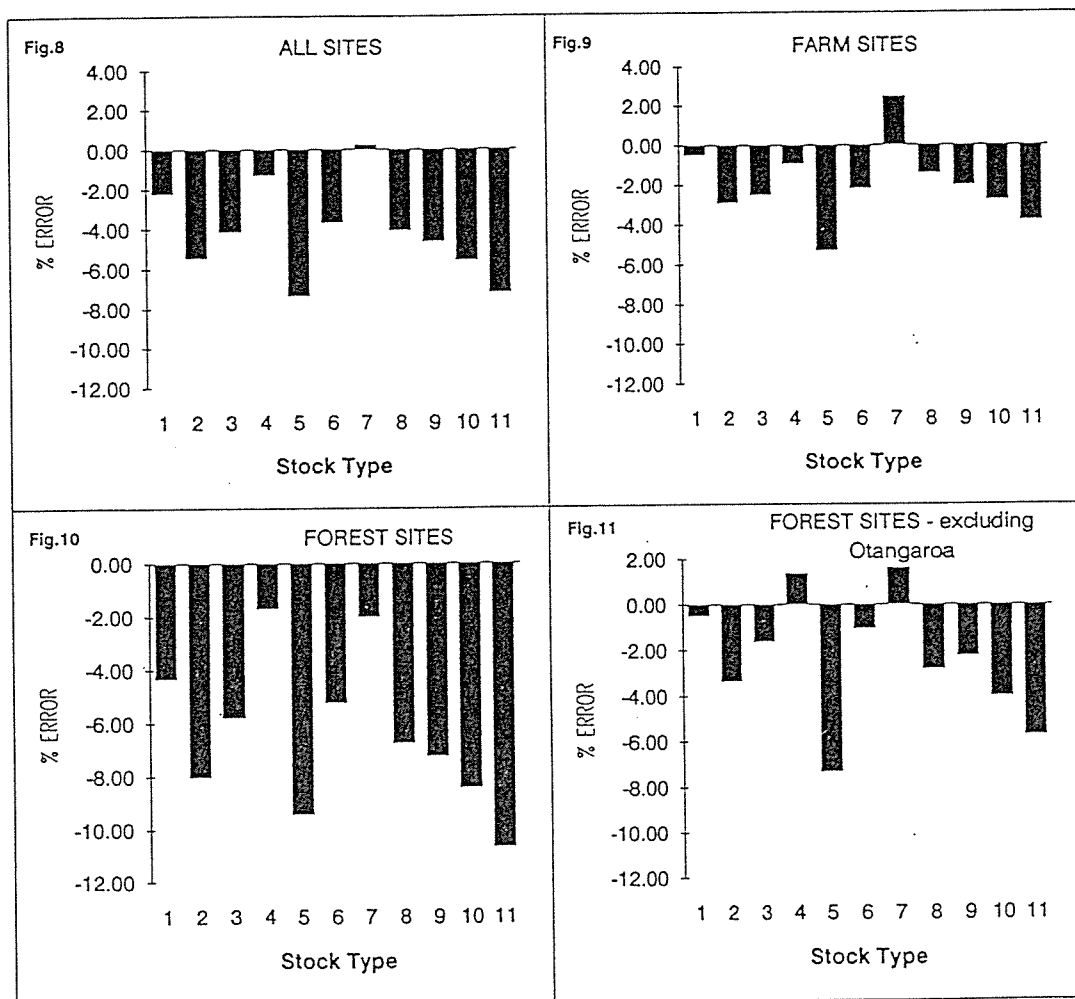
Fig 7



COMPARISON OF ERRORS IN BASAL AREA PREDICTION FOR EACH STOCK TYPE

The mean error at age 7 years for each stock type on all sites is shown in Figure 8 and separately for farm and forest sites in Figure 9 and 10. Otangaroa was omitted from the forest site data and the error shown in Figure 11.

Predicted basal area error for each stock type.



Basal area growth is overpredicted for all stock types except the juvenile cuttings (from 2-year-old trees) which are slightly underpredicted. Overall errors are less than 10% and there is an indication of increasing overprediction with increasing parent age of cutting material.

Basal area growth on forest sites is overpredicted more than farm sites although the relativity between stock types is similar. Omitting the Otangaroa data from the forest sites gives a similar error level for forest and farm sites.

DISCUSSION

Both seedlings and cuttings have grown well on 9 sites, the exception being Otangaroa in Northland, where the initial growth was good, but following the initial pruning growth has been poor, with EARLY overpredicting both basal area and height increment. This site is considered nutrient deficient.

At Oroua Downs, a farm site in the Manawatu, the trend has been the opposite with poor initial growth followed by improved subsequent increment, resulting in underprediction by the model. This site has a dry sandy topsoil, but moisture is available once the trees are established and the trial has performed similarly to other plantings in the district.

Perhaps the most surprising result is that there are no apparent trends in improved height growth (site index) or basal area increment attributable to the GF ratings, which vary for both seedlings and cuttings between GF12 and GF17. By comparison, cuttings of the same GF rating as seedlings add almost a metre to site index on both farm and forest sites. Basal area increment shows a trend of increasing overprediction relative to GF rating, with an apparent reduction in basal area (as shown by an increase in error) of almost 4% when GF rating increases from 12 to 17. A similar trend is evident in basal area increment relative to increasing age of cuttings. It is likely such differences are not significantly different.

CONCLUSIONS

EARLY predicts the growth of young, pruned stands equally well on both farm and forest sites, and for seedlings and cuttings. Differences between seedlings and cuttings are:

- an increase of up to a metre in site index attributable to cuttings
- a reduction in basal area prediction of about 4% attributable to cuttings.

There is no obvious benefit in terms of estimated site index or basal area increment attributable to material ranging in GF number from 12 to 17.

This study should be viewed as being very much of an interim nature, as the stands are currently at around 10 m height, and will provide a more complete picture of growth trends for EARLY validation over the following 4-5 years. This analysis will need to be extended in future.

