

## Education and training challenges for the Australian forestry sector: an analysis based on recent trends in university and vocational education and training (VET) completions\*

J.E. Pratley<sup>1,2</sup>, P.J. Kanowski<sup>3</sup> and L.M. Bull<sup>3</sup>

<sup>1</sup>Australian Council of Deans of Agriculture, Charles Sturt University, Wagga Wagga, NSW 2678, Australia

<sup>2</sup>Email: jpratley@csu.edu.au

<sup>3</sup>Fenner School of Environment and Society, Australian National University, Canberra, ACT 0200, Australia

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### Summary

As in other Australian primary industry sectors, there has been increasing concern over the past decade about the skills shortages evident in the forestry sector, and the education and training needs of the sector. The forestry sector, like others in the primary industries, is characterised by relatively low levels of workforce qualifications compared with community-wide averages. We review nationally-consistent data on degree completions at postgraduate research and undergraduate levels, and course completions at vocational levels, in 'forestry' across Australia, and discuss the results in the context of the current workforce at these levels in the Australian forestry sector.

Comparative data for postgraduate research and undergraduate completions were available for the years 1994 and 2005–2007, and the years 2001, 2004 and 2007, respectively. The number of research higher degree completions classified as 'forestry' in the period 2005–2007 was around 20 annually, more or less equally divided between PhD and Masters by research; this was substantially more than completions in 1994. Undergraduate pass degree completions declined by more than 50%, to a total of about 30 annually, over the seven-year period studied (2001–2007). In contrast, honours degree completions increased by about the same proportion, but from a very low base, to around eight annually.

Data for total course completions in vocational education and training (VET) 'forestry' programs were available for the four-year period 2004–2007. Total completions over this period were around 2000, but declined by nearly 50% between 2004 and 2007. These data underestimate participation in the VET sector and predate the establishment of ForestWorks as the sector's Industry Skills Council.

We conducted a simple workforce planning analysis based on available estimates of the workforce employed in the forestry sector and assumed career durations. On this basis, the level of supply of higher-degree research graduates in forestry—at around 20 in 2007—would seem to be of the right order, although our

analysis does not account for the high level of specialisation which characterises both completions and workforce needs. In contrast, the current and projected numbers of undergraduate forestry completions, currently at 19 and projected to decline to 10 by 2013, are well below workforce replacement levels. The decline in undergraduate forestry completions is being offset to an extent by increased numbers of professional Masters graduates in forestry, at around 25 annually, but the combined number of expected undergraduate and professional Masters completions remains less than is required for sustaining the professional workforce at existing levels.

The comparatively low rates of completion of vocational-level qualifications suggest that the vocational-level workforce engaged in forest growing and management, in forest operations and in primary processing will remain less formally-qualified than both the primary industry sector and the community more generally. These results emphasize the need for the forestry sector to continue to focus on, and invest in, the education and training needs of its workforce, at all levels.

*Keywords:* forestry; education; training; personnel; qualifications; planning; demand; supply; Australia

### Introduction

Education and training in the Australian primary industry sector—defined here, following the Productivity Commission (2005:2), as 'the *Agriculture, Forestry and Fishing* division of the Australian and New Zealand Standard Industrial Classification'—have not received the priority they have been accorded in other sectors of the Australian economy (Productivity Commission 2005). For example, in 2004, only about 7% of the primary industry sector workforce was degree-qualified, relative to the proportion in the community as a whole of about 22% (Productivity Commission 2005: 108). While the corresponding proportions were less differentiated, at 32% and 35% respectively, for non-degree qualifications (Productivity Commission 2005: 108), data we present in this paper suggest that the relative level of under-qualification is greater in at least some parts of the forestry workforce than within the primary industry sector generally.

