

A review of the Plantation Management Research Cooperative Trials and PSP's

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Plantation Management Cooperative

Report No. 102, June 2006

EXECUTIVE SUMMARY

A REVIEW OF THE PLANTATION MANAGEMENT RESEARCH COOPERATIVE TRIALS AND PSP'S

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THE PROBLEM

The last review of the Plantation Management Cooperative (PMC) trials took place in 1996. There are currently (June 2006) 21 sets of trials listed in the Cooperative Trials register, with over 1100 current Permanent Sample Plots remeasured at varying intervals, implying a considerable workload and cost.

COOP INITIATIVES

The formation of a Pan cooperative that would coordinate and /or merge the existing cooperatives has made this review timely. The inventory of the existing situation is a prerequisite for any development of a science strategy and research plan for the combined entity. This report could be a guide on how to carry out such a review on the whole set of trials from all the cooperatives, while providing a basis for on going development of a unified research strategy.

THIS PROJECT

The current proposal is to review the status of the trials as at 2006 in order to determine ongoing re-measurement requirements and enable the development of a blueprint of where the cooperative wished to be in, say five years time with respect to its trials programme.

RESULTS

Of the 21 sets of trials list in the register, 10 sets of experimental trials remain current and with PSPs controlled and remeasured at the Cooperative's expense, while a further set, the silviculture x traits trial has been established but awaits the installation of PSP's. There is a set of non-experimental or monitoring plots established mainly in farm forests that are an important source of data from the non-corporate management. The 1130 current PMC PSP's form a significant set of the some 13,255 experimental and monitoring plots recorded as current in the national Permanent Sample Plot data base system.

IMPLICATIONS FOR THE COOP

Some degree of rationalisation is possible, but at a national level, rather than within the PMC only. The data set of the PMC alone has gaps. As stated in previous reports including those from the Stand Growth Modelling and Site Management Cooperatives, trials are required in the four key main effects and their interactions: Genetics x Site x Silviculture x Stocking (levels of growing stock), and it is timely to consider the establishment of a core set to replace the Final Crop Stocking and Genetic Gain trials as they mature. There will always be a need for smaller sets of trials to supplement this core network and answer specific research questions, for example, what is the minimum size of gap to allow young Radiata pine to growth within an existing stand and provide continuous cover.

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INTRODUCTION

New Zealand has a very large number of current and historical trials and permanent sample plots that measure growth responses in its exotic plantation forests. These have been established and maintained by a variety of users from both operational management and research, with area based plots that are (or are intended to be) remeasured more than once, frequently many times over a long period of years. Data from such plots are usually stored in the New Zealand Forest Research Institute Limited (Scion) Permanent Sample Plot Database System, under a variety of agreements regarding access and confidentiality. The resultant total data set when viewed nationally is one of the more comprehensive collections of information regarding the growth of trees in the world.

The Plantation Management Research Cooperative (PMC) and its predecessors, has established a range of trials and growth monitoring plots that form an important sub-set of the national database. Similarly, the other forest management research cooperatives (Stand growth modelling, Site management, Douglas fir and Eucalypts) have also important sub-sets, which complement a range of experiments established mainly by government funded researchers and a range of monitoring plots predominantly controlled by forest managers. As at May 2006, the PMC trial register lists 21 sets of trials established by the Coop, of which four are described as “completed” or “abandoned”. The latest version of the register is to be found in the proceedings of the annual May meeting, 2006. Each trial set may contain one or more experiments with associated Permanent Sample Plots (PSP’s), for a total of 1130 PSP’s.

A review of the PMC trials and PSP’s was proposed as a project and accepted by members for the 2004/2005 financial year. However, no progress was made and this project was carried over into the 2005/2006 year, with resources assigned to it in September 2005. The written project proposal was brief. It was thought that some rationalisation of trials may be needed and indications formulated as to how the PMC trials integrated with and complemented other trials series in the wider domain. The potential benefits of the review would be to enable “a blue print of where the Coop wished to be in say, five years, with respect to its trial and PSP programme”. The terms of reference for the project are defined below.

Terms of Reference

To review the Coop trials and PSP’s to determine ongoing re-measurement requirements. This would comprise the following components:

- A review of all plantation management trials and PSP’s
- Where does the Cooperative want to be in five years time?
- Develop a methodology to calculate cost benefits of new projects submitted to the Coop.

The budget for the review was strictly limited. Moreover, since the project was first defined, the “Pan Cooperative” initiative has been mooted, whereby the PMC is likely (at the time of writing) to be merged with the other radiata pine research cooperatives into one integrated *theme*. The complete definition of a five-year blueprint for this theme must therefore await a similar review exercise for the complete trial set with contribution from all active participants. The review documented in this report therefore concentrates on an audit of the PMC trial series, with indications of gaps in the distribution of plots from a mathematical modelling perspective for

radiata pine. It demonstrates how a similar exercise could be carried out on the much larger combined data set. A listing of potential research questions is also given as a continuation of the PMC strategy. This should enable “a blue print of where the Coop wished to be in say, five years, with respect to its trial and PSP programme” to be formulated.

PREVIOUS WORK

There have been ten previous reviews or partial reviews of research trials for silviculture and growth prediction by the PMC and the Stand Growth Modelling Cooperative (SGMC), listed in Table 1. The Site Management Cooperative has not carried out an equivalent review as such, but it has work plans for its series of Long Term site productivity trials.

Table 1: List of Cooperatives Strategy Reports

Plantation Management Cooperative Strategy Reports

<u>Report No. and Title</u>	<u>Date</u>
15 A strategy for efficient selection and evaluation of “designer breeds”	Nov 1995
35 A strategic plan for new and existing silvicultural trials	Nov 1996

Stand Growth Modelling Cooperative Strategy Reports

<u>Report No. and Title</u>	<u>Date</u>
4 Minimum standards for collection of growth data from Permanent Sample Plots (Revision of 1987 report)	Aug 1991
15 Permanent Sample Plot survey: radiata pine regional analysis (Growth plots)	Mar 1990
16 Permanent Sample Plot survey: radiata pine regional analysis (Experimental plots)	Jun 1990
22 PSP future strategy committee report	Jun 1991
42 A strategy for efficient selection and evaluation of ‘Designer Breeds’	Jul 1995
96 PSP matrix development	Jan 2001
124 Towards the next generation of modelling trials	Sep 2004
128 Growth Model development of radiata pine clones: A Gap analysis	Jan 2006

The SGMC in 1991 proposed a strategy for the establishment of a core framework or matrix of PSP's suitable over the long term for the development of growth prediction in response to regional differences, site quality, spacing and genetic gain. Sets of trials were established to quantify genetic gain, part in existing trials and part planted specifically for the purpose, the Silviculture/breeds trials. Comprehensive summaries of the status of these trials has been produced periodically, the last being SGMC report 70, 1998. In 2001, the SGMC also surveyed the national PSP database to produce a national matrix of number of PSP's according to:

- Region
- Site (productivity)
- Silviculture (stocking density)
- Genetics
- Mean Crop Height

More recently, the issues of clonal forestry were raised in SGMC reports 124, 2004 and 128, 2006, particularly how to benchmark clones versus seedling material and hence evaluate their relative benefits to ultimately determine how to incorporate clonal information in growth prediction.

