

# Radiata plantation statistics

## NEFD and notes on Chilean, Australian and other resource descriptions

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### Abstract

*Chile, New Zealand, and Australia, the three principal growers of Pinus radiata, account for 88% of a world total of about 3.5 million hectares of plantations of this premier multi-purpose softwood species. The quality of published resource descriptions is reviewed and the integrity of the databases is considered to be generally high in each of these three largest grower-countries. Information on much of the balance throughout the world is not as readily accessed. Management and silvicultural issues pertaining to, and the relative resource maturity of, the radiata pine estates of the three principal countries are commented upon.*

### Introduction

NEFD, a NATIONAL EXOTIC FOREST DESCRIPTION, describes itself as "a statistical interpretation of New Zealand's plantation forest resource as at April 1, 1989". The sixth annual edition of The Description has been recently released for public information and scrutiny.

Looking at statistics, like looking at economic appraisals, is known to appear rarely on the list of the forester's favourite viewings. NEFD is about statistics. This article commenced life as a response to a request to provide a review of NEFD 6 Ed., but opportunity has been taken to have a look beyond the local picture to the broader canvas, as the title above indicates.

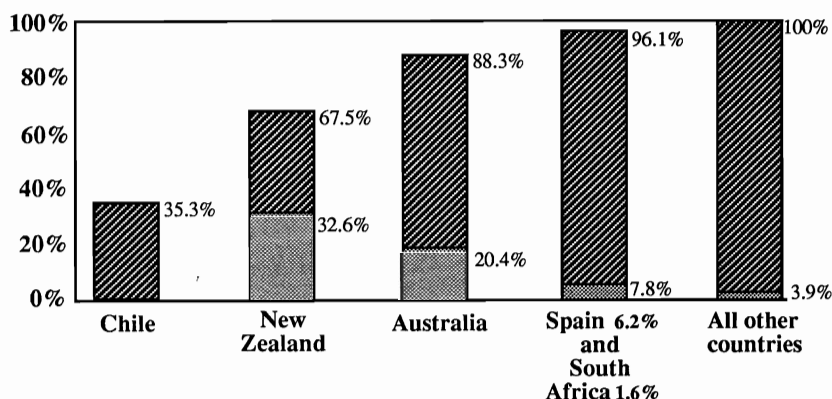
Figure 1 provides an introduction to that broader canvas, and highlights why the Pacific Rim group of Chile, New Zealand and Australia must dominate any discussion about the current global resource of plantation-grown *Pinus*

*radiata*. The radiata story in each of these three countries is a success story, for combinations of reasons, but consistently not the least of these is the market-driven reason that the properties radiata pine wood has displayed have allowed it to move into a broad range of applications across the solid wood, reconstituted wood, and fibre pulp markets. Consequently radiata pine has developed the reputation of outstanding versatility, a premier multi-purpose softwood rather than a speciality timber.

Forest Service plantations now undergoing privatisation. NEFD is the product of a small central unit in Ministry of Forestry (MOF) in Wellington working in conjunction with an informal network of regional data facilitators.

Essentially a detailed plantation area statement and a database by crop type, NEFD is interpreted outside the country as official national statistics. The Description presents nation-wide data aggregated by Territorial Authority (or former united/regional council) as the

Figure 1. Estimated current proportions by area of global estate of *Pinus radiata*, by grower countries (with cumulative proportions left to right)



These notes are largely restricted to commentary on resource description by area and age-class rather than by growing stock volume or by availabilities through simulated woodflow projections. But firstly to the New Zealand resource as described by NEFD.

### NEFD and NZ Statistics

The stated intent of NEFD [Turland & Novis 1990] is "to facilitate the modelling of changes in the forest resource, and to determine processing opportunities and infrastructure requirements". NEFD relies on input from plantation growers, but as a national statement it is ostensibly arm's length from all individual growers, including the Forestry Corporation responsible through NZ Timberlands Ltd for the interim management of the former New Zealand

fundamental geographic unit. Disaggregated information on individual growers is not made available. The majority of the forms of data presented is by way of area statistics in five-year age-classes. NEFD is updated annually, the current edition being compiled by John Turland and John Novis. The hard copy 106 page version can by arrangement be supplemented with greater database detail on disc or tape for computer system analysis.

