

Rationalisation of volume and taper functions

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Plantation Management Cooperative

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EXECUTIVE SUMMARY

RATIONALISATION OF VOLUME AND TAPER FUNCTIONS

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THE PROBLEM

FORECASTER allows users to select from a number of different volume and taper functions. Currently the list is long and includes some unnecessary functions. This contributes to the difficulty experienced by some users when compiling the necessary inputs to run the simulation.

COOP INITIATIVES

Other Coop sponsored research aiming to promote FORECASTER use and improve FORECASTER functionality include the development of a simple look-up table of default start values and the provision of a broader range of parameters for sweep and forking functions.

THIS PROJECT

A survey was carried out to identify redundant volume and taper equations in the growth modelling software FORECASTER.

RESULTS

Forty percent of the volume and twenty percent of the taper functions were identified as redundant and are to be removed or hidden in the function lists. This results in an updated list of 66 volume and 33 taper equations. Volume and taper equations 182 and 237 are the most widely used in radiata forests. The 3D equation is not being widely used. Some information on the location of forests that respondents apply equations to is provided in the updated lists.

IMPLICATIONS FOR THE COOP

Improving the functionality of FORECASTER will contribute to its wider use and further development.

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INTRODUCTION

FORECASTER allows users to select from a number of different volume and taper functions. Currently the list is long and includes some unnecessary functions, over 70 percent of the volume functions were created before 1980. Ideally this could be replaced by the exclusive use of the new 3-D functions (Gordon and Budianto, 1999). However for Coop members who do not want to use the 3-D taper and volume functions, and for the non-Coop members who do not have access to this model (due to IP restriction on the publication of the relevant scientific paper), a rationalisation of the volume and taper table was needed to improve the functionality of FORECASTER.

METHOD

A simple survey (see Appendix 1) of current FORECASTER and STANDPAK users and Plantation Management Co-op members was designed to determine which of the public domain:

- Volume and taper functions are now redundant.
- Functions are used in different forests.

A better understanding of the current usage of volume and taper equations will allow for a revised list of ‘appropriate’ selections in FORECASTER for growth modelling.

RESULTS

Of the 60 FORECASTER and STANDPAK users and Plantation Management Coop members surveyed,

- 24 responded
- 19 provided information on the volume and taper functions used
- 5 indicated they did not use FORECASTER
- 14 provided information on the forests the functions were applied to
- 5 have developed private functions.

The most commonly used volume functions were 182 and 237 for radiata pine, and 136 for Douglas-fir. Several respondents indicated they used 182 for most young pruned and thinned stands, regardless of location or region. In general the most recently created functions available for radiata and Douglas-fir were preferred, especially if applicable nationally. Forty percent of the volume functions and 20 percent of the taper functions have been identified as redundant and will be removed or hidden from the equation lists in FORECASTER (see Table 1). The number of private functions developed by respondents is also demonstrated. Appendix 1 shows the updated lists to be used in FORECASTER and some of the forests to which they are applied.

Table 1: Volume and Taper functions identified as redundant and number of private functions currently used with FORECASTER

Function	P. radiata and D. fir			All species		
	Original	Surveyed	% Removed	Original	Surveyed	% Removed
Volume	46	36	22	109	66	40
Taper	26	23	8	42	33	21
Private	-	19	-	-	24	-

Figure 1 shows the majority of redundant volume functions to be for minor species; 22 percent of radiata and Douglas functions were not in use whereas 52 percent of alternative species volume functions were not used by respondents. However, interest in alternative species made it necessary to retain at least one equation for each species, even if not currently being used. The most recently created/nationally applicable function of any alternative species that was not used at the time of the survey was retained.