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APPENDIX I - Legend for Appendices II - XII

Column No.	Code	Definition
1	Trt	Treatment No. 1 to 11 (see Table 1)
2	Date	Measurement date
3	S1	Calculated site index (MTH @ age 20)
4	A.Ht	Actual mean height
5	P.Ht	Predicted mean height
6	Diff.	Actual height - Predicted height
7	% Error	$(\text{Actual ht} - \text{Predicted ht} / \text{Pred ht}) \times 100$
8	A.BA	Actual basal area
9	P.BA	Predicted basal area
9 a	medium/low	Estimated basal area level
10	Diff	Actual BA - Predicted BA
11	% Error	$(\text{Actual BA} - \text{Predicted BA} / \text{Pred BA}) \times 100$

APPENDIX II

WHANGAREI

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								medium		
1	88JUL	30.2	4.90	4.90	0.00	0.00	2.39	2.39	0.00	0.00
	89JUN		6.30	6.50	-0.20	-3.08	4.15	4.18	-0.03	-0.72
	90AUG		8.60	8.20	0.40	4.88	5.94	6.27	-0.33	-5.26
	91JUL		10.10	9.80	0.30	3.06	6.57	7.56	-0.99	-13.10
2	88JUL	30.3	5.10	5.10	0.00	0.00	2.53	2.53	0.00	0.00
	89JUN		6.50	6.70	-0.20	-2.99	4.33	4.29	0.04	0.93
	90AUG		8.80	8.50	0.30	3.53	6.01	6.37	-0.36	-5.65
	91JUL		10.20	10.10	0.10	0.99	6.57	7.65	-1.08	-14.12
3	88JUL	29.4	5.00	5.00	0.00	0.00	2.44	2.44	0.00	0.00
	89JUN		6.40	6.50	-0.10	-1.54	4.15	4.19	-0.04	-0.95
	90AUG		8.60	8.20	0.40	4.88	5.79	6.27	-0.48	-7.66
	91JUL		9.80	9.80	0.00	0.00	6.43	7.56	-1.13	-14.95
4	88JUL	30.7	5.20	5.20	0.00	0.00	2.89	2.89	0.00	0.00
	89JUN		6.60	6.80	-0.20	-2.94	4.85	4.73	0.12	2.54
	90AUG		8.90	8.60	0.30	3.49	6.76	6.87	-0.11	-1.60
	91JUL		10.40	10.30	0.10	0.97	7.54	8.14	-0.60	-7.37
5	88JUL	29	4.80	4.80	0.00	0.00	2.44	2.44	0.00	0.00
	89JUN		6.20	6.30	-0.10	-1.59	4.08	4.27	-0.19	-4.45
	90AUG		8.20	8.00	0.20	2.50	5.65	6.40	-0.75	-11.72
	91JUL		9.60	9.50	0.10	1.05	6.36	7.70	-1.34	-17.40
6	88JUL	30	5.30	5.30	0.00	0.00	2.78	2.78	0.00	0.00
	89JUN		6.70	6.90	-0.20	-2.90	4.66	4.58	0.08	1.75
	90AUG		8.80	8.60	0.20	2.33	6.23	6.68	-0.45	-6.74
	91JUL		10.00	10.20	-0.20	-1.96	6.79	7.95	-1.16	-14.59
7	88JUL	30.7	5.10	5.10	0.00	0.00	2.53	2.53	0.00	0.00
	89JUN		6.60	6.70	-0.10	-1.49	4.40	4.29	0.11	2.56
	90AUG		9.10	8.50	0.60	7.06	6.38	6.37	0.01	0.16
	91JUL		10.40	10.20	0.20	1.96	7.09	7.65	-0.56	-7.32
8	88JUL	30.3	5.10	5.10	0.00	0.00	2.58	2.58	0.00	0.00
	89JUN		6.70	6.70	0.00	0.00	4.46	4.36	0.10	2.29
	90AUG		8.80	8.50	0.30	3.53	6.15	6.45	-0.30	-4.65
	91JUL		10.20	10.10	0.10	0.99	6.94	7.73	-0.79	-10.22
9	88JUL	31.2	5.30	5.30	0.00	0.00	2.58	2.58	0.00	0.00
	89JUN		7.00	7.00	0.00	0.00	4.39	4.32	0.07	1.62
	90AUG		9.30	8.80	0.50	5.68	6.01	6.38	-0.37	-5.80
	91JUL		10.70	10.50	0.20	1.90	6.58	7.65	-1.07	-13.99
10	88JUL	32	5.60	5.60	0.00	0.00	2.53	2.53	0.00	0.00
	89JUN		7.50	7.30	0.20	2.74	4.46	4.22	0.24	5.69
	90AUG		9.80	9.20	0.60	6.52	6.15	6.23	-0.08	-1.28
	91JUL		11.10	10.90	0.20	1.83	6.72	7.49	-0.77	-10.28
11	88JUL	31.4	5.80	5.80	0.00	0.00	2.48	2.48	0.00	0.00
	89JUN		7.50	7.50	0.00	0.00	4.33	4.14	0.19	4.59
	90AUG		9.60	9.40	0.20	2.13	6.08	6.12	-0.04	-0.65
	91JUL		10.80	11.10	-0.30	-2.70	6.65	7.37	-0.72	-9.77