The PMC last reviewed its strategy for silvicultural trials in 1996, report 35. The definition of silviculture was restricted to stand management rather than site or establishment management and the report attempted to identify "what silvicultural questions will the forest owner/manager of 2010 want answered". An unresolved issue was that of classifying site. Since the time of the report, measures of site productivity have been improved with the development of the 300Index. A matrix of treatments was developed to include genetics, site type and treatment, further refined by factors to be examined (e.g. growth and form versus long internode). Populating this matrix with PSP and trial numbers was deferred to the year following the report but there is no evidence that this was ever completed. Suggested research issues included tree breeding, environmentally sustainable silviculture and "main stream" silviculture, the last issue concerned with the appropriateness of growth prediction through Standpak, with forest health and with stand nutrition.

Each report on the meeting proceedings of the PMC contains an up-to-date register of trials that have been established and/or installed by the cooperative. This inventory contains trials that are current and continue to be remeasured and maintained by the cooperative, along with trials that remain current but are remeasured by someone other the coop and trials that have been completed, abandoned or clearfelled. This register is a complete record at a high descriptive level. Additionally, there is a list of trials at the experiment level detailing each set of experiments and PSPs classified by trial type and providing information on location, owner, species, number of plots, planting year and proposed clearfell year, cross-linked with report number.

AN INVENTORY OF TRIALS AND PLOTS

The PMC trials PSP database is a subset of the larger national PSP system, with just under 10% of the total national number of PSP's regarded as "current" at the time of writing. There are many advantages for analyses carried out under the PMC research programme to utilise this much larger data set, as appropriate. For example, the formal validation of the 300Index growth model in 2005/06 utilised a data base of over 7,000 *P. radiata* PSP's. Any review of the PMC trials must be carried out in this context. A brief summary of the size of the national data set is given below, while an abbreviated 2004/05 annual report of the PSP system that can be used publicly is given in Appendix 1, derived from the larger, formal but internal annual report.

The National PSP Database

The database is maintained by Ensis, with data supplied from both forest companies and owners and researchers, stored under a range of agreements, confidentiality and access rights. It is administered by staff at Ensis and the system should be thought of as three components:

- Database software
- Database administration, including input / output, reporting and security
- Data - the experiments, trials and monitoring plots.

In brief, from the report in appendix 1, the PSP database has a total of 27,267 plots as at 22 November 2005. 13,255 plots (49%) are considered to be still current and the remainder 14,012 are either abandoned or clear felled. Over 4,000 of the current plots were re-measured during the previous measurement season. There are 49 private companies or Scion groups who control and measure PSP plots. Plots are distributed throughout New Zealand (also Fiji and South Australia), and represent 66 forest owner companies and 227 private forest owners. There are 725 different forests represented. Some 55 % of the data base is comprised of PSP's within some form of experimental trial, that is to say the plots may not be typical of the surrounding stand within which they are located. Table 2 summarises the size of the data base, its currency and distribution by species.

Table 2: National PSP data base summary statistics

PSP Plots and Measurements						
Year	Total	Current	Plots Established	Plots Measured	% of plots measured	Total no. of measurements
2004/05	27,267	13,255	151	4,149	31	191,215

PSP Plots by Species								
Year	P.Rad	%P.Rad	Psmen	%Psmen	Euc	%Euc	Indig	Other
2004/05	19,348	71	1,658	6	1,706	6	270	4,350

Plantation Management Cooperative Trials

The register of PMC trials produced at each meeting classifies the 21 sets of trials (as at May 2006) by broad descriptions, rather than the four research themes listed in the policy or the seven research themes listed in the Strategy (approved November 1999). Virtually all the trials have PSP's installed, (or are scheduled to in the near future), and the data from the measurements is stored in the PSP system. Many of the trials listed in the proceedings are completed and clearfelled or abandoned, have been transferred to other entities such as the Radiata Pine Breeding Company, or are being re-measured by Ensis using FRST funds, independently from the PMC programme and budget. A brief summary of the trials with regards to experiment identification number, forest location and establishment report number is given in the back of each volume of meeting proceedings, along with a more detailed list by experiment/sub experiment number. These two listings do not distinguish between current, transferred etc.

There are some 1130 PSP's still being re-measured within the PMC programme at the PMC's expense, Table 3. Of these, 230 are growth monitoring plots established mainly on small woodlots to assist with farm forestry research. In contrast, the "non-farm" growth monitoring plots are generally established and re-measured by forest companies, and these farm growth monitoring plots are the only plots besides those established in parallel by Ensis under the FRST programme, that give an independent set of data of operational practice by small woodlot owners.

Table 3: Statistics of current PMC PSP re-measurement programme

	P.Rad		Alternative Species	Total
	Experimental	Growth monitoring	All plots	
PSP Plots	823	230	77	1130

Table 4 summarises the situation as at June 2006 with regards to current, ongoing trial sets that are the responsibility of the PMC, that is, the PMC own the rights to the data and fund the maintenance and re-measurement of the PSPs. There are 10 sets of trials with PSP's eight of which are in radiata pine. An additional set, the silviculture by traits trial, no 16, has plots yet to be established. A further set of the growth monitoring plots, approximately 15% of which are now funded and measured independently of the PMC, are located mainly on farm forests. The number of PSP's listed in Table 4 does not equate to the total noted as current in the PSP database listed in Table 3 above.