For the record, the summary table in NEFD reveals a national net stocked exotic forest estate at April 11, 1989 of some 1,239,886 hectares, of which 1,108,203 ha happens to be of the one species. No prizes for guessing which one. Age 1 stands, being 1988 new plantings plus replants, comprise 41,525 ha.

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Since the first editions prepared as Working Papers of the NZ Forestry Council, there has been an ongoing evolution of NEFD under the Steering Committee now constituted by the NZ Forest Owners' Association and MOF.

The simple concept of crop typing is a key and distinguishing element of New Zealand's official statistics on its national plantation resource. Crop typing involves the aggregating of plantation stands "where each stand can be said to grow according to the same yield curve". Over the years there have been changes to the construction of NEFD crop types. The current crop types are defined by four species groupings (radiata pine, Douglas fir, other exotic conifers, all exotic hardwoods), and four silvicultural tending regimes. Gone over the years are productivity stratification within Territorial Authority, percentages of area roaded to a harvestable standard and percentages requiring hauler (cable) logging.

The four categories of tending regime recognised in this edition are:

- \* intensive tending with production thinning (207,944 ha)
- \* intensive tending without production thinning (436,307 ha)
- \* minimum tending with production thinning (103,132 ha)
- \* minimum tending without production thinning (492,380 ha)

where intensive tending refers to pruning carried out prior to age 12 years such that more than 50% of the stems in the final crop stocking will contain a pruned butt log of not less than four metres in length.

In comparison to the previous year's (Edition Five) break-up by tending regime, there appear to be substantial changes – e.g. + 62% change in hectares of the second category above, inferring a dramatic acceleration in the rate of silvicultural tending. However the changes in proportions are primarily an artifact of definition, involving policy change on the part of NZ Timberlands to declaring intention regarding future tending of very young stands.

Data capture methods are also changing over time. With the disestablishment of the NZ Forest Service in 1987 went the primary medium of data collection. The NEFD Management Unit within MOF has been attempting to expand the system of direct data capture – meaning the system by which area statistics by crop types are obtained directly from individual owners, often on floppy disc if not on pro forma returns.

The proportion of area of the national resource that is being monitored by annual returns directly from owners is now up to 85%. Virtually all the larger owners have been adequately forthco-

ming with crop type area data considered to be of high reliability. Nonetheless, comment can be offered on a number of issues relating to data capture and data reliability that one suspects must be affecting the integrity of some aspects of The Description.

Firstly, for example, it is noteworthy that attempts over the last year to solicit full returns for the first time for additional known plantation owners holding between 100 and 500 hectares achieved only a 27% return. A disappointing response rate from this small-to-medium grower sector, warranting appraisal.

A second and related issue is the now quite dated nature of the source data on the surmised "residual resource" – meaning the national estate of smaller private plantations for which information has not this year been directly captured. This component of The Description still has to be derived from the old PRIFO database. PRIFO, the private forest area information system of the defunct Forest Service, probably had its peak level of data integrity back in the so-called halcyon days when NZFS field officers were involved in the administration both of Forestry Encouragement Grants and of Inland Revenue's forestry taxation system. Updating to the present has had to be performed by judicious but subjective extrapolation over the intervening years. Brave assumptions about levels of new plantings, of harvesting and of replanting for the small grower sector *as a whole* often have to be made to complete national statistics, but such figures don't bear local disaggregation. The NEFD "residual resource" components of areas *at the individual Territorial Authority level* must now be considered statistics of dubious quality.