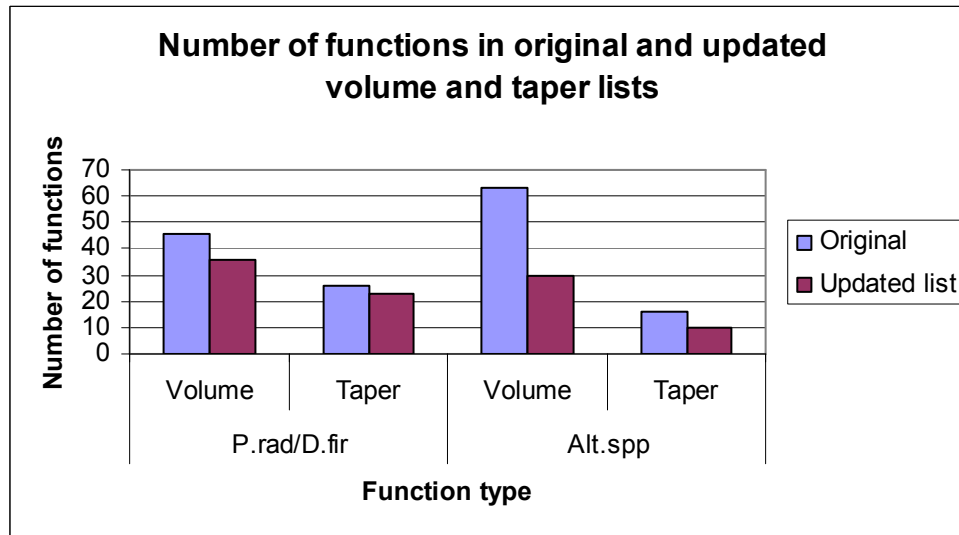


Figure 1: Functions removed from list by major and minor species

Figure 2 illustrates the composition of updated volume and taper function lists where;

- 26% of retained functions are for alternative species not used at time of survey
- 19% of retained functions used by one respondent at time of survey
- 55% of retained functions used by majority of respondents.

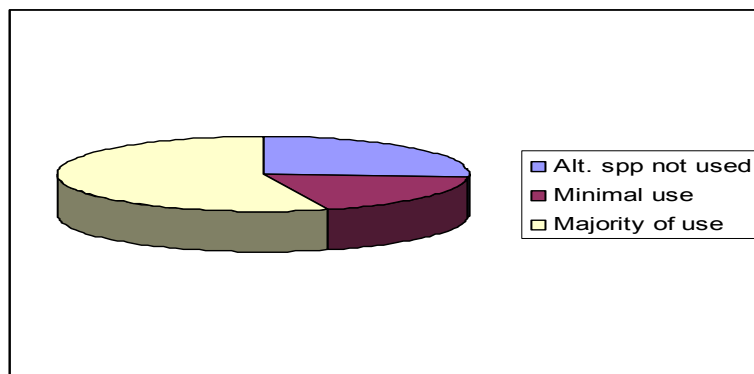


Figure 2: Composition of updated Volume and Function tables.

The three-point stem volume and taper equation for radiata pine is not part of public domain and was not included in the survey list. However, respondents indicated the 3D function was either not needed, or too little was known about it to confidently apply it to modelling scenarios. A common misconception was that the additional upper-stem diameter had to be measured to use the 3D function, when in fact it can be predicted from stand-level information within FORECASTER.

CONCLUSIONS

This survey has identified redundant functions and has allowed for a more ‘appropriate’ list of volume and taper functions in FORECASTER. Detail on the forests some equations are used in by respondents will provide additional support to decision making. However there is a lack of reasons or comparative studies for user choice other than the function description and inherent/historical knowledge, which some users may not have. The 3D function is not being widely used. Some respondents are still using functions from 1952 in their forests, while others base their choice of volume and taper equations on ‘what seems about right.’

FUTURE SCOPE

In addition to the revised list it is suggested a user-defined method of further refining the function list available be introduced to FORECASTER. The functions could be screened by frequency of use, region, and species to provide a list more relative to the users needs and could be especially useful to those working in unfamiliar regions. Extolling the benefits of the 3D equation to users could further improve FORECASTER functionality. Furthermore, a sensitivity analysis to identify which models are practically identical and which are substantially unusual could provide further support for volume/taper function selection.

APPENDIX 1: VOLUME AND TAPER FUNCTION SURVEY

Please refer to the list of volume and taper equations provided, and their corresponding numbers on the following pages.

- 1. Do you use the public domain volume and taper equations?

If yes, please list the equations used and the forest in which they are used in the tables provided, save the document and send it to paul.silcock@ensisjv.com

If no, please reply to paul.silcock@ensisjv.com with “no” in the subject heading.

- 2. Do you use privately developed volume and taper equations?

If so and willing, please provide details in the tables provided.

Table 1: Volume equation(s) used.

Volume equation number	Forest

Table 2: Taper equation(s) used.