Table 4: Summary of PMC current trials, plot numbers and types

Trial No.¹		Sites	No of plots established	Age range at 1 April 2006
	<i>P. radiata</i> trials			
1	Demonstration/Research Nelders of Improved Radiata Pine Breeds	10	97	26-30
2	Clonal Management trials	3	170	11-15
8	Followers Trials	7	109	16-22
11	Ultra High Pruning Trials	5	108	19-22
13	Pruning Trials – Improved Breeds	4	149	9-18
18	Final Crop Stocking Trials (50% still current)	10	97	26-30
19	Pole Trials	2	44	14-26
20	Pruning Trials	1	30	21
16	Silviculture x Traits Trials	5	180 proposed	2-4
	Growth Monitoring Plots (mainly farm) 29 plots measured by Ensis with FRST funds	66	250	10-28
	Other Species			
6	<i>Eucalyptus nitens</i>	1	18	14
17	Redwood Silviculture: Final crop steking and Pruning Reponse Trials	5	49	8-28

Several sets of trials originally established by the PMC are measured by Ensis using FRST funds, listed in Table 5.

Table 5: Trials established by the PMC, Measured by Ensis with FRST funds

Trial No.		Sites	No of plots established	Age range at 1 April 2006
5	<i>Cupressus macrocarpa</i> (FR126)	9		15-16
12	Older Physiologically-aged Cuttings Trial	1	25	12
21	Silviculture Trial (FR151)	1	25	27

The sets of trials listed in the trial register in the appendix of each meeting proceedings that have been transferred to other entities, or have been completed, are listed below.

¹ These numbers correspond to the trial number in the May 2006 proceedings

Transferred to other entities (RPBC, SGMC)

- 3 Dothistroma Genetic Gain Trials FR 122 & 204)
- 9 Special Purpose Radiata Pine Breeds Trials 9FR 172)
- 10 Clonal Trial for Special Purpose Radiata Pine Breeds

Completed/ clearfelled or abandoned

- 4 Nursery Conditioning Trials
- 7 Marlborough Dryland Understorey Pasture Production
- 14 Severe Lateral Root Trimming and Contrasting of Rating, Toppling Trials
- 15 Crown lightening, Toppling Trials

To demonstrate the spread of plots when taken as a whole data set, the percentages of PMC current plots were calculated for four main classifications:

- Growth modelling region
- Final Crop Stocking
- 300Index
- GF rating

Tabulations are shown below.

GM Region	% of PSP plots		
	Experimental	Growth monitoring	All plots
Canty	2	2	4
Clays	2	2	4
CNI	39	4	43
HBAY	6	6	12
Nelson	4	2	6
Sands	14	1	15
South	8	5	13
Australia	3	0	3

FCS	% of PSP plots		
	Growth		
	Experimental	monitoring	All plots
<150	8	2	10
150-350	35	12	47
350-500	19	5	24
500-750	8	2	10
750-1000	4	0	4
>=1000	5	0	5

300 Index	% of PSP plots		
	Growth		
	Experimental	monitoring	All plots
Low	11	2	13
Med	19	8	27
High	26	6	32
Very High	8	2	10
Unknown	16	2	18

GF rating	% of PSP plots		
	Growth		
	Experimental	monitoring	All plots
Unimproved	4	0	4
Climbing select	3	1	4
Open pollinated	16	2	18
Control pollinated	12	2	14
Not coded	44	16	60

It is clear from the above that there exist gaps in the distribution of the plots when considered as a whole data set to be used for an application such as mathematical modelling of growth. However, the set is important as a sub-set of the national data base, and a classification exercise such as the above should be repeated for the whole. This is beyond the scope of this exercise, but should lead to recommendations to establish PSPs to “fill in the gaps”.

RESEARCH QUESTIONS

New Zealand plantation forestry still remains 90% Radiata pine, perhaps an even higher percentage when levels of harvest now and into the future are considered, due to the intrinsic higher yields from Radiata pine. In the decade since Report 35 was written, the New Zealand harvest has gone from largely supplying the domestic and Australian markets to competing on the international market with the major wood product exporting countries of the world. When the national harvest reaches the volume indicated by the long term sustainable yield (LTSY) of the current 1.8 million hectares, exports will be some 22 to 23 million m³ /year round wood equivalent, 70% of the total harvest (domestic demand is some 8 million m³ of the 31 million m³ /year total LTSY) and three times that of the early to mid 1990's. Continuous improvements in per hectare volume productivity and wood quality per cubic metre will be required to remain internationally competitive with other exporting countries.

Interest in alternative species and silviculture is high, partially in an attempt to minimise risk, partially to diversify and partially because of the increasing proportion of farm forestry area where other species are desired for their own sake. Alternative silvicultural systems to clear felling are likely to be required in forests close to urban areas or where visitor numbers are high in or adjacent to the forest, for example the Coromandel, but also where risk of erosion is high in the critical period before the next rotation of trees develops an extensive root mass to stabilise the soil.

As stated in previous reports, trials are required in the four key main effects and their interactions:

Genetics x Site x Silviculture x Stocking (levels of growing stock)

Each main effect can be broken down further

Genetics

- Growth
- Traits (wood quality)
- Clones

Site

- Productivity (growth and quality)
- Nutrition
- Health and risk (wind, snow etc)

Silviculture

- Pruning intensity
- Thinning regime
- Even / Uneven aged
- Establishment (clear felling / continuous cover)

Stocking

Initial

Final Crop

To a greater or lesser extent, the above schema applies to each species. It will not be possible to design one or two large experiments or experimental schema that cover all the above factors and their interactions. However, it should be possible once again to implement some few core designs that can be supplemented by many other individual, single issue trials answering specific questions (almost certainly on an ad hoc basis) to provide data that determine desirable forest management practice and to be used for the next generation of growth predictive systems. If past experience is a guide, a new generation of growth models are likely to be required within a decade. The Final Crop Stocking trials and the Genetic Gain Trials are examples of core schema that could be modified and repeated so that equivalent PSP's remain current once the originals have been felled or abandoned.

Tree breeding should present an ever moving target for predictive growth models. It is however, not the job of the mensurationist to predict the improvements of the latest breed or tree stock. Rather, a quantitative scale is required such as updated versions of the growth and form indices that can be used directly with models, (e.g. in the manner of the state space models) or indirectly to predict change in productivity index such as the 300Index. Relying on the hypothesis that such improvement can be implicitly contained in measurements of starting points when running growth models is insufficient. Often it is too late for some functions of planning to wait until such a measurement is possible. Also such reliance implies that the growth patterns remain essentially unmodified and the same percentage change continues throughout the remainder of the tree's life. Given such indices, it becomes the tree breeders' responsibility to estimate and prove where the latest tree stock is positioned on the scale.

Such a philosophy simplifies the issue of predicting the effects of clonal forest management. The key difference as regards tree development in stands is the differences in inter-tree competition within a clonal stand as compared to a mixed stand. Accordingly, perhaps a series of paired contrasts of pure clonal and non-clonal plots could be established where for each pair all other factors are identical.