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								medium		
1	88JAN	28.7	6.10	6.10	0.00	0.00	3.28	3.28	0.00	0.00
	89AUG		6.70	6.50	0.20	3.08	4.10	4.24	-0.14	-3.30
	90JUN		7.90	7.70	0.20	2.60	6.79	6.09	0.70	11.49
	91JUN		9.20	9.10	0.10	1.10	9.49	8.36	1.13	13.52
2	88JAN	29.4	6.20	6.20	0.00	0.00	3.42	3.42	0.00	0.00
	89AUG		6.70	6.60	0.10	1.52	4.15	4.39	-0.24	-5.47
	90JUN		7.90	7.80	0.10	1.28	6.73	6.23	0.50	8.03
	91JUN		9.40	9.30	0.10	1.08	9.03	8.55	0.48	5.61
3	88JAN	28.5	6.00	6.00	0.00	0.00	3.14	3.14	0.00	0.00
	89AUG		6.40	6.40	0.00	0.00	3.70	4.07	-0.37	-9.09
	90JUN		7.40	7.60	-0.20	-2.63	6.47	5.88	0.59	10.03
	91JUN		9.10	8.90	0.20	2.25	8.81	8.18	0.63	7.70
4	88JAN	28.5	6.00	6.00	0.00	0.00	3.42	3.42	0.00	0.00
	89AUG		6.60	6.40	0.20	3.12	4.36	4.39	-0.03	-0.68
	90JUN		7.70	7.60	0.10	1.32	6.66	6.27	0.39	6.22
	91JUN		9.10	8.90	0.20	2.25	9.11	8.63	0.48	5.56
5	88JAN	30.7	6.60	6.60	0.00	0.00	4.00	4.00	0.00	0.00
	89AUG		7.20	7.00	0.20	2.86	5.08	5.04	0.04	0.79
	90JUN		8.40	8.30	0.10	1.20	7.66	6.92	0.74	10.69
	91JUN		10.00	9.80	0.20	2.04	9.87	9.17	0.70	7.63
6	88JAN	31.2	6.60	6.60	0.00	0.00	4.10	4.10	0.00	0.00
	89AUG		7.30	7.00	0.30	4.29	5.02	5.19	-0.17	-3.28
	90JUN		8.60	8.40	0.20	2.38	7.53	7.12	0.41	5.76
	91JUN		10.20	9.90	0.30	3.03	10.19	9.47	0.72	7.60
7	88JAN	30.1	6.30	6.30	0.00	0.00	3.23	3.23	0.00	0.00
	89AUG		6.90	6.70	0.20	2.99	4.26	4.18	0.08	1.91
	90JUN		8.30	8.00	0.30	3.75	6.99	5.97	1.02	17.09
	91JUN		9.70	9.50	0.20	2.11	9.41	8.11	1.30	16.03
8	88JAN	29.6	6.20	6.20	0.00	0.00	2.79	2.79	0.00	0.00
	89AUG		6.80	6.60	0.20	3.03	3.75	3.74	0.01	0.27
	90JUN		8.10	7.90	0.20	2.53	6.04	5.54	0.50	9.03
	91JUN		9.50	9.30	0.20	2.15	8.16	7.70	0.46	5.97
9	88JAN	29.6	6.20	6.20	0.00	0.00	2.92	2.92	0.00	0.00
	89AUG		6.80	6.60	0.20	3.03	3.80	3.80	0.00	0.00
	90JUN		8.10	7.90	0.20	2.53	5.79	5.53	0.26	4.70
	91JUN		9.50	9.30	0.20	2.15	7.87	7.61	0.26	3.42
10	88JAN	30.3	6.60	6.60	0.00	0.00	3.01	3.01	0.00	0.00
	89AUG		7.10	7.00	0.10	1.43	3.80	3.89	-0.09	-2.31
	90JUN		8.30	8.30	0.00	0.00	5.97	5.57	0.40	7.18
	91JUN		9.80	9.80	0.00	0.00	8.15	7.67	0.48	6.26
11	88JAN	31	6.70	6.70	0.00	0.00	2.83	2.83	0.00	0.00
	89AUG		7.30	7.10	0.20	2.82	3.65	3.72	-0.07	-1.88
	90JUN		8.60	8.50	0.10	1.18	5.79	5.39	0.40	7.42
	91JUN		10.10	10.00	0.10	1.00	7.73	7.43	0.30	4.04

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								medium		
1	88OCT	28.7	5.00	5.00	0.00	0.00	2.58	2.58	0.00	0.00
	89AUG		5.90	5.90	0.00	0.00	3.93	4.20	-0.27	-6.43
	90JUN		7.40	7.10	0.30	4.23	5.83	6.22	-0.39	-6.27
	91JUN		9.10	8.50	0.60	7.06	7.06	7.12	-0.06	-0.84
2	88OCT	28.9	5.00	5.00	0.00	0.00	2.44	2.44	0.00	0.00
	89AUG		6.00	5.90	0.10	1.69	3.76	4.01	-0.25	-6.23
	90JUN		7.60	7.10	0.50	7.04	5.69	5.99	-0.30	-5.01
	91JUN		9.20	8.50	0.70	8.24	7.00	6.89	0.11	1.60
3	88OCT	29.2	5.10	5.10	0.00	0.00	2.67	2.67	0.00	0.00
	89AUG		6.10	6.00	0.10	1.67	3.93	4.32	-0.39	-9.03
	90JUN		7.60	7.30	0.30	4.11	5.83	6.35	-0.52	-8.19
	91JUN		9.30	8.60	0.70	8.14	7.06	7.23	-0.17	-2.35
4	88OCT	28	4.80	4.80	0.00	0.00	2.44	2.44	0.00	0.00
	89AUG		5.80	5.70	0.10	1.75	3.71	4.07	-0.36	-8.85
	90JUN		7.30	6.80	0.50	7.35	5.76	6.12	-0.36	-5.88
	91JUN		8.90	8.10	0.80	9.88	7.20	7.07	0.13	1.84
5	88OCT	29.8	5.20	5.20	0.00	0.00	2.58	2.58	0.00	0.00
	89AUG		6.30	6.10	0.20	3.28	3.82	4.16	-0.34	-8.17
	90JUN		7.90	7.40	0.50	6.76	5.76	6.12	-0.36	-5.88
	91JUN		9.60	8.80	0.80	9.09	6.93	6.98	-0.05	-0.72
6	88OCT	30.3	5.90	5.90	0.00	0.00	3.76	3.76	0.00	0.00
	89AUG		6.90	6.90	0.00	0.00	5.17	5.48	-0.31	-5.66
	90JUN		8.20	8.20	0.00	0.00	7.25	7.55	-0.30	-3.97
	91JUN		9.80	9.70	0.10	1.03	8.25	8.24	0.01	0.12
7	88OCT	30.1	5.20	5.20	0.00	0.00	2.85	2.85	0.00	0.00
	89AUG		6.40	6.20	0.20	3.23	4.21	4.52	-0.31	-6.86
	90JUN		8.00	7.40	0.60	8.11	6.31	6.55	-0.24	-3.66
	91JUN		9.70	8.90	0.80	8.99	7.68	7.39	0.29	3.92
8	88OCT	29.6	5.10	5.10	0.00	0.00	2.40	2.40	0.00	0.00
	89AUG		6.40	6.00	0.40	6.67	3.66	3.96	-0.30	-7.58
	90JUN		7.80	7.30	0.50	6.85	5.63	5.90	-0.27	-4.58
	91JUN		9.50	8.70	0.80	9.20	6.86	6.79	0.07	1.03
9	88OCT	29.8	5.10	5.10	0.00	0.00	2.44	2.44	0.00	0.00
	89AUG		6.30	6.00	0.30	5.00	3.66	4.02	-0.36	-8.96
	90JUN		7.80	7.30	0.50	6.85	5.56	5.97	-0.41	-6.87
	91JUN		9.60	8.70	0.90	10.34	6.80	6.85	-0.05	-0.73
10	88OCT	30.1	5.30	5.30	0.00	0.00	2.36	2.36	0.00	0.00
	89AUG		6.50	6.30	0.20	3.17	3.60	3.87	-0.27	-6.98
	90JUN		8.00	7.50	0.50	6.67	5.43	5.75	-0.32	-5.57
	91JUN		9.70	9.00	0.70	7.78	6.47	6.61	-0.14	-2.12
11	88OCT	30.1	5.10	5.10	0.00	0.00	1.83	1.83	0.00	0.00
	89AUG		6.30	6.10	0.20	3.28	2.85	3.18	-0.33	-10.38
	90JUN		7.90	7.30	0.60	8.22	4.56	4.92	-0.36	-7.32
	91JUN		9.70	8.80	0.90	10.23	5.73	5.84	-0.11	-1.88