Taper equation number	Forest

VOLUME EQUATIONS

Number	Species	District	Creation Date	Forest
5	ALLSP	ALL NZ	0	SECTIONAL M.
9	P.RAD	AK	1952	MARMPUHITIRU
10	P.RAD	RO	1953	KANGWAKAROEU
11	P.RAD	NN	1952	GDNSWIRU
12	P.RAD	CY	1952	ALL CY
13	P.RAD	SD	1952	ALL SD
14	P.RAD	ALL NZ SHELTBELT	1977	ALL NZ
16	P.LCO	RO	1952	KANGWAKA
17	P.LCO	SD	1954	SD
18	P.PON	ALL NZ NOT SD	1956	KANGWAKA
20	P.CNG	ALL NZ	1954	ALL NZ
21	L.DEC	ALL NZ	1956	RO WN NNCYSD
22	P.MCA	ALL NZ	1958	ROAKWNNNCYWD
23	CHLAW	ALL NZ	1958	ALL NZ
24	P.STB	ALL NZ	1953	RO
25	P.ELL	ALL NZ	1953	AK RO
26	P.PAL	ALL NZ	1958	AK RO
27	P.PTA	ALL NZ	1954	AK RO
28	P.PIN	ALL NZ	1954	WIPO
29	P.TAE	ALL NZ	1953	AK RO
31	SQSEM	ALL NZ	1959	AK RO
32	P.ECH	ALL NZ	1960	AK
34	EUFAS	TARANAKI	1959	OAKURA
35	P.SCP	ALL NZ	1960	RO CY SD
36	P.AUS	ALL NZ	1960	RO CY SDWNNN
37	THPLI	ALL NZ	1961	AK RO WNNNSD
38	EU	ALL NZ	1961	ALL NZ
39	P.RAD	KROI	1961	KROI
40	CUMAC	ALL NZ	1961	ALL NZ
41	PISIT	ALL NZ	1961	WD SD
42	PIABI	ALL NZ	1961	RO CY SD
43	DCCUP	WD POLE STANDS	1978	WD
44	HDWDS	AK INDIG HARDWDS	1978	AK
45	CRJAP	ALL NZ	1964	AK RO WNNNSD
63	P.RAD	WAKA	1968	WAKA
65	P.RAD	HOKO	1969	HOKO
73	P.RAD	MARMWOODPUHIATHN	1975	GROUP 1 AK
74	P.RAD	COFP WIPO	1969	GROUP 2 AK
75	P.RAD	GLNB WHAP	1969	GROUP 3 AK
76	P.RAD	AUPO	1969	GROUP 4 AK
77	P.RAD	OMHU RVHD	1969	GROUP 5 AK
78	P.RAD	BALM	1969	BALM
87	P.RAD	WD	1969	WMWDNEMOGRAN
89	P.RAD	BALM	1969	BALM
92	FREXC	ALL NZ	1962	
93	QU	ALL NZ	1962	
94		OTHER BROADLVS.	1962	

95		OTHER CONIFERS	1962	SD P.LCO
97	P.LCO	ALL AK	1962	SD
99	P.LCO	ALL WN	1962	KANG WAKA
101	P.LCO	HANM LOW ALT.	1971	HANM
103	P.PON	WTAP	1972	WTAP
107	P.LCO	OMIH	1970	OMIH
109	P.RAD	ASHY	1971	ASHY
113	PO	ALL NZ	1972	RO WN
114	P.PON	KANG	1975	KANG
115	P.RAD	KANG YOUNG CROP	1975	KANG
116	P.RAD	KANG OLD CROP	1975	KANG
117	P.PON	KANG	1975	KANG
118	P.RAD	KANG YOUNG CROP	1975	KANG
119	P.RAD	KANG OLD CROP	1975	KANG
120	PSMEN	ASHY	1973	ASHY
121	P.LCO	HANM HIGH ALT.	1975	HANM
125	AGAUS	ALL NZ	1978	AK RO
126	P.RAD	OTCO	1974	OTCO
128	P.RAD	ESK	1976	ESK
129	NO	ALL NZ	1978	WN NNWSD
130	AGAUS	ALL NZ POLE STDS	1978	AK
131	DCCUP	ALL NZ MATURE	1978	RO SDNNWD
132	BSTAW	ALL NZ MATURE	1978	RO
133	NO	WD POLE STANDS	1978	WD
134	P.RAD	GWAV	1976	GWAV
136	PSMEN	ALL NZ	1977	ALL NZ
138	DCCUP	WD	1978	WD
139	PLCO	ALL NZ	1977	ALL NZ
141	PLCO	KROI HIGH ALT.	1980	KROI
145	L.DEC	HANM	1979	HANM
149	P.RAD	WTRE	1980	WTRE
152	L.KAE	GDNS	1980	GDNS
163	P.RAD	NGAU	1984	NGAU
165	P.RAD	TIRU	1981	TIRU
167	P.RAD	LTAU 1000 THIN.	1982	L.TAUPO
169	P.RAD	MOHA	1981	MOHA
182	P.RAD	ALL NZ D.SAW LOG	1980	AKROWNNSD
183	P.RAD	WOOD O/C	1982	WOODHILL
188	P.RAD	WUKU	1983	WAIUKU
190	P.LCO	TIRU	1983	TAIRUA
196	P.RAD	ROEU	1983	ROTOEHU
205	P.RAD	WOOD O/C 2 THIN	1983	WOODHILL
206	P.RAD	MARM 2 CROP	1984	MARAMARUA
212	P.RAD	SANTOFT	1984	SANTOFT
214	P.RAD	MGAT 250-320 sph	1984	MANGATU
218	P.RAD	MGAT 450 sph	1985	Mangatu
224	P.RAD	LISM ages 7-22	1985	Lismore
226	P.LCO	LONG ages 23,24	1985	Woodlaw Blk
227	P.RAD	POMA 500sph ag30	1986	Pukerau Blk.
228	PSMEN	LONG age 33-37	1986	Longwood