A research question now gaining momentum is how to design a silvicultural system or species combination to avoid clear-felling, perhaps with alternatives to Radiata pine. Even with Radiata pine, the question must be "can a continuous cover forest (CCF) system be employed profitably, albeit less so than one where clearfelling occurs. There is over-seas interest in converting even aged pure plantations, and classical silvicultural systems of Central Europe are also a source of information. It is not necessarily true that some stands of Radiata pine could not be managed on CCF. Such CCF systems need not be single tree selection systems but group selection systems, where the minimum sized gap to ensure good growth of the newly established stock must be determined. Is there a species that can be interplanted with radiata pine to perhaps provide the continuity desired, perhaps with a longer rotation length to increase the uneven aged effect? Research on Redwood silviculture could provide an answer to this question.

COST BENEFITS OF NEW PROJECTS

It is not possible to design a cost/benefit methodology for long term trials that is meaningful and different from standard cost/benefit methodology. Accordingly, where cost / benefit calculations are required it is recommended that standard methods be employed, as found in any appropriate text book. However, in many cases, such methods fail in that while costs can be reasonably predicted, estimates of benefits are subject to large errors. The benefit of an individual trial may be quite limited, but when taken in combination with past efforts or in the whole data base, is invaluable.

CONCLUSIONS

The PMC funds the maintenance and remeasurement of 1130 PSPs in 20 sets of trials, with a further set of PSP's yet to be established in the Silviculture x Traits experiment covering five sites. Of the 21 sets of trials listed in the PMC trial register in each of the meeting proceedings, 9 sets are in radiata pine and are current. Two of these sets are 26 years and older. There is a need to design a core set of trials to provide data for the next generation of growth models in much the same way as the Final Crop Stocking trials and the SGMC Genetic Gain trials were designed. It should be some loose form of robust factorial design with genetic improvement, site quality, silvicultural regime and level of growing stock as its main effects, along with at least a first order interaction. This design must integrate with the needs of the other cooperatives and should be implemented over an extended period of time. Smaller trials can then be implemented to answer specific questions and to extend the domain of the data set.

The inventory of trials and plots and the analysis of their distribution described in this report should be carried out in a similar fashion on the whole national PSP database. The move towards a pan cooperative will encourage this and perhaps this will be one of the first tasks in the new organisation.

Should agreement be reached concerning monitoring for forest carbon, some 400 clusters of 4 plots will be established in Kyoto forests (established after 1990 on non-forest land) in the proposed network of continuous forest inventory plots. Some suggestions have been made for a similar sized network in the "pre-Kyoto" forests. These will provide a source of operational monitoring data, allowing the research cooperatives to concentrate their efforts on experimental trials.

Permanent Sample Plot Database System

2004/2005 Annual Report Public

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December 2005

Scion

PERMANENT SAMPLE PLOT DATA BASE SYSTEM

2004/2005 ANNUAL REPORT - PUBLIC

Carolyn Andersen, Judy Hayes Lisa Blomquist PSP Database Manager / Administrators

This annual report details the processing and management of permanent sample plot measurements during the period 1 July 2004 to 30 June 2005 on the Scion Permanent Sample Plot database.

The PSP Database System

Plots on the system are managed by individual forestry companies/managers, Research Cooperative programmes and/or Scion government funded projects. Most forestry companies throughout New Zealand, including Scion, are committed to a permanent sample plot programme, both for growth monitoring and experimental purposes.

The PSP system is a software product suitable for licensing to individual forest companies either as a stand-alone system or in collaboration (this is the preferred option) with Scion.

Electronic data capture continues to be the major source of PSP data entry (89% of all data processed) and is still carried out very successfully by many companies as well as Scion field staff using the DOS based program PSPDC (V2.2).

The 'conversion utility' allowing data from spreadsheets to be processed directly onto the system continues to be an extremely useful tool, particularly for Scion staff. This year, a total of 260 measurements (5% of data) have been processed in this manner.

A small amount of data (265 measurements, approximately 6%) continues to be punched from the pre-printed hand written forms - this facility will continue to be an integral part of the system. Even though this is not as efficient as direct data entry onto hand-held computers, the inclusion of the previous year's data still allows visual checking in the field.

Data Storage

The Scion PSP database has a total of 27,267 plots as at 22 November 2005. 13,255 plots (49%) are considered to be still current and the remainder 14,012 are either abandoned or clear felled.

There are 49 private companies or Scion groups who control and measure PSP plots. Plots are distributed throughout New Zealand (also Fiji and South Australia), and represent 66 forest owner companies and 227 private forest owners. There are 725 different forests represented.

Data Quality Control

PSP Version 4.2 is hosted on the database server on Scion's local area network. It is backed up daily by Information Technology staff and is stored on tape weekly. As well, a full backup copy of the database is kept on disk and archived every six months, to cover any major catastrophes.

All plots processed in 2004/05 were checked for errors. Printouts of any errors are returned to the plot controllers who are responsible for checking the data and returning the corrections back to the PSP Administrators. The use of the electronic data capture program, which has a simple error checking program, helps keep the amount of measurement data errors to a minimum.

All new plots have the stand history information entered manually in conjunction with the first updated measurement, if the plot controller supplies this.

Plot Measurement Processing

For this period, a total of 4862 plot measurements were processed and updated onto the Scion PSP system.

The total amount of data processed this year was almost the same as last year, with just over 57% of the data processed from Scion sources.

The number of new plots processed this year was 256, 28% less than last year. Of the new plots processed onto the system, 63 plots were established prior to 2004.

The user defined fields continue to be well used for data assessments such as resin bleeding, multiple descriptive codes, pruning codes, clonal ids etc. There are 2797 plots with approximately 8026 plot measurements with user defined data additional to standard growth measurements. There are also 1711 plots with detailed tree descriptions stored on the database. There are now 615 plots with root collar diameter measurements.

Data Reporting

All clients, including Scion staff controlling plots, receive an error check and full summary listing on completion of processing and/or completion of corrections. Plot listings and summaries of all Scion controlled plots are also sent to appropriate forest owners.

A few Scion scientists/technicians are retrieving their own data from the system but most still make use of the database administrator's expertise to retrieve appropriate data. Data retrieval by the database administrators, for both internal and external clients, accounts for a significant amount of time. Strict rules apply for release of data for both Scion/Ensis projects and external client requests. Written approval is required if the data requested is not owned/controlled by that person/company.