APPENDIX V

KANUI STATION

TRT	DATE	S I	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								medium		
1	89FEB	26.9	5.40	5.40	0.00	0.00	4.18	4.18	0.00	0.00
	89JUL		5.70	5.60	0.10	1.79	4.76	4.92	-0.16	-3.25
	90JUN		7.30	6.80	0.50	7.35	6.06	6.16	-0.10	-1.62
	91AUG		8.30	8.30	0.00	0.00	8.40	8.69	-0.29	-3.34
2	89FEB	26.4	5.30	5.30	0.00	0.00	4.37	4.37	0.00	0.00
	89JUL		5.60	5.50	0.10	1.82	4.82	5.11	-0.29	-5.68
	90JUN		7.00	6.70	0.30	4.48	5.92	6.31	-0.39	-6.18
	91AUG		8.10	8.10	0.00	0.00	8.09	8.87	-0.78	-8.79
3	89FEB	26.9	5.50	5.50	0.00	0.00	4.56	4.56	0.00	0.00
	89JUL		5.70	5.70	0.00	0.00	5.16	5.32	-0.16	-3.01
	90JUN		7.20	6.90	0.30	4.35	6.47	6.54	-0.07	-1.07
	91AUG		8.30	8.40	-0.10	-1.19	8.80	9.13	-0.33	-3.61
4	89FEB	26.2	5.30	5.30	0.00	0.00	4.31	4.31	0.00	0.00
	89JUL		5.60	5.50	0.10	1.82	4.82	5.05	-0.23	-4.55
	90JUN		7.10	6.70	0.40	5.97	6.19	6.26	-0.07	-1.12
	91AUG		8.00	8.10	-0.10	-1.23	8.32	8.80	-0.48	-5.45
5	89FEB	26.4	5.20	5.20	0.00	0.00	3.65	3.65	0.00	0.00
	89JUL		5.60	5.40	0.20	3.70	4.12	4.36	-0.24	-5.50
	90JUN		7.00	6.60	0.40	6.06	5.09	5.64	-0.55	-9.75
	91AUG		8.10	8.00	0.10	1.25	7.03	8.10	-1.07	-13.21
6	89FEB	27.6	5.80	5.80	0.00	0.00	5.29	5.29	0.00	0.00
	89JUL		6.10	6.00	0.10	1.67	5.86	6.06	-0.20	-3.30
	90JUN		7.60	7.30	0.30	4.11	6.89	7.18	-0.29	-4.04
	91AUG		8.60	8.80	-0.20	-2.27	8.96	9.81	-0.85	-8.66
7	89FEB	27.9	5.70	5.70	0.00	0.00	4.95	4.95	0.00	0.00
	89JUL		6.10	5.90	0.20	3.39	5.50	5.73	-0.23	-4.01
	90JUN		7.70	7.20	0.50	6.94	6.82	6.90	-0.08	-1.16
	91AUG		8.70	8.70	0.00	0.00	9.13	9.49	-0.36	-3.79
8	89FEB	28.3	5.80	5.80	0.00	0.00	4.25	4.25	0.00	0.00
	89JUL		6.10	6.10	0.00	0.00	4.76	4.98	-0.22	-4.42
	90JUN		7.70	7.30	0.40	5.48	5.86	6.17	-0.31	-5.02
	91AUG		8.80	8.90	-0.10	-1.12	8.16	8.58	-0.42	-4.90
9	89FEB	28.3	5.80	5.80	0.00	0.00	4.76	4.76	0.00	0.00
	89JUL		6.10	6.10	0.00	0.00	5.23	5.51	-0.28	-5.08
	90JUN		7.60	7.30	0.30	4.11	6.40	6.67	-0.27	-4.05
	91AUG		8.80	8.90	-0.10	-1.12	8.96	9.18	-0.22	-2.40
10	89FEB	28.3	5.80	5.80	0.00	0.00	4.12	4.12	0.00	0.00
	89JUL		6.10	6.10	0.00	0.00	4.56	4.83	-0.27	-5.59
	90JUN		7.60	7.30	0.30	4.11	5.53	6.02	-0.49	-8.14
	91AUG		8.80	8.90	-0.10	-1.12	7.70	8.46	-0.76	-8.98
11	89FEB	28.8	5.80	5.80	0.00	0.00	3.65	3.65	0.00	0.00
	89JUL		6.10	6.10	0.00	0.00	4.06	4.32	-0.26	-6.02
	90JUN		7.60	7.40	0.20	2.70	5.15	5.50	-0.35	-6.36
	91AUG		9.00	9.00	0.00	0.00	7.11	7.84	-0.73	-9.31