230	P.RAD	GDNS ages 26-30	1986	Long Gully
231	P.RAD	TEWR ages 9-31	1986	Te Wera
232	P.RAD	LONG ages 14-24	1986	Woodlaw Blk
235	P.RAD	LONG age30sph370	1986	LONG Cpt29
236	P.RAD	WOOD 370sph	1986	WOOD Cpt67,6
237	P.RAD	KANG Trans. crop	1987	KANG
275	PSMEN	CA	1990	Canterbury
276	EUFAS	C.N.I.	1992	C.N.I.
280	CUSPP	NZ cumac/culus	1992	Various
306	JUNIG	N.Z. Aus.	1993	Various
362	P.RAD	Tasmania	1989	Tasmania
394	POP	Poplar mix	1998	All NZ

TAPER EQUATIONS

Number	Species	District	Creation Date	Forest
5	ALLSP	ALL NZ	0	SECTIONAL M.
21	L.DEC	ALL NZ	1956	RO WNNNCYSD
114	P.PON	KANG	1975	KANG
115	P.RAD	KANG YOUNG CROP	1975	KANG
116	P.RAD	KANG OLD CROP	1975	KANG
128	P.RAD	ESK	1976	ESK
136	PSMEN	ALL NZ	1977	ALL NZ
139	P.LCO	ALL NZ	1977	ALL NZ
145	L.DEC	HANM	1979	HANM
149	P.RAD	WTRE	1980	WTRE
163	P.RAD	NGAU	1984	NGAU
165	P.RAD	TIRU	1983	TAIRUA
167	P.RAD	LTAU 1000 THIN	1982	L.TAUPO
169	P.RAD	MOHA	1981	MOHAKA
182	P.RAD	ALL NZ D.SAW LOG	1980	AKROWNNSD
183	P.RAD	WOOD	1982	WOODHILL
188	P.RAD	WUKU	1983	WAIUKU
190	P.LCO	TIRU	1983	TAIRUA
196	P.RAD	ROEU	1983	ROTOEHU
205	P.RAD	WOOD O/C 2 THIN	1983	WOODHILL
206	P.RAD	MARM 2 CROP	1984	MARAMARUA
212	P.RAD	SANTOFT	1984	SANTOFT
214	P.RAD	MGAT 250-320 sph	1984	MANGATU
218	P.RAD	MGAT 450 sph	1985	Mangatu
224	P.RAD	LISM ages 7-22	1985	Lismore
226	P.LCO	LONG ages 23,24	1985	Woodlaw Blk
227	P.RAD	POMA 500sph ag30	1986	Pukerau Blk.
228	PSMEN	LONG age 33-37	1986	Longwood
230	P.RAD	GDNS ages 26-30	1986	Long Gully
231	P.RAD	TEWR ages 9-31	1986	Te Wera
232	P.RAD	LONG ages 14-24	1986	Woodlaw Blk
235	P.RAD	LONG age30sph370	1986	LONG Cpt29
236	P.RAD	WOOD 370sph	1986	WOOD Cpt67,6
237	P.RAD	KANG Trans. crop	1987	KANG
258	AAMEL	All NZ	1992	Hunua Whaka
273	PSMEN	ALL NZ	1977	ALL NZ F136
274	PSMEN	ALL NZ	1977	ALL NZ F136
275	PSMEN	ALL NZ	1977	ALL NZ F136
276	EUFAS	C.N.I.	1992	C.N.I.
280	CUSPP	NZ cumac/culus	1992	Various
362	P.RAD	Tasmania	1989	Tasmania
394	POP	Poplar Mix	1998	ALL NZ