A third matter worthy of comment concerns volume woodflow projections. The NEFD Management Unit considers that NEFD consist of snapshot descriptions which, on their own, have nothing predictive about them. NEFD does quote current annual increments (CAI), but the longer-term future can be readily explored by making use of the various yield tables which are available on request. Woodflow projections are able to be made as a product of coupling the yield tables to the area x age x crop type data. This set of yield tables available currently is a simplified set derived some years back from the multitude of yield tables then in existence. This simplification was through territorial aggregation by united/regional council rather than by any notion of ecosystem territory embracing climatic regional groupings or major soil types. It is not difficult to agree with the suggestion found on page 96 that for more detailed local planning there is requirement for more precise and specific yield information than is

presented in the book version of NEFD. For this level of planning, engagement of accredited forestry consultants or access to NEFD computer database through MOF is required. These issues have been previously discussed in this journal in relation to the fourth edition of NEFD [Whyte 1988].

Rather than describing areas of concern such as the above three examples as major problems or deficiencies, they can be viewed more positively as priority areas for further development of NEFD. Quite clearly the NEFD Management Unit is tackling ongoing evolution of the system in this positive manner. For example, during the coming year there is to be emphasis on improving the level of direct capture of crop type area data from the small-to-medium grower group, and/or a review of options for describing this "residual resource". For the 1991 Description it is intended to incorporate estimates of recoverable log volumes by log types, using the national system of log classification [Whiteside & Manley 1987] that is gaining increasing acceptance and usage. Also on the schedule for the coming year is a full revision of the set of yield tables, though it bears stressing that by design NEFD is a highly aggregated description. As a consequence, projections of indicative availabilities using NEFD yield tables should always be restricted to simulations at overview scales only, meaning for strategic national and regional studies under broad assumptions about future management and harvesting policy.

NEFD is, and is only, a resource state description and not a compendium of broader sector statistics – it is not a NZ equivalent to the annual Chilean "Estadísticas Forestales" (see below). The difficulties of access to broader macro-economic indicators for the industrial sector, and the indirect mechanism for estimation of utilisation levels in terms of total wood removals in New Zealand, remain as described in the previous review [Whyte 1988].

Notwithstanding the obvious areas for enhancement, The Description undoubtedly represents statistics of commendable thoroughness and integrity with respect to the plantation estate at a national perspective. But how does this picture of a local New Zealand system look in the broader perspective of global statistics for *Pinus radiata*? Let's briefly look in turn at the approaches employed in the other two of the big three grower countries.

### Chilean Statistics

Historical evidence about *Pinus radiata* in Chile points to species introduction in 1886, first plantings of a commercial though limited scale in 1907, major plantation development not until the early

1940s, with possibly up to 290,000 hectares of radiata plantations by 1974 [e.g. Contesse Gonzalez 1987]. A dramatic increase since the mid-1970s has seen the national radiata estate increase nearly four-fold. The most current official national statistics [CORFO/INFOR 1990] describe a total radiata resource as at December 1989 of 1,192,287 net hectares with an age-class and geographical distribution as indicated in Table 1.

**Table 1. Chile: confirmed plantation area statement for *Pinus radiata* as at December 1989 (in thousand hectares), by Region of national administration and by age-class**

REGION	Age-class (years)								TOTAL
	<1	1-5	6-10	11-15	16-20	21-25	26-30	31 +	
V + RM	<1	2	4	10	3	2	2	<1	25
VI	3	14	9	22	8	<1	<1	<1	56
VII	15	87	58	45	39	3	1	5	254
VIII	25	120	152	168	73	2	1	1	560
IX	14	72	65	38	15	6	3	2	215
X	7	33	16	21	3	1	<1	2	83
<b>TOTAL</b>	<b>65</b>	<b>327</b>	<b>303</b>	<b>303</b>	<b>141</b>	<b>32</b>	<b>9</b>	<b>11</b>	<b>1,192</b>

Decree Law 701 (DL 701), passed in 1974 and variously amended, has been outstandingly effective in encouraging private afforestation and reforestation. The provisions of the decree have included a rebate system to forestry companies of a proportion (mostly 75%) of most costs involved with the establishment and early tending of plantations, but only on categories of land designated and mapped by survey through a process of national land-use planning. DL 701 is administered by Corporacion Nacional Forestal (CONAF). Intensive management techniques involving high pruning in conjunction with early waste thinning were adopted to a greater or lesser degree by the major companies from the early 1980s. Some optimistic projections indicate that by 1995 up to 75% of radiata plantations in the country could be under *manejo intensivo* (intensive management). Technology transfer from radiata R & D in New Zealand has in the past been considerable, but management regimes adopted are mostly not as "direct" as in NZ in that waste thinnings are more moderate to allow one or two pulpwood-only extraction thinnings at a relatively early age, often by age 13 to 14 years.