APPENDIX VI

OROUA DOWNS

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								medium		
1	89JUL	24.5	4.50	4.50	0.00	0.00	2.95	2.95	0.00	0.00
	90AUG		6.30	5.70	0.60	10.53	5.77	5.41	0.36	6.65
	91AUG		8.00	7.00	1.00	14.29	7.33	7.11	0.22	3.09
2	89JUL	24.5	4.50	4.50	0.00	0.00	2.58	2.58	0.00	0.00
	90AUG		6.40	5.70	0.70	12.28	5.12	4.89	0.23	4.70
	91AUG		8.00	7.00	1.00	14.29	6.64	6.57	0.07	1.07
3	89JUL	24.1	4.30	4.30	0.00	0.00	2.63	2.63	0.00	0.00
	90AUG		6.10	5.50	0.60	10.91	5.26	5.02	0.24	4.78
	91AUG		7.80	6.80	1.00	14.71	6.79	6.75	0.04	0.59
4	89JUL	23.9	4.30	4.30	0.00	0.00	2.68	2.68	0.00	0.00
	90AUG		6.10	5.50	0.60	10.91	5.33	5.09	0.24	4.72
	91AUG		7.70	6.70	1.00	14.93	6.87	6.82	0.05	0.73
5	89JUL	23.5	4.30	4.30	0.00	0.00	2.53	2.53	0.00	0.00
	90AUG		6.00	5.50	0.50	9.09	5.05	4.88	0.17	3.48
	91AUG		7.50	6.70	0.80	11.94	6.42	6.61	-0.19	-2.87
6	89JUL	24.5	4.70	4.70	0.00	0.00	3.11	3.11	0.00	0.00
	90AUG		6.50	5.90	0.60	10.17	6.00	5.57	0.43	7.72
	91AUG		8.00	7.30	0.70	9.59	7.57	7.24	0.33	4.56
7	89JUL	24.1	4.40	4.40	0.00	0.00	2.79	2.79	0.00	0.00
	90AUG		6.20	5.60	0.60	10.71	5.55	5.22	0.33	6.32
	91AUG		7.80	6.90	0.90	13.04	7.18	6.94	0.24	3.46
8	89JUL	24.7	4.60	4.60	0.00	0.00	2.68	2.68	0.00	0.00
	90AUG		6.50	5.90	0.60	10.17	5.26	5.01	0.25	4.99
	91AUG		8.10	7.20	0.90	12.50	6.72	6.66	0.06	0.90
9	89JUL	24.5	4.50	4.50	0.00	0.00	2.68	2.68	0.00	0.00
	90AUG		6.30	5.70	0.60	10.53	5.40	5.03	0.37	7.36
	91AUG		8.00	7.00	1.00	14.29	6.95	6.72	0.23	3.42
10	89JUL	24.5	4.50	4.50	0.00	0.00	2.53	2.53	0.00	0.00
	90AUG		6.30	5.70	0.60	10.53	5.12	4.82	0.30	6.22
	91AUG		8.00	7.00	1.00	14.29	6.57	6.49	0.08	1.23
11	89JUL	25	4.70	4.70	0.00	0.00	2.11	2.11	0.00	0.00
	90AUG		6.60	6.00	0.60	10.00	4.31	4.18	0.13	3.11
	91AUG		8.30	7.30	1.00	13.70	5.64	5.76	-0.12	-2.08

APPENDIX VII

OTANGAROA

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								low		
1	89FEB	24.7	5.90	5.90	0.00	0.00	1.87	1.87	0.00	0.00
	89JUN		6.00	6.10	-0.10	-1.64	2.01	2.17	-0.16	-7.37
	90AUG		7.20	7.50	-0.30	-4.00	2.79	3.51	-0.72	-20.51
	91JUL		7.60	8.70	-1.10	-12.64	3.85	4.90	-1.05	-21.43
2	89FEB	27.1	6.20	6.20	0.00	0.00	2.29	2.29	0.00	0.00
	89JUN		6.30	6.50	-0.20	-3.08	2.49	2.64	-0.15	-5.68
	90AUG		7.40	8.00	-0.60	-7.50	3.25	4.10	-0.85	-20.73
	91JUL		8.70	9.30	-0.60	-6.45	4.28	5.58	-1.30	-23.30
3	89FEB	27.9	5.90	5.90	0.00	0.00	1.98	1.98	0.00	0.00
	89JUN		6.10	6.20	-0.10	-1.61	2.13	2.32	-0.19	-8.19
	90AUG		7.50	7.70	-0.20	-2.60	3.02	3.75	-0.73	-19.47
	91JUL		9.10	9.10	0.00	0.00	4.12	5.20	-1.08	-20.77
4	89FEB	27.3	6.40	6.40	0.00	0.00	2.37	2.37	0.00	0.00
	89JUN		6.50	6.70	-0.20	-2.99	2.53	2.72	-0.19	-6.99
	90AUG		7.30	8.20	-0.90	-10.98	3.60	4.22	-0.62	-14.69
	91JUL		8.80	9.50	-0.70	-7.37	4.85	5.73	-0.88	-15.36
5	89FEB	28.7	6.20	6.20	0.00	0.00	2.13	2.13	0.00	0.00
	89JUN		6.40	6.50	-0.10	-1.54	2.29	2.45	-0.16	-6.53
	90AUG		8.00	8.10	-0.10	-1.23	3.40	3.82	-0.42	-10.99
	91JUL		9.50	9.50	0.00	0.00	4.67	5.22	-0.55	-10.54
6	89FEB	26.7	5.90	5.90	0.00	0.00	1.94	1.94	0.00	0.00
	89JUN		6.10	6.10	0.00	0.00	2.05	2.25	-0.20	-8.89
	90AUG		7.40	7.60	-0.20	-2.63	2.88	3.61	-0.73	-20.22
	91JUL		8.50	8.90	-0.40	-4.49	3.96	5.00	-1.04	-20.80
7	89FEB	26.9	6.00	6.00	0.00	0.00	2.01	2.01	0.00	0.00
	89JUN		6.20	6.20	0.00	0.00	2.17	2.34	-0.17	-7.26
	90AUG		8.20	7.80	0.40	5.13	3.11	3.73	-0.62	-16.62
	91JUL		8.60	9.10	-0.50	-5.49	4.23	5.17	-0.94	-18.18
8	89FEB	28.3	6.30	6.30	0.00	0.00	1.98	1.98	0.00	0.00
	89JUN		6.50	6.60	-0.10	-1.52	2.13	2.29	-0.16	-6.99
	90AUG		8.00	8.20	-0.20	-2.44	2.97	3.61	-0.64	-17.73
	91JUL		9.30	9.60	-0.30	-3.12	4.01	4.99	-0.98	-19.64
9	89FEB	27.7	6.20	6.20	0.00	0.00	1.98	1.98	0.00	0.00
	89JUN		6.30	6.50	-0.20	-3.08	2.09	2.30	-0.21	-9.13
	90AUG		7.80	8.00	-0.20	-2.50	2.88	3.66	-0.78	-21.31
	91JUL		9.00	9.40	-0.40	-4.26	3.80	5.06	-1.26	-24.90
10	89FEB	27.7	6.10	6.10	0.00	0.00	2.01	2.01	0.00	0.00
	89JUN		6.20	6.40	-0.20	-3.13	2.17	2.34	-0.17	-7.26
	90AUG		8.00	7.90	0.10	1.27	3.11	3.76	-0.65	-17.29
	91JUL		9.00	9.30	-0.30	-3.23	4.06	5.21	-1.15	-22.07
11	89FEB	27.7	6.10	6.10	0.00	0.00	1.72	1.72	0.00	0.00
	89JUN		6.30	6.40	-0.10	-1.56	1.83	2.00	-0.17	-8.50
	90AUG		7.70	7.90	-0.20	-2.53	2.53	3.26	-0.73	-22.39
	91JUL		9.00	9.30	-0.30	-3.23	3.45	4.59	-1.14	-24.84