PSP Plot Statistics

The number of plots and measurements stored on the database on an annual basis, is described in Table 1.

There has only been a 2% increase in total number of plots stored on the database over the year. Once again there was a decrease overall in the number of plots measured during the 2004 year.

Table 1.

PSP Plots and Measurements							
Year	Total	Current	Plots Established	Plots Measured	% of plots measured	Total no. of measurements	Av. no. meas / plot
1993	18,292	11,136	708	6,747	61	124,939	6.8
1994	19,844	12,525	1027	6,805	54	131,596	6.6
1995	20,693	13,088	801	6,727	51	138,115	6.7
1996	21,309	13,047	719	7,256	56	145,242	6.8
1997	21,830	12,494	683	6,281	50	151,284	6.9
1998	22,555	12,813	583	6,554	51	157,717	7.0
1999	25,070	14,141	540	6,171	44	163,635	6.5
2000	25,696	13,818	420	5,896	43	169,117	6.6
2001	25,952	13,694	524	5,678	41	174,881	6.7
2002	26,389	13,709	121	4,679	34	180,401	6.8
2003	26,732	13,292	343	4,756	36	185,047	6.9
2004	27,267	13,255	151	4,149	31	191,215	7.0

A summary of plots on the PSP system from 1976 to 2004 (Figure 1) shows the total and current number of plots, and the number of plots measured in each year.

All current plots have been summarised by Controller (Figures 2 and 3). The Controller is the company, Cooperative or Scion group that manages the plot and is generally responsible for all remeasurement and silviculture.

The system has a purpose field for all plots, coded as 'growth and yield' or 'experimental' which includes such types as thinning, pruning, fertiliser, genetics etc. 55% of the current PSP plots are designed for experimental purposes. A regional summary of plots throughout New Zealand (Table 2 and Figure 4) still shows the Bay of Plenty region to have the largest number plots overall, as well as the largest amount of experimental plots.

Table 2.

REGION	% of total Plots	
	GROW	EXPT
Northland	8	15
Auckland	4	6
Waikato	17	12
Bay of Plenty	18	25
Gisborne	9	2
Taranaki	1	0
Wang/Manawatu	4	2
Hawkes Bay	8	8
Wellington	1	1
Nelson	4	5
Marlborough	2	1
Canterbury	10	9
Westland	6	5
Otago	6	6
Southland	2	3

Figure 5 shows a regional distribution of plots by species. Marlborough and Wanganui/Manawatu regions continue to show the least amount of 'other' species plots, not *Pinus radiata*. Canterbury again has the highest percentage of 'other' species (43 % of plots are not *Pinus radiata*).

There is a wide range of forest owners from the large corporate companies to the small private farm forest owners. The PSP database administrators endeavour to keep up with changes in forest ownership and provide an up-to-date Forest Owners database for all Scion users. There are 310 small private forest owners with a total of 2603 plots established on their land.

Overall, the database still contains predominantly *Pinus radiata* plots (71%), although nationally this accounts for 89% of all forests. Douglas fir and Eucalypt plots each make up 6% of the database (Table 3 & Figure 6).

Table 3.

PSP Plots by Species								
Year	P.rad	%P.rad	Psmen	%Psmen	Eucalypt	%Euc	Indigen	Other
1993	12,699	69	946	5	1,110	6	145	3,392
1994	13,762	69	1,340	7	1,117	6	145	3,480
1995	14,301	69	1,444	7	1,143	6	145	3,660
1996	14,649	69	1,466	7	1,251	6	165	3,778
1997	15,161	69	1,475	7	1,255	6	170	3,769
1998	15,726	70	1,486	7	1,273	6	183	3,887
1999	17,463	70	1,507	6	1,291	5	191	4,618
2000	18,187	71	1,579	6	1,334	5	264	4,332
2001	18,415	71	1,599	6	1,645	6	264	4,029
2002	18,807	71	1,631	6	1,698	6	264	3,989
2003	18,976	71	1,639	6	1,699	6	265	4,195
2004	19,348	71	1,658	6	1,706	6	270	4,350

Table 4 details the plot count of 'other' species on the Scion PSP database. There was a 155 plot increase in the 'other' species group which consisted mainly of 146 plots in the 'other pines' species.

Table 4.

Other Species	Other Pines	Cypress	Acacia	Poplar/Larch	Black Walnut	Sequoia	Rest
2004	2714	762	531	120	94	71	58

Figure 1.