Based on the statistics of the time, it appeared that in the early 1980s the country surpassed New Zealand as the world's largest radiata grower on an area basis. The resource on average is considerably younger than in New Zealand, and even more so with respect to Australia. The DL 701 rebate system is due

to terminate in 1994; so it will be interesting to observe subsequent levels of plantation development and intensive early tending. There are strong indications that eucalypt plantation development will come more to the fore.

As was noted by the 1985 NZ Forestry Industry Mission to Chile [Hunter 1987], the quality of national forestry statistics of a macro-economic nature is good, and undoubtedly superior to statistics for

most other sectors of the Chilean economy. They tend moreover to be qualitatively richer and produced more promptly than in other radiata countries. Export markets are tracked in particularly fine detail. The 110 + page annual Estadísticas Forestales [CORFO/INFOR 1990] even includes tabular summaries of a range of wood availability scenarios to the year 2015.

However, with regard to basic area statistics, there were until recent years very real difficulties in obtaining precise area statements for the Chilean plantation resource, or at least in interpreting official statistics. The difficulties arose due to the fragmented nature of ownership, the frequent use of statistics related to gross titled area, and uncertainty about corrections for failed areas.

Through 1981 to 1986, a major inventory project down to individual property level was undertaken. This was a national project involving Corporacion de Fomento de la Produccion (CORFO), Instituto Forestal (INFOR), and other resource organisations. It covered the plantation resource of Regions V to X, within which all Chilean plantings of radiata are to be found, and its objectives, *inter alia*, were to locate and quantify establishment failures, fire-killed stands and other losses as well as to detect plantations omitted by conventional cartography, and to improve discovery of unrecorded stands within plantations.

It no doubt has taken some years for inventories to be purged of earlier ent-

ries that have proven inaccurate for reasons such as poor establishment success, double-counting of replantings, and confusion of gross and net areas. But there is every reason to be confident that this now has largely been achieved, and current national statistics reflect this.

Full inventory of plantation resources of each Region is now ongoing on a five-year cycle. The initial phase of the cycle involves INFOR staff directly and independently re-mapping at 1:50,000 by air-photo interpretation with field checking. The second phase sees full inventory on each property being carried out and documented on central national computer files, recording net hectares, owner, history of pruning and thinning, site index, management status by crop type as either MI (*manejo intensivo*) or MT (*manejo tradicional*), as well as volume from plot data, all by individually defined stand. INFOR's regional reports, which are obtainable as public domain reports, though not widely circulated beyond immediately interested parties, include all data at individual stand level. Very detailed, but also very open, somewhat in contrast to the paranoia about confidentiality sometimes in evidence with radiata growers elsewhere.

Updates prepared by INFOR for annual statistical reports such as Estadísticas Forestales involve the input of figures from CONAF for new plantings, and deduction of clearfelling areas estimated from utilisation figures supplied by CONAF and the major companies. The management status (MI/MT) cannot be updated this way between the five-yearly regional reviews, so is not included in annual National Statistics. However, running estimates (unpublished) are maintained and are currently being used in the national growth modelling project being facilitated through Fundación Chile and Universidad Austral in Valdivia.

From a first-hand examination of the process in Chile, my personal impression is that current area statements from INFOR now have a high level of precision by world standards outside Europe, and the data integrity is successfully being maintained by very detailed ongoing national inventory.

An effect of the phase-in of this upgraded system of area data monitoring is an apparent reduction in earlier plantings, particularly the P1975 to P1985 age-class. The difference in the size of the Chilean and the New Zealand estates of *Pinus radiata* is less than New Zealanders tend to realise, currently (Nov. 90) of the order of 95,000 hectares (author's projection).