APPENDIX 2: UPDATED FORECASTER VOLUME AND TAPER EQUATION LISTS

Volume Equations

Number	Species	District	Created	Forest	Response	Region used
9	P.RAD	AK	1952	MARMPUHITIRU	1	Auckland clays
12	P.RAD	CY	1952	ALL CY	1	Canterbury
13	P.RAD	SD	1952	ALL SD	1	Otago/Sthland
29	P.TAE	ALL NZ	1953	AK RO		
28	P.PIN	ALL NZ	1954	WIPO	1	
23	P.CNG	ALL NZ	1958	ALL NZ		
31	SQSEM	ALL NZ	1959	AK RO		
34	EUFAS	TARANAKI	1959	OAKURA		
32	P.ECH	ALL NZ	1960	AK		
35	P.SCP	ALL NZ	1960	RO CY SD		
36	P.AUS	ALL NZ	1960	RO CY SDWNNN		
37	THPLI	ALL NZ	1961	AK RO WNNNSD		
38	EU	ALL NZ	1961	ALL NZ	2	H.Bay
40	CUMAC	ALL NZ	1961	ALL NZ	1	
41	PISIT	ALL NZ	1961	WD SD		
42	PIABI	ALL NZ	1961	RO CY SD		
92	FREXC	ALL NZ	1962			
93	QU	ALL NZ	1962			
94		OTHER BROADLVS.	1962			
95		OTHER CONIFERS	1962	SD P.LCO		
99	P.LCO	ALL WN	1962	KANG WAKA	1	H.Bay
45	CRJAP	ALL NZ	1964	AK RO WNNNSD		
63	P.RAD	WAKA	1968	WAKA	1	
113	PO	ALL NZ	1972	RO WN		
120	PSMEN	ASHY	1973	ASHY	1	
126	P.RAD	OTCO	1974	OTCO	3	
115	P.RAD	KANG YOUNG CROP	1975	KANG	2	
116	P.RAD	KANG OLD CROP	1975	KANG	1	
117	P.PON	KANG	1975	KANG	1	
118	P.RAD	KANG YOUNG CROP	1975	KANG	7	BOP, Tokoroa, Caxton, Kinleith, King Country
119	P.RAD	KANG OLD CROP	1975	KANG	1	

128	P.RAD	ESK	1976	ESK	4	H.Bay
14	P.RAD	ALL NZ SHELTBELT	1977	ALL NZ	1	
136	PSMEN	ALL NZ	1977	ALL NZ	15	H.Bay, Cant, Hills, Plains (also for MXEXO and SQSEM)
139	PLCO	ALL NZ	1977	ALL NZ	5	Nth Waikato, Sands, Hills, Plains (also for P.NIG)
44	HDWDS	AK INDIG HARDWDS	1978	AK		
125	AGAUS	ALL NZ	1978	AK RO		
129	NO	ALL NZ	1978	WN NNWDSD		
131	DCCUP	ALL NZ MATURE	1978	RO SDNNWD		
132	BSTAW	ALL NZ MATURE	1978	RO		
133	NO	WD POLE STANDS	1978	WD		
145	L.DEC	HANM	1979	HANM		
149	P.RAD	WTRE	1980	WTRE	2	Tainuia, Kawhia
152	L.KAE	GDNS	1980	GDNS		
182	P.RAD	ALL NZ D.SAW LOG	1980	AKROWNNNSD	16	Sth, Nth, QC, Mapua, Nelson, Moutere, Granites, East Hills
165	P.RAD	TIRU	1981	TIRU	4	Auckland clays
169	P.RAD	MOHA	1981	MOHA	5	Gisborne
196	P.RAD	ROEU	1983	ROTOEHU	3	
205	P.RAD	WOOD O/C 2 THIN	1983	WOODHILL	2	
163	P.RAD	NGAU	1984	NGAU	7	Sthn Nth Isl, Wairarapa, Manawatu, Wanganui, Taranaki
206	P.RAD	MARM 2 CROP	1984	MARAMARUA	2	
212	P.RAD	SANTOFT	1984	SANTOFT	3	
214	P.RAD	MGAT 250-320 sph	1984	MANGATU	4	
218	P.RAD	MGAT 450 sph	1985	Mangatu	3	Gisborne, E.cape
224	P.RAD	LISM ages 7-22	1985	Lismore	6	SNI, Wgtn,
228	PSMEN	LONG age 33-37	1986	Longwood	1	
230	P.RAD	GDNS ages 26-30	1986	Long Gully	2	
231	P.RAD	TEWR ages 9-31	1986	Te Wera	2	
235	P.RAD	LONG age30sph370	1986	LONG Cpt29	2	
236	P.RAD	WOOD 370sph	1986	WOOD Cpt67,6	2	
237	P.RAD	KANG Trans. crop	1987	KANG	13	CNI, Kinleith, King Country, TAHO, Nth Waikato, Sands, Warkworth, Hills, Plains
362	P.RAD	Tasmania	1989	Tasmania	3	Tas
276	EUFAS	C.N.I.	1992	C.N.I.	5	MTHA
280	CUSPP	NZ cumac/culus	1992	Various	4	
306	JUNIG	N.Z. Aus.	1993	Various	1	
394	POP	Poplar mix	1998	All NZ	2	