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								low		
1	88DEC	26.6	6.30	6.30	0.00	0.00	4.97	4.97	0.00	0.00
	89JUN		6.70	6.70	0.00	0.00	6.41	5.99	0.42	7.01
	90MAR		7.90	8.00	-0.10	-1.25	8.39	7.64	0.75	9.82
	90AUG		8.30	8.30	0.00	0.00	8.68	8.03	0.65	8.09
	91JUL		9.50	9.70	-0.20	-2.06	10.34	9.67	0.67	6.93
2	88DEC	26.9	6.20	6.20	0.00	0.00	4.53	4.53	0.00	0.00
	89JUN		6.80	6.60	0.20	3.03	5.72	5.50	0.22	4.00
	90MAR		7.90	7.90	0.00	0.00	7.53	7.09	0.44	6.21
	90AUG		8.40	8.20	0.20	2.44	7.81	7.47	0.34	4.55
	91JUL		9.60	9.60	0.00	0.00	9.19	9.04	0.15	1.66
3	88DEC	26.6	6.10	6.10	0.00	0.00	4.38	4.38	0.00	0.00
	89JUN		6.60	6.50	0.10	1.54	5.59	5.37	0.22	4.10
	90MAR		7.80	7.80	0.00	0.00	7.44	6.99	0.45	6.44
	90AUG		8.30	8.10	0.20	2.47	7.72	7.36	0.36	4.89
	91JUL		9.50	9.40	0.10	1.06	9.19	8.90	0.29	3.26
4	88DEC	26.9	6.20	6.20	0.00	0.00	4.38	4.38	0.00	0.00
	89JUN		6.80	6.60	0.20	3.03	5.83	5.33	0.50	9.38
	90MAR		8.00	7.90	0.10	1.27	7.81	6.90	0.91	13.19
	90AUG		8.30	8.20	0.10	1.22	8.10	7.27	0.83	11.42
	91JUL		9.60	9.60	0.00	0.00	9.70	8.82	0.88	9.98
5	88DEC	23.7	5.70	5.70	0.00	0.00	3.77	3.77	0.00	0.00
	89JUN		6.20	6.00	0.20	3.33	4.82	4.70	0.12	2.55
	90MAR		7.20	7.20	0.00	0.00	6.38	6.24	0.14	2.24
	90AUG		7.50	7.40	0.10	1.35	6.55	6.60	-0.05	-0.76
	91JUL		8.40	8.60	-0.20	-2.33	7.81	8.12	-0.31	-3.82
6	88DEC	28.2	6.70	6.70	0.00	0.00	5.75	5.75	0.00	0.00
	89JUN		7.20	7.10	0.10	1.41	7.03	6.82	0.21	3.08
	90MAR		8.40	8.50	-0.10	-1.18	9.19	8.54	0.65	7.61
	90AUG		8.90	8.80	0.10	1.14	9.39	8.96	0.43	4.80
	91JUL		10.00	10.30	-0.30	-2.91	11.00	10.70	0.30	2.80
7	88DEC	27.9	6.40	6.40	0.00	0.00	5.04	5.04	0.00	0.00
	89JUN		7.10	6.80	0.30	4.41	6.59	6.06	0.53	8.75
	90MAR		8.30	8.20	0.10	1.22	8.68	7.72	0.96	12.44
	90AUG		8.70	8.50	0.20	2.35	8.88	8.10	0.78	9.63
	91JUL		9.90	9.90	0.00	0.00	10.56	9.69	0.87	8.98
8	88DEC	26.6	6.40	6.40	0.00	0.00	4.38	4.38	0.00	0.00
	89JUN		7.00	6.80	0.20	2.94	5.59	5.33	0.26	4.88
	90MAR		8.10	8.10	0.00	0.00	7.35	6.90	0.45	6.52
	90AUG		8.40	8.40	0.00	0.00	7.44	7.26	0.18	2.48
	91JUL		9.50	9.80	-0.30	-3.06	8.78	8.78	0.00	0.00
9	88DEC	26.3	6.10	6.10	0.00	0.00	3.77	3.77	0.00	0.00
	89JUN		6.70	6.50	0.20	3.08	4.89	4.69	0.20	4.26
	90MAR		7.70	7.70	0.00	0.00	6.55	6.21	0.34	5.48
	90AUG		8.20	8.00	0.20	2.50	6.72	6.55	0.17	2.60
	91JUL		9.40	9.40	0.00	0.00	8.10	7.99	0.11	1.38

APPENDIX IX

POUTO

10	88DEC	27.7	6.50	6.50	0.00	0.00	4.24	4.24	0.00	0.00
	89JUN		7.10	6.90	0.20	2.90	5.35	5.17	0.18	3.48
	90MAR		8.20	8.30	-0.10	-1.20	7.17	6.72	0.45	6.70
	90AUG		8.60	8.60	0.00	0.00	7.35	7.08	0.27	3.81
	91JUL		9.80	10.00	-0.20	-2.00	8.78	8.61	0.17	1.97
11	88DEC	27.4	6.50	6.50	0.00	0.00	4.04	4.04	0.00	0.00
	89JUN		7.10	6.90	0.20	2.90	5.20	4.95	0.25	5.05
	90MAR		8.20	8.20	0.00	0.00	6.90	6.47	0.43	6.65
	90AUG		8.60	8.50	0.10	1.18	7.08	6.82	0.26	3.81
	91JUL		9.70	10.00	-0.30	-3.00	8.49	8.32	0.17	2.04