## Australian Statistics

Various Commonwealth (federal) government agencies compile and issue national statistics, but *national* forestry statistics should generally be recognised basically as simple aggregations of separate State data sets.

The current official national accounts [ABARE 1990] reveal a *Pinus radiata* land-base as at March 31, 1989 of some 669,698 net hectares, with distribution as indicated in Table 2. In contrast to Chile and to a lesser extent New Zealand, Australia has a softwood plantation estate with an appreciable proportion of "other" conifer species – particularly *Pinus elliottii*, *P. caribaea*, *P. taeda*, and *Araucaria* spp in northern east-coast environments (Queensland and New South Wales), and *Pinus pinaster* especially in Western Australia.

*Pinus radiata* has a long history in Victoria [Lavery 1988], some of the more recent phases involving conservation policy issues about clearing land carrying native vegetation and subsequent interaction with rural sectors feeling threatened by the planting of pines on cleared land formerly used for grazing. Right up till the present, both area and inventory data set for Victorian plantations have been meticulously maintained for the public sector plantations. However, for the private sector estate, the State database has relied on voluntary data returns from the major industrial and investment companies. For other smaller growers, individuals and corporate, the statistics in most cases involve a simple extrapolation of data from a 1978 census by the former Forests Commission, the Victorian forest service which was dis-

established early in the 1980s some years in advance of New Zealand's.

On a national scale it is fair comment that within Australia there has not been the same level of cohesiveness to standardise national accounting of plantation statistics as in New Zealand, where largely only one Government agency is involved and where the one set of crop-type classes is able to be adopted nationally. Maybe it should be viewed as inevitable that there will be somewhat incompatible data sets of statistics from the individual States within the Australian confederation, given the circumstances of sovereign rights of the individual States over direct management of forested public lands.

Nonetheless, the co-ordinating functions of the Australian Forestry Council and the emerging roles of both the recently-constituted Resource Assessment Commission and the National Forest Inventory Unit in Canberra need to be recognised, the first two of these bodies having recently published statements on national forest inventory [AFC 1989, RAC 1990]. In addition, the Australian Forest Development Institute, which is an organisation of private plantation growers, is developing its co-ordinating function with respect to regional inventory of the plantation resource of smaller private growers.

## A Global Perspective

A century and a half back, before substantial human intervention, the global

**Table 2. Australia: confirmed softwood plantation area statement as at March 1989 (in thousand hectares), by State and by sector ownership**

Species	NSW	Vic	SA	Tas	WA	ACT	Qld	NT	Total
<i>Pinus radiata</i> - public	165	101	66	39	38	14	2	0	425
<i>Pinus radiata</i> - private	67	103	26	31	16	0	1	0	244
All other conifers - public	14	3	4	<1	29	<1	165	0	217
All other conifers - private	1	1	0	<1	<1	0	20	4	27
<b>TOTAL ALL CONIFERS</b>	<b>248</b>	<b>207</b>	<b>96</b>	<b>71</b>	<b>84</b>	<b>15</b>	<b>189</b>	<b>4</b>	<b>914</b>

Detailed statements of plantation area are produced annually by the individual States, and these reports are public domain, but only effectively so if one knows where to obtain them. The data sets assembled by the individual State Departments with forestry responsibilities have varying degrees of reliability for private grower area and inventory, but most in true forest service tradition tend still to be models of detail and precision with respect to the area data of the public sector plantation estates.

As an example, let us look at the State of Victoria where the public sector plantations account for 50.4% of the State total, 48.6% being controlled by the Department of Conservation and Environment (DCE) with another 1.8% by other public instrumentalities – and where, incidentally, the State Government has recently announced that this DCE plantation estate is to be privatised. As at June 1990 and not including the P1990 winter plantings, the official statistics [DCE 1990] indicate a total public plus private estate of softwood plantations of some 209,341 net hectares. Some 101,724 ha of this form the DCE plantations, of which 98,803 ha (97.1%) are *Pinus radiata*, and the age-class distribution is indicated in Table 3.