PSP Database System Statistics

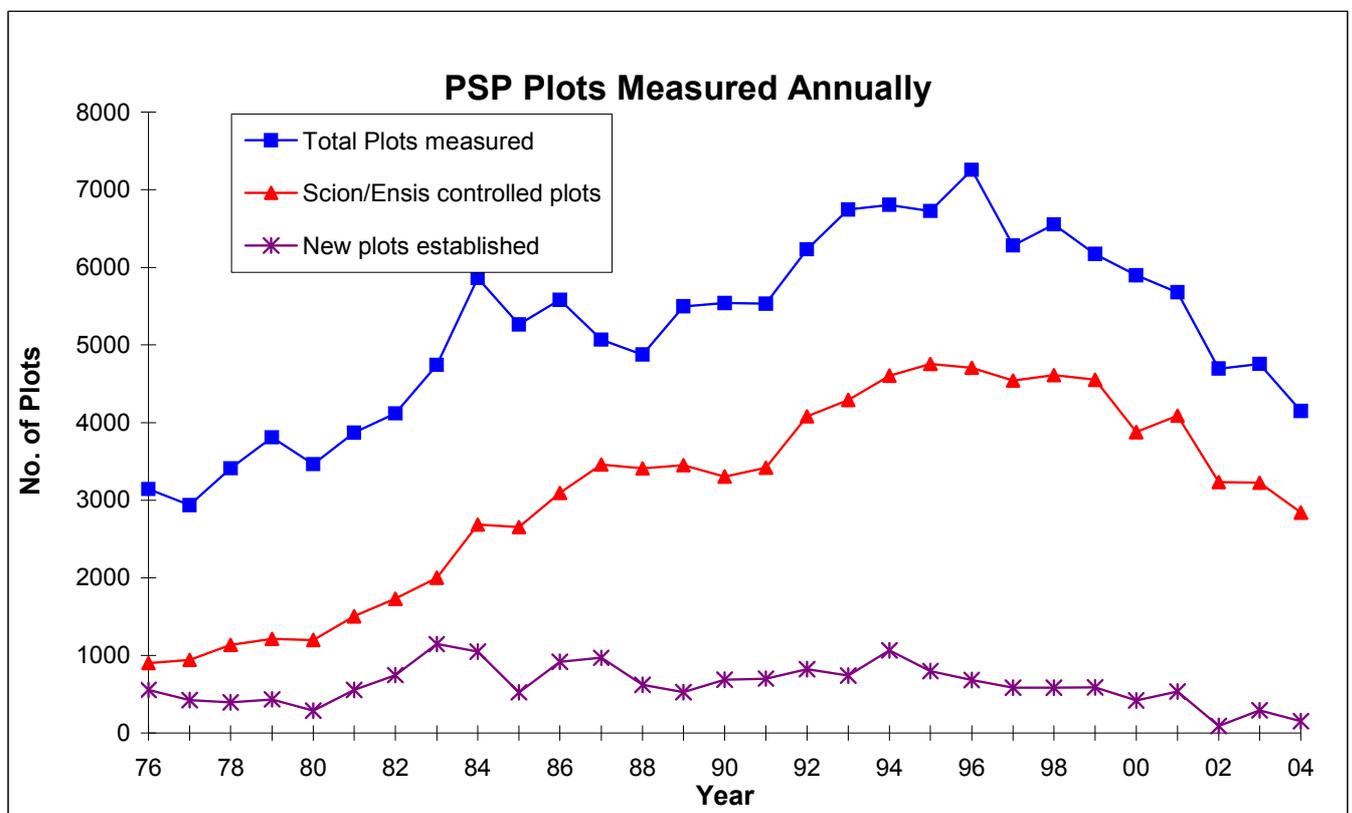
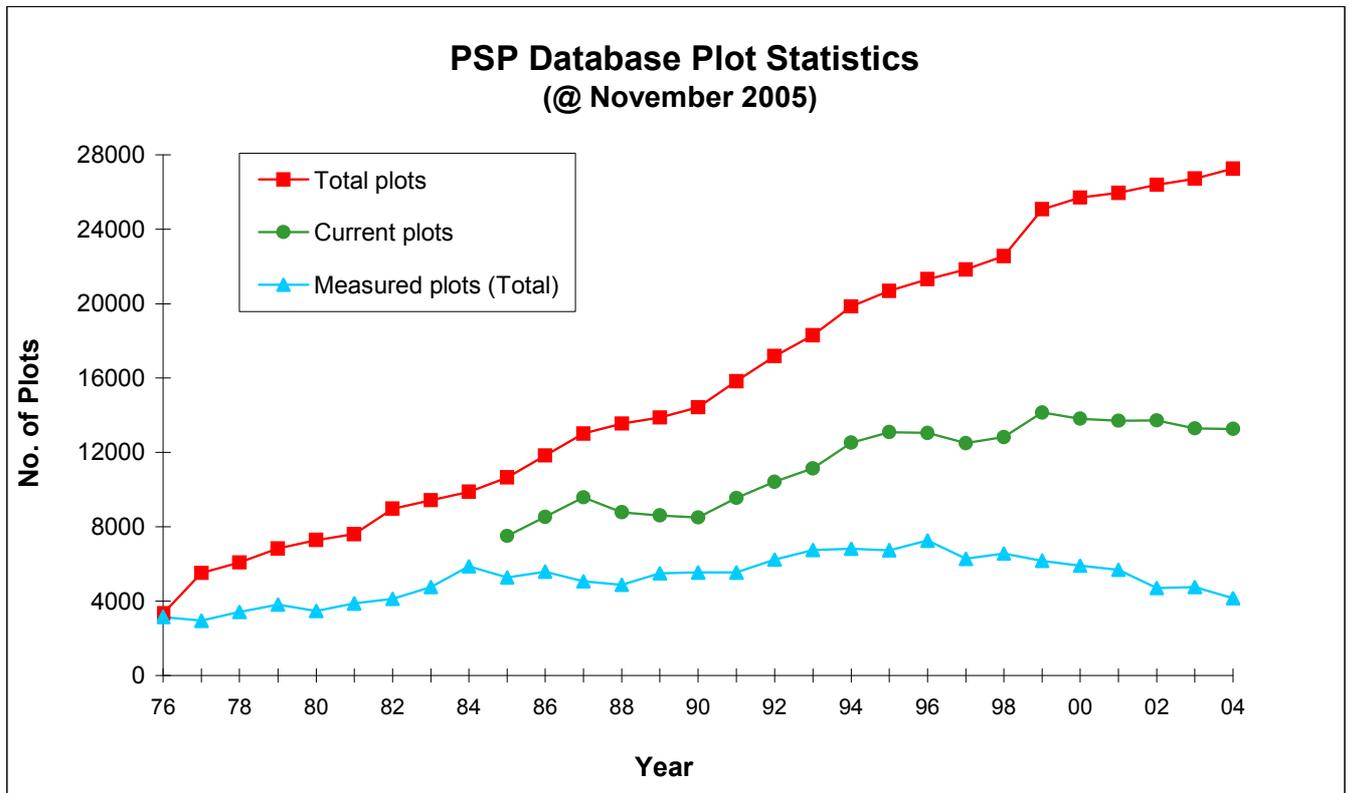


Figure 2.