Taper Equations

Number	Species	District	Created	Forest	Response	Region used
114	P.PON	KANG	1975	KANG	1	
115	P.RAD	KANG YOUNG CROP	1975	KANG	8	BOP, Tokoroa, Caxton, Kinleith, King country
116	P.RAD	KANG OLD CROP	1975	KANG	1	
128	P.RAD	ESK	1976	ESK	4	H.Bay
136	PSMEN	ALL NZ	1977	ALL NZ	15	H.Bay, Far Nth, Cant, Hills, Plains
139	P.LCO	ALL NZ	1977	ALL NZ	6	Used for P.NIG in Nth Waikato, Sands, Hills, Plains. (Also used for P.PIN)
145	L.DEC	HANM	1979	HANM		
149	P.RAD	WTRE	1980	WTRE	2	Tainuia, Kawhia
163	P.RAD	NGAU	1984	NGAU	7	Sthn Nth Island, Wairarapa, Manawatu, Taranaki
165	P.RAD	TIRU	1983	TAIRUA	4	Auckland clays
169	P.RAD	MOHA	1981	MOHAKA	5	Gisborne
182	P.RAD	ALL NZ D.SAW LOG	1980	AKROWNNNSD	16	Sth, Nth, QC, Mapua, Nelson, Moutere, Granites, East Hills
183	P.RAD	WOOD	1982	WOODHILL	3	Nth Sands
196	P.RAD	ROEU	1983	ROTOEHU	3	
205	P.RAD	WOOD O/C 2 THIN	1983	WOODHILL	2	
206	P.RAD	MARM 2 CROP	1984	MARAMARUA	2	
212	P.RAD	SANTOFT	1984	SANTOFT	3	
214	P.RAD	MGAT 250-320 sph	1984	MANGATU	4	Gisborne, E.Cape
218	P.RAD	MGAT 450 sph	1985	Mangatu	3	
224	P.RAD	LISM ages 7-22	1985	Lismore	5	SNI, Wellington
227	P.RAD	POMA 500sph ag30	1986	Pukerau Blk.	1	
228	PSMEN	LONG age 33-37	1986	Longwood	1	
230	P.RAD	GDNS ages 26-30	1986	Long Gully	2	
231	P.RAD	TEWR ages 9-31	1986	Te Wera	2	
235	P.RAD	LONG age30sph370	1986	LONG Cpt29	2	
236	P.RAD	WOOD 370sph	1986	WOOD Cpt67,6	2	
237	P.RAD	KANG Trans. crop	1987	KANG	19	CNI, Nth Waikato, Sands, Warkworth, Hills, Plains (also - P.PON, P.MUR, P.ELL, P.MCA)
258	AAMEL	All NZ	1992	Hunua Whaka		
274	PSMEN	ALL NZ	1977	ALL NZ F136	1	
276	EUFAS	C.N.I.	1992	C.N.I.	4	
280	CUSPP	NZ cumac/culus	1992	Various	4	
362	P.RAD	Tasmania	1989	Tasmania	3	
394	POP	Poplar Mix	1998	ALL NZ	2	