**Table 3. Victoria, Australia: confirmed area statement for DCE softwood plantations as at June 1990, by age-class**

Age (years)	<i>Pinus radiata</i> (hectares)	All other Conifers (hectares)	Total Area (hectares)	Proportion of Total	Cumulative Proportion
1-5	16 261	67	16 328	16.1%	16.1%
6-10	16 936	93	17 029	16.7%	32.8%
11-15	21 834	116	21 950	21.6%	54.4%
16-20	19 967	699	20 667	20.3%	74.7%
21-25	15 923	370	16 293	16.0%	90.7%
26-30	5 891	148	6 039	5.9%	96.6%
31-35	709	82	791	0.8%	97.4%
36-40	427	7	434	0.4%	97.8%
41+	854	1 337	2 191	2.2%	100.0%
<b>TOTAL</b>	<b>98 803</b>	<b>2 921</b>	<b>101 724</b>	<b>100.0%</b>	

estate of *Pinus radiata*, all in natural stands, was less than 12,000 hectares and probably of the order of a mere 10,000 ha. By 1957 the area of exotic commercial plantations of *Pinus radiata* in New Zealand, Chile, Australia, Spain and South Africa reputedly totalled some 625,000 ha [Scott 1960], split 37%, 22%, 20%, 8% and 3% respectively. The global total probably passed the three million hectares mark about 1986, and currently at November 1990 is most likely to be in the range  $3.50 \pm 0.05$  million hectares.

This would represent well over five times the 1957 total, and some 500 times the current area of the five relic native populations – the Californian mainland populations of Año Nuevo, Monterey, and Cambria, and the Mexican off-shore populations on Cedros and Guadalupe Islands. The Guadalupe provenance, var *binata*, in which tree breeders are taking increasing interest, is now almost extinct *in situ* at currently less than 100 trees, though the genepool resource has been successfully captured and is being maintained *ex situ* in a number of locations, primarily at the initiative of CSIRO in Australia in co-operation with FRI in New Zealand through an internationally co-ordinated project.

The proportional breakdown by country of the current world total of radiata plantation area, earlier shown indicatively in Figure 1, highlights how the global resource is dominated more so than ever before by the group of the “big three”, each of which has expanded its resource substantially since the 1960s.

Of the other grower countries, Spain and South Africa form a separate second group, representing a proven viable resource base which nonetheless is not expanding. Spain's radiata resource in the Basque region has in recent times suffered unprecedented, politically-associated sabotage by arson, and while revised statistics are not yet at hand, the radiata land-base in Spain appears now to be a little below the quarter million hectares. In South Africa, the softwood plantation resource (of all conifer species) is more substantial than ever before, but climatic and pathogen circumstances see *Pinus radiata* now relegated to the status of a minor species, accounting for only about 9% by area of the republic's plantation estate.

Of the remaining third group, countries making minor contributions to the global plantation resource of *Pinus radiata* include Argentina, Italy (mainly Sardinia), Turkey, Albania, Ecuador, Kenya, Zimbabwe, Colombia, and Peru. A totally insignificant contribution is made by all other countries that have dabbled with radiata as a plantation species, including for example France, the United Kingdom, Ireland, Greece, and

USA (California and Oregon). Some of the radiata resource of this third group is of dubious commercial viability, and clearly some must be considered non-renewable in view of pathogen introductions – either actual introductions as in the cases of Zimbabwe and Kenya after initial eras of successful radiata establishment, or future pathogen build-up as history suggests is inevitable at high altitudes in very low (near equatorial) latitudes, such as in Ecuador.

English-language statistics in the public domain for the radiata resource in this third group of countries tend to be sketchy and unreliable and sometimes incestuously re-cycled. It appears that no one public organisation is in possession of well-collated statistics with any degree of currency on *Pinus radiata*. In particular, English-language reviews have sometimes substantially misrepresented the resource in the Spanish speaking world. In fact much information in the English-speaking world on this third group might still be best summarised as more anecdotal than hard at this stage.