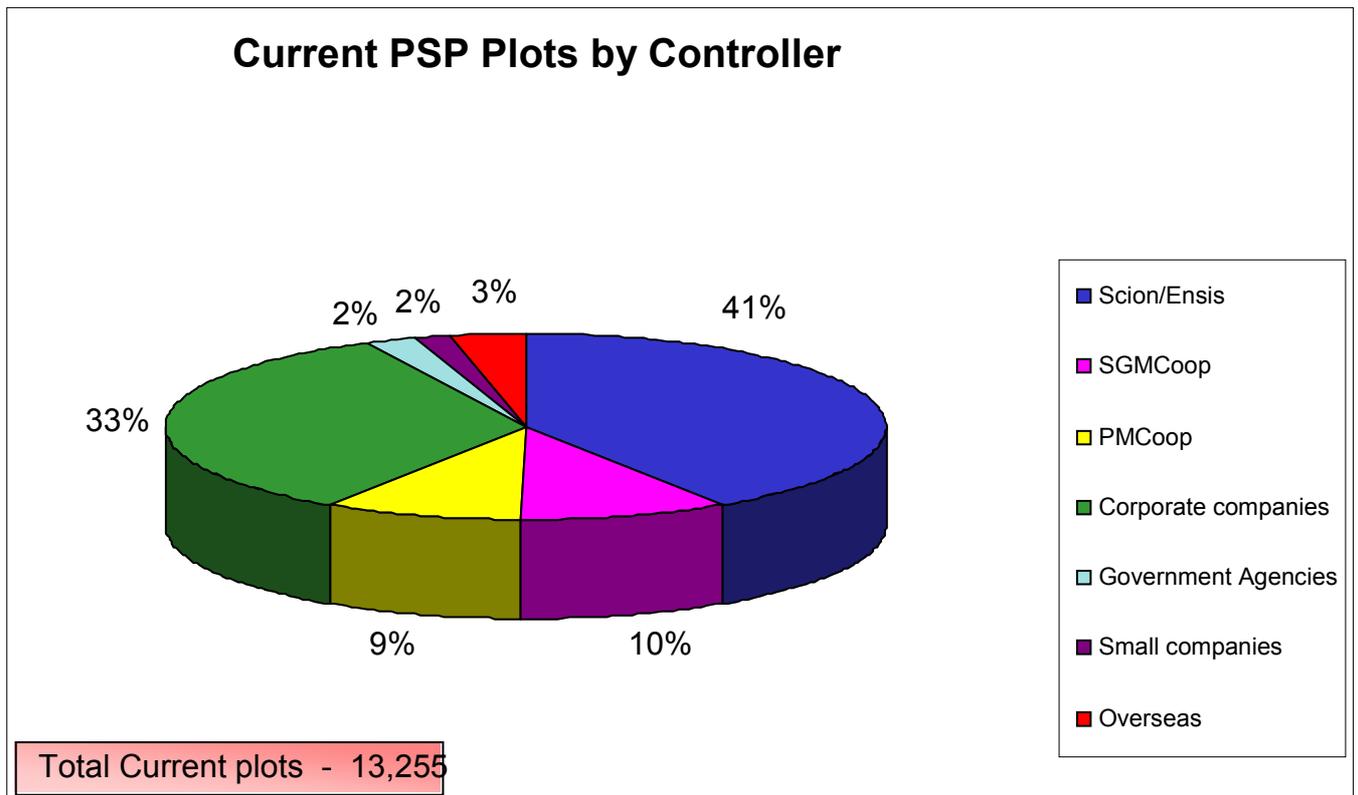


Figure 3.

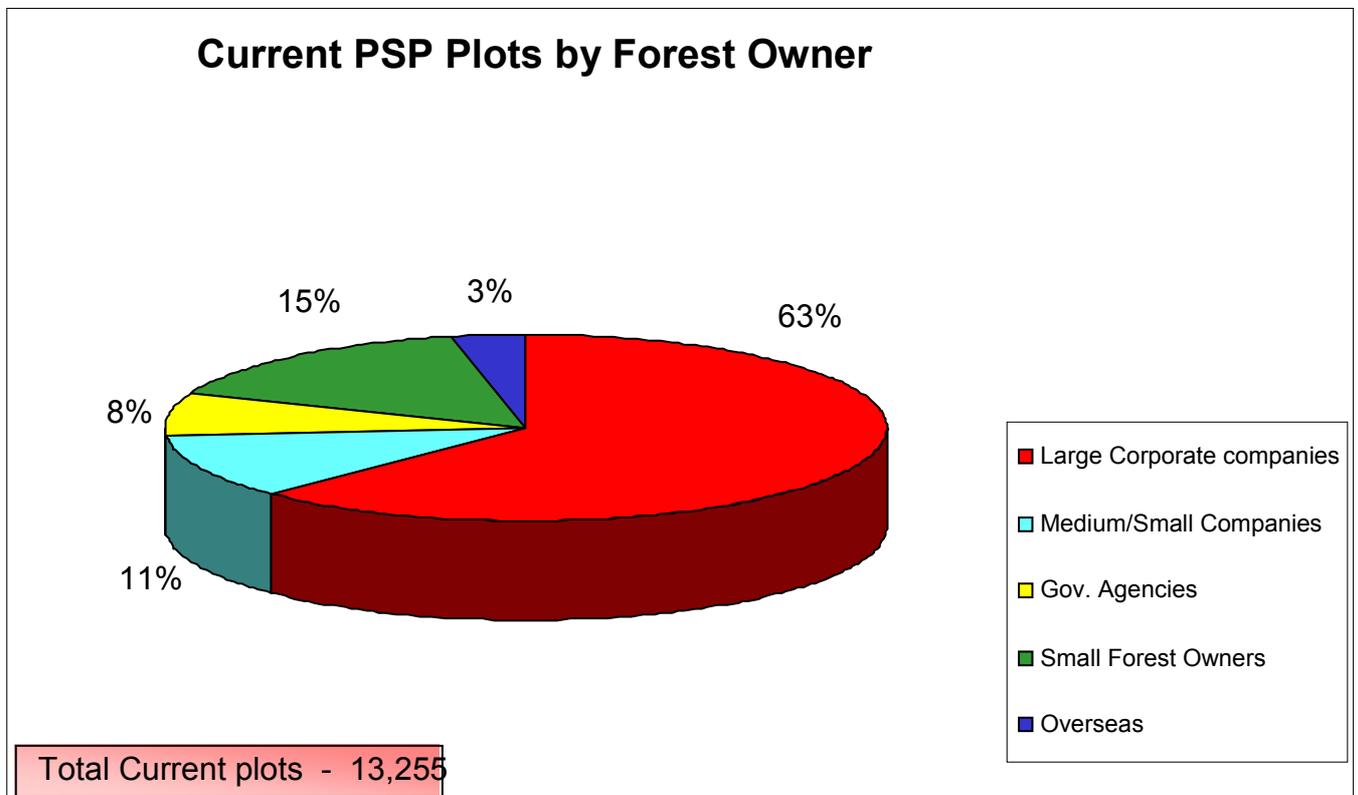


Figure 4.