APPENDIX X

REREWHAKAAITU

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								medium		
1	89 AUG	27.3	5.30	5.30	0.00	0.00	2.66	2.66	0.00	0.00
	90 JUN		6.80	6.40	0.40	6.25	4.92	4.64	0.28	6.03
	90 DEC		7.80	7.40	0.40	5.41	5.55	5.52	0.03	0.54
	91 JUN		8.40	7.70	0.70	9.09	6.64	6.71	-0.07	-1.04
2	89 AUG	27.5	5.50	5.50	0.00	0.00	2.66	2.66	0.00	0.00
	90 JUN		7.00	6.60	0.40	6.06	4.72	4.57	0.15	3.28
	90 DEC		7.90	7.60	0.30	3.95	5.41	5.42	-0.01	-0.18
	91 JUN		8.50	8.00	0.50	6.25	6.49	6.62	-0.13	-1.96
3	89 AUG	26.3	4.90	4.90	0.00	0.00	2.23	2.23	0.00	0.00
	90 JUN		6.60	6.00	0.60	10.00	4.46	4.14	0.32	7.73
	90 DEC		7.50	6.80	0.70	10.29	5.14	5.03	0.11	2.19
	91 JUN		8.00	7.20	0.80	11.11	6.26	6.25	0.01	0.16
4	89 AUG	27.1	5.30	5.30	0.00	0.00	2.86	2.86	0.00	0.00
	90 JUN		6.90	6.40	0.50	7.81	5.26	4.83	0.43	8.90
	90 DEC		7.70	7.30	0.40	5.48	5.76	5.69	0.07	1.23
	91 JUN		8.30	7.70	0.60	7.79	6.95	6.93	0.02	0.29
5	89 AUG	28.7	5.70	5.70	0.00	0.00	2.91	2.91	0.00	0.00
	90 JUN		7.30	6.90	0.40	5.80	5.40	4.90	0.50	10.20
	90 DEC		8.30	7.90	0.40	5.06	6.34	5.76	0.58	10.07
	91 JUN		8.90	8.30	0.60	7.23	7.66	6.96	0.70	10.06
6	89 AUG	28.9	6.10	6.10	0.00	0.00	3.45	3.45	0.00	0.00
	90 JUN		7.60	7.30	0.30	4.11	5.83	5.50	0.33	6.00
	90 DEC		8.40	8.30	0.10	1.20	6.56	6.36	0.20	3.14
	91 JUN		9.00	8.70	0.30	3.45	7.66	7.62	0.04	0.52
7	89 AUG	27.8	5.70	5.70	0.00	0.00	3.06	3.06	0.00	0.00
	90 JUN		7.30	6.90	0.40	5.80	5.54	5.05	0.49	9.70
	90 DEC		8.10	7.80	0.30	3.85	6.12	5.91	0.21	3.55
	91 JUN		8.60	8.20	0.40	4.88	7.34	7.12	0.22	3.09
8	89 AUG	27.1	5.40	5.40	0.00	0.00	2.46	2.46	0.00	0.00
	90 JUN		7.00	6.50	0.50	7.69	4.59	4.31	0.28	6.50
	90 DEC		7.80	7.40	0.40	5.41	5.07	5.14	-0.07	-1.36
	91 JUN		8.30	7.80	0.50	6.41	6.19	6.30	-0.11	-1.75
9	89 AUG	27.1	5.20	5.20	0.00	0.00	2.19	2.19	0.00	0.00
	90 JUN		7.00	6.30	0.70	11.11	4.40	4.02	0.38	9.45
	90 DEC		7.70	7.20	0.50	6.94	4.81	4.86	-0.05	-1.03
	91 JUN		8.30	7.60	0.70	9.21	5.90	6.03	-0.13	-2.16
10	89 AUG	28.2	5.70	5.70	0.00	0.00	2.66	2.66	0.00	0.00
	90 JUN		7.40	6.90	0.50	7.25	4.85	4.58	0.27	5.90
	90 DEC		8.00	7.90	0.10	1.27	5.27	5.43	-0.16	-2.95
	91 JUN		8.70	8.20	0.50	6.10	6.41	6.62	-0.21	-3.17
11	89 AUG	27.5	5.30	5.30	0.00	0.00	2.10	2.10	0.00	0.00
	90 JUN		7.30	6.40	0.90	14.06	3.97	3.83	0.14	3.66
	90 DEC		7.90	7.40	0.50	6.76	4.25	4.64	-0.39	-8.41
	91 JUN		8.50	7.80	0.70	8.97	5.21	5.76	-0.55	-9.55

APPENDIX XI

TAHORAKURI

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								medium		
1	89MAR	30.2	6.40	6.40	0.00	0.00	3.69	3.69	0.00	0.00
	89AUG		6.60	6.70	-0.10	-1.49	4.11	4.22	-0.11	-2.61
	90JUL		8.00	8.00	0.00	0.00	6.41	6.29	0.12	1.91
	91JUL		9.60	9.50	0.10	1.05	8.83	8.83	0.00	0.00
2	89MAR	30.2	6.30	6.30	0.00	0.00	3.47	3.47	0.00	0.00
	89AUG		6.50	6.60	-0.10	-1.52	3.75	3.99	-0.24	-6.02
	90JUL		8.00	7.90	0.10	1.27	5.97	6.06	-0.09	-1.49
	91JUL		9.60	9.40	0.20	2.13	8.16	8.59	-0.43	-5.01
3	89MAR	30.2	6.30	6.30	0.00	0.00	3.64	3.64	0.00	0.00
	89AUG		6.50	6.60	-0.10	-1.52	3.93	4.16	-0.23	-5.53
	90JUL		8.10	7.90	0.20	2.53	6.26	6.22	0.04	0.64
	91JUL		9.60	9.40	0.20	2.13	8.59	8.74	-0.15	-1.72
4	89MAR	30	6.30	6.30	0.00	0.00	3.75	3.75	0.00	0.00
	89AUG		6.50	6.60	-0.10	-1.52	4.11	4.28	-0.17	-3.97
	90JUL		8.20	7.90	0.30	3.80	6.48	6.36	0.12	1.89
	91JUL		9.50	9.40	0.10	1.06	9.03	8.85	0.18	2.03
5	89MAR	30	6.30	6.30	0.00	0.00	2.73	2.73	0.00	0.00
	89AUG		6.50	6.60	-0.10	-1.52	3.03	3.22	-0.19	-5.90
	90JUL		7.90	7.90	0.00	0.00	4.29	5.23	-0.94	-17.97
	91JUL		9.50	9.40	0.10	1.06	5.75	7.66	-1.91	-24.93
6	89MAR	30.7	6.60	6.60	0.00	0.00	4.05	4.05	0.00	0.00
	89AUG		6.80	6.90	-0.10	-1.45	4.36	4.59	-0.23	-5.01
	90JUL		8.40	8.30	0.10	1.20	6.71	6.71	0.00	0.00
	91JUL		9.80	9.80	0.00	0.00	9.12	9.25	-0.13	-1.41
7	89MAR	30.4	6.30	6.30	0.00	0.00	3.35	3.35	0.00	0.00
	89AUG		6.50	6.60	-0.10	-1.52	3.64	3.86	-0.22	-5.70
	90JUL		8.00	7.90	0.10	1.27	6.11	5.91	0.20	3.38
	91JUL		9.70	9.40	0.30	3.19	8.42	8.37	0.05	0.60
8	89MAR	30.7	6.50	6.50	0.00	0.00	3.25	3.25	0.00	0.00
	89AUG		6.80	6.80	0.00	0.00	3.58	3.74	-0.16	-4.28
	90JUL		8.30	8.20	0.10	1.22	5.75	5.70	0.05	0.88
	91JUL		9.80	9.70	0.10	1.03	7.99	8.13	-0.14	-1.72
9	89MAR	30.7	6.40	6.40	0.00	0.00	3.58	3.58	0.00	0.00
	89AUG		6.60	6.70	-0.10	-1.49	3.87	4.09	-0.22	-5.38
	90JUL		8.30	8.10	0.20	2.47	5.97	6.11	-0.14	-2.29
	91JUL		9.80	9.60	0.20	2.08	8.16	8.54	-0.38	-4.45
10	89MAR	30.7	6.40	6.40	0.00	0.00	2.93	2.93	0.00	0.00
	89AUG		6.70	6.70	0.00	0.00	3.25	3.42	-0.17	-4.97
	90JUL		8.20	8.10	0.10	1.23	5.20	5.38	-0.18	-3.35
	91JUL		9.80	9.60	0.20	2.08	7.26	7.78	-0.52	-6.68
11	89MAR	31.3	6.60	6.60	0.00	0.00	2.93	2.93	0.00	0.00
	89AUG		6.90	6.90	0.00	0.00	3.19	3.41	-0.22	-6.45
	90JUL		8.40	8.30	0.10	1.20	5.13	5.36	-0.23	-4.29
	91JUL		10.10	9.90	0.20	2.02	7.10	7.68	-0.58	-7.55