#### Comments: Chile, NZ and Australia vis-a-vis

The integrity of national statistics on plantation areas in the three largest radiata-grower countries, which account for about 88% of the world total, must be rated as impressive by most global standards outside of Europe. After total net hectares, the next key element of resource description is age-class breakdown, and Figure 2 shows some interesting contrasts. In this diagram, current areas by age for the older age-classes (smoothed by use of five-year age-class projections) are presented as cumulative proportions of respective national estates, to highlight differing levels of maturity between the radiata resource of the grower countries. See also Table 4. The capacity to produce in the short to

medium term is very much a function of the distribution of the older age-classes. While the Australian plantation resource has not yet reached a dynamic state of maturity in equilibrium, its relatively greater maturity is clearly in evidence.

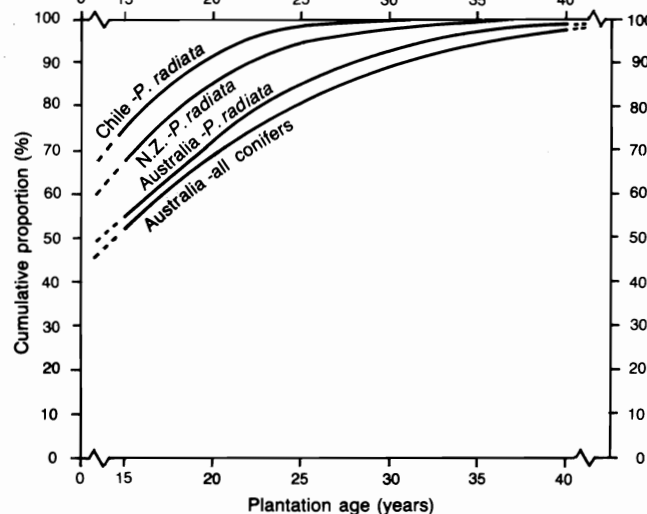
This resource maturity is relevant not only to volume production, but also to quality out-turns from industry as cambial age-related quality considerations come into play. Of particular relevance in the Australian domestic market is that out-turns for the sawmill industry producing structural timbers will be markedly superior – such as in proportions of stress grades greater than F5 – where the resource base allows a high proportion of log input to be from stands beyond 30 years of age.

Data on age-class distribution then can contribute considerable feel for the supply capacity of a national or regional resource and the maturity of the total sector, and this information is generally available. What are not available in the national statistics for the major countries are proportions of plantation estate by productivity rating, such as by yield class in terms of merchantable  $m^3/ha/year$  mean annual increment (MAI) over the rotation and regime employed. The nearest approach is assignment in New Zealand to a broad NEFD crop type with its weighted average CAI.

Subjective perceptions may be unreliable, but this author's firm impression is of a considerably greater proportion of stands of very high productivity in New Zealand than in Chile. This is notwithstanding the large Chilean estate centred on Region VIII in ideal near-coastal climates, and the potential to expand the plantation base in the volcanic zone of the high rainfall pre-Andean foothills, such as in the far east of Regions VIII and IX.

More particularly, consider a yield class (YC) of 14 as a threshold for recog-

Figure 2. Estimated current age-class distribution in plantations in Chile, New Zealand and Australia, as cumulative percentages of respective national totals





**Table 4. Estimated proportions by area of national plantation estates greater than 20 and 30 years old, as at November 1990**

Country	> 20 years old	> 30 years old
Chile - <i>Pinus radiata</i>	7.2%	0.7%
New Zealand - <i>Pinus radiata</i>	15.1%	2.0%
Australia - <i>Pinus radiata</i>	28.1%	7.1%
Australia - all softwood species	31.1%	9.9%

nitiation as *fast-growing*, YC below 6 as *slow-growing*, and YC between 6 and 14 as forming an intermediate category. In Chile, New Zealand and Australia, *radiata* plantations in the *slow-growing* category probably make no *cost-effective* contribution to national woodflows, though to suggest YC<6 is *non-viable* in all circumstances with conifers would, for example, incur vigorous response from most of Scandinavia. A proportion of the northern-most Chilean estate of *Pinus radiata* will never surpass YC6, mainly in Regions V and VI on coastal sands receiving less than 425 mm annual rainfall (in some locations less than 350 mm) and on degraded agricultural lands on clays of the dry interior inside the coastal range. In Australia this proportion of *slow-growing radiata* is lower, and it is negligible in New Zealand. Similarly the intermediate YC6-14 category could be less than 15% of the NZ estate but possibly more than 20% or so in Chile.