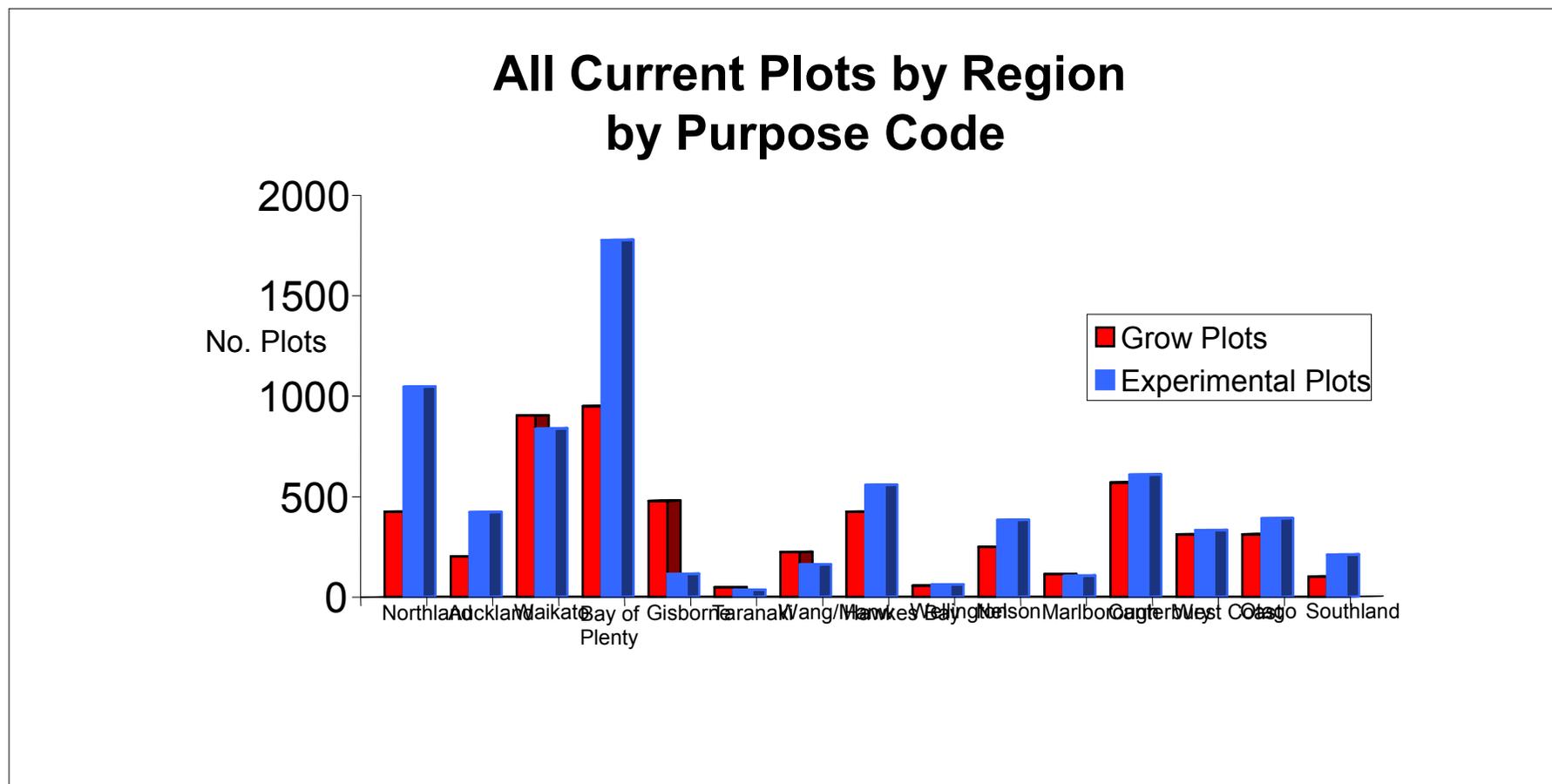


Figure 5.

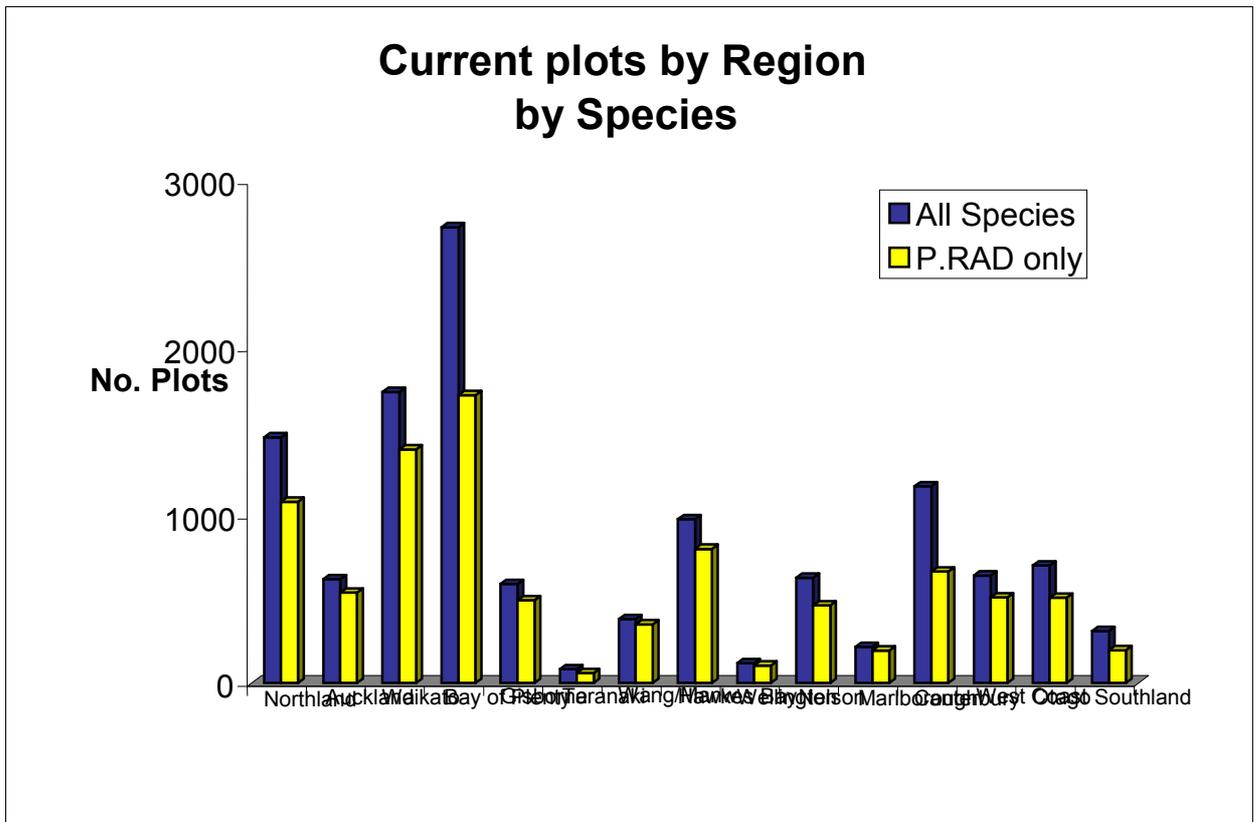


Figure 6.