TRT	DATE	SI	A.HT	P.HT	DIFF	% P	A.BA	P.BA	DIFF	% P
								medium		
1	89JUN	30.2	6.60	6.60	0.00	0.00	4.00	4.00	0.00	0.00
	90JUL		8.30	8.00	0.30	3.75	6.01	6.27	-0.26	-4.15
	91FEB		9.50	9.20	0.30	3.26	6.28	6.50	-0.22	-3.38
	91AUG		9.90	9.70	0.20	2.06	6.78	7.23	-0.45	-6.22
2	89JUN	28.9	6.30	6.30	0.00	0.00	3.57	3.57	0.00	0.00
	90JUL		7.90	7.70	0.20	2.60	5.36	5.80	-0.44	-7.59
	91FEB		9.20	8.80	0.40	4.55	5.67	6.11	-0.44	-7.20
	91AUG		9.40	9.20	0.20	2.17	6.03	6.82	-0.79	-11.58
3	89JUN	29.1	6.50	6.50	0.00	0.00	3.84	3.84	0.00	0.00
	90JUL		8.00	7.90	0.10	1.27	5.68	6.10	-0.42	-6.89
	91FEB		9.20	9.00	0.20	2.22	6.03	6.37	-0.34	-5.34
	91AUG		9.50	9.50	0.00	0.00	6.40	7.11	-0.71	-9.99
4	89JUN	29.1	6.40	6.40	0.00	0.00	3.78	3.78	0.00	0.00
	90JUL		7.90	7.80	0.10	1.28	5.95	6.06	-0.11	-1.82
	91FEB		9.20	8.90	0.30	3.37	6.34	6.35	-0.01	-0.16
	91AUG		9.50	9.40	0.10	1.06	6.72	7.11	-0.39	-5.49
5	89JUN	29.1	6.40	6.40	0.00	0.00	3.47	3.47	0.00	0.00
	90JUL		7.90	7.80	0.10	1.28	4.99	5.67	-0.68	-11.99
	91FEB		9.20	8.90	0.30	3.37	5.21	5.99	-0.78	-13.02
	91AUG		9.50	9.40	0.10	1.06	5.50	6.70	-1.20	-17.91
6	89JUN	30.7	6.90	6.90	0.00	0.00	3.95	3.95	0.00	0.00
	90JUL		8.40	8.40	0.00	0.00	5.81	6.21	-0.40	-6.44
	91FEB		9.70	9.60	0.10	1.04	6.22	6.46	-0.24	-3.72
	91AUG		10.10	10.10	0.00	0.00	6.66	7.19	-0.53	-7.37
7	89JUN	30	6.60	6.60	0.00	0.00	3.89	3.89	0.00	0.00
	90JUL		8.20	8.00	0.20	2.50	5.81	6.13	-0.32	-5.22
	91FEB		9.50	9.20	0.30	3.26	6.22	6.38	-0.16	-2.51
	91AUG		9.80	9.70	0.10	1.03	6.78	7.11	-0.33	-4.64
8	89JUN	30.4	6.70	6.70	0.00	0.00	3.78	3.78	0.00	0.00
	90JUL		8.40	8.20	0.20	2.44	5.42	5.99	-0.57	-9.52
	91FEB		9.70	9.30	0.40	4.30	5.85	6.26	-0.41	-6.55
	91AUG		10.00	9.80	0.20	2.04	6.22	6.97	-0.75	-10.76
9	89JUN	30.2	6.50	6.50	0.00	0.00	3.57	3.57	0.00	0.00
	90JUL		8.20	7.90	0.30	3.80	5.62	5.80	-0.18	-3.10
	91FEB		9.60	9.10	0.50	5.49	5.97	6.11	-0.14	-2.29
	91AUG		9.90	9.60	0.30	3.13	6.40	6.82	-0.42	-6.16
10	89JUN	30	6.60	6.60	0.00	0.00	3.42	3.42	0.00	0.00
	90JUL		8.20	8.00	0.20	2.50	5.11	5.57	-0.46	-8.26
	91FEB		9.50	9.20	0.30	3.26	5.44	5.89	-0.45	-7.64
	91AUG		9.80	9.70	0.10	1.03	5.79	6.60	-0.81	-12.27
11	89JUN	30.7	6.90	6.90	0.00	0.00	2.93	2.93	0.00	0.00
	90JUL		8.40	8.40	0.00	0.00	4.51	4.92	-0.41	-8.33
	91FEB		9.80	9.60	0.20	2.08	4.83	5.29	-0.46	-8.70
	91AUG		10.10	10.10	0.00	0.00	5.16	5.97	-0.81	-13.57