This suggests that upwards of 85% of existing *radiata* stands in NZ may be considered *fast-growing* but in Chile the current figure may be downwards of 75% – with the Australian *radiata* estate closer to the Chilean proportions. In its favour Chile has the largest estate, and undoubtedly achieves the highest proportion of total potential volume captured as harvested volume. However, analysis of recent woodflow projections [Hunter 1987, CORFO/INFOR 1990] suggests that there is less potential for sustainable utilisation levels in Chile to surge ahead of New Zealand's than might have been conventional wisdom to believe in the earlier 1980s.

Similarly to *radiata* in some regions in Australia but in marked contrast to plantations in much of New Zealand's North Island, *radiata* in a high proportion of Chile experiences growth conditions that can give rise to trees of quite excellent stem form and fine branching. This is so over a broad range of sites, not just on coastal sands. Thus in the absence of pruning – or above the pruned buttlog – Chile potentially has a competitive advantage in the global marketplace for solid *radiata* wood, particularly for structural grades, by being able to grow a higher proportion of *radiata* with acceptably small knots, albeit more bark-

encased than intergrown knots.

It has recently been observed that the export market is already much more closely linked to the plantation grower sector in Chile than is the case in New Zealand [Hunter 1987], or in Australia. This is to Chile's advantage, but there are signs that requirements for the immediate export cashflow, generated more from the pulping sector than the solid wood sector, may see rotation lengths compromised in the near term. There is a real potential for the appetite of the wood usage system to which the plantations are coupled to dominate the wood-growing system to the detriment of the combined sector, to the tune of 20 to 22 year rotations becoming the norm very soon. This would be many years short of the peak in MAI production for individual stands, and in turn suggests potential at a national level for a substantial compromise of production capability in the medium to longer term. There are severe ramifications regarding future pulplog/sawlog proportions. Of interest to New Zealand foresters is that one of the issues in question is the preparedness of corporate management in Chile to acknowledge the causal link between pruning for premium clearwood production and a sufficiently long rotation to secure an adequate proportion.

To end with an utter aside, it is also of interest to note in the title of NEFD the term *exotic forest*, a term now quite institutionalised in this country. Not so to anywhere near the same extent in the other major *radiata*-grower countries. In Chile, *una plantacion es una plantacion*, even though the property as land is invariably referred to as *el predio* or *el fundo* (farm); and these days the species is most often accorded the common name *pino radiata*, though in Spain *pine insignie* and *pino de Monterrey* still persist. In parts of Australia, any discussion about *radiata* monoculture is likely to generate a variety of exotic if not complimentary descriptions, but a plantation is not so often graced by being referred to as forest. To confuse the discussion it must be stated that in most States of Australia the tenure category of the land-base for public plantations is often termed "State Forest".

*Exotic forest* is a term that did gene-

rate some debate within professional circles in New Zealand in years gone by, but more so the *exotic* component. In this journal a 1980 Editorial [25(2):111-112] addressed the semantics, and in a 1986 Letter to Editor, W.R.J. Sutton exhorted that as "we do not talk about cows . . . or kiwifruit as being exotic anymore has not the time come to regard *radiata* pine . . . as no longer being alien . . . ?" To this reviewer *exotic forest* is a term which should cause one to ask – "What is a forest?" To ask "Is a *radiata* plantation really a forest?" is to pose as much a conundrum as considering "Is a paddock of carrots really an ecosystem?" [To which the Editor added – "No correspondence please".]

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