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Over the past decade, key actors in the forestry sector have grown increasingly concerned about the skills shortages evident in the sector, and have responded in several ways relevant to education and training. For example, the peak national forest sector industry associations, A3P<sup>2</sup> and NAFI, collaborated in the conduct of a national survey of skills shortages in the sector (NAFI+A3P 2006), complementing an industry workforce survey report (FAFPSC 2006). On the basis of this information, and in response to other inputs and opportunities, the sector supported the recognition of ForestWorks, the industry representative organisation in the Vocational Education and Training system, as one of the 11 national Industry Skills Councils (Forestworks 2010); and supported the university partnership that successfully sought Australian Government funding for the National Forestry Masters Program (Bull and Kanowski 2009). Forest and Wood Products Australia, the forest sector's national research and development entity, supported studies of options for delivering university-level education in advanced wood processing (Candish 2007; Roberts 2007) and a more recent review of Australian forestry education (de Fégely 2010).

The education and training needs of the production forestry sector extend from those of the variously-skilled workforce in both field operations and the wood processing industries to professional foresters, research scientists and academics (NAFI+A3P 2006; Anon. 2010). Assessment of education and training needs must consider a range of factors, including current and projected numbers in the forest sector workforce, the adequacy of those numbers in relation to various functions and tasks, and the skill levels needed to sustain and enhance the productivity of that sector. Pratley and Copeland's (2008) study of agricultural graduates revealed a long-term decline in supply, and a substantial current skills shortage in that sector—for example, in 2006, there were fewer than 800 agriculture graduates nationally relative to an employment market of several thousand per year. Pratley (2008) made a case for a concerted focus on the need for an educated workforce in the agricultural industry at all levels, including in research and development. At face value, there would appear to be comparable concerns in the forestry sector.

As Pratley's (2008) study of the agricultural sector demonstrates, the availability of data on supply and demand for labour across the sector can inform policy and planning which may otherwise be susceptible to hearsay or even manipulation. A strong basis for such policy decisions is critical given the new opportunities and challenges facing the forestry sector—for example, in forest-based climate change mitigation and adaptation strategies (Garnaut 2007; Wentworth Group 2009), in land management to reduce bushfire risk and impact (e.g. Institute of Foresters of Australia 2009), and in management of the relationship between forests and water (e.g. DEWHA 2010)—as well as the more general issues of maintaining the economic viability and comparative advantage of Australia's forest industries (e.g. URS Australia 2007) and effective management of Australia's forested conservation estate.

To this end, we review available data on degree completions at postgraduate research and undergraduate levels, and course

completions at vocational levels, in 'forestry' across Australia, and discuss these data in the context of the current workforce in the Australian forestry sector. We recognise caveats to the data and to workforce estimates, and do not suggest that the results presented here are more than indicative approximations of education and training needs. We believe, however, they are nevertheless valuable as a starting point for further discussion and policy development.

## Methods

For the university sector, data on postgraduate research and undergraduate completions in forestry from Australian universities were obtained from official records reported to Universities Australia. These data were selected because of their national comparability, both within the forestry sector and across sectors. Their use, however, also imposed some constraints in data availability. In the case of undergraduate completions, the only data available were from 2001, 2004 and 2007; these were used to provide a seven-year period of comparison for both pass and honours degrees. Research higher degree completions data were available for a different period—the years 2005 to 2007 inclusive; 1994 data were also made available to provide a longer-term perspective. Workforce data and the level of education qualification were obtained from information collected by the 2006 Census (Australian Bureau of Statistics 2010).

For the VET sector, data were drawn from information on forestry sector course completions provided to the National Centre for Vocational Education Research (NCVER), over the four years 2004–2007 inclusive. Data were analysed according to level of course and the state delivering the programs. Completions, rather than enrolments, were evaluated, both for consistency with other studies (e.g. Pratley and Copeland 2008) and because only completions provide a consistent measure of the number of formally-qualified personnel. However, as we discuss subsequently, the difference between participation and completion rates is a significant issue in the VET sector, which requires enrolment in a whole qualification even if the participant is pursuing only a subset of units of competency; our results need to be interpreted in that light. As for graduate analysis, workforce size and education profile for the forestry sector were obtained from the 2006 Census.

The data sets we use have the advantage of national consistency and comparability, but also the attendant disadvantages of high-level summary statistics. We draw attention to three sets of issues. The first is that there are discrepancies between workforce estimates made by the Productivity Commission (2005) and those reported by the 2006 Census; different workforce categorisations in the two make it difficult to reconcile the estimates. Secondly, postgraduate research completions relevant to the forestry sector may not be classified by either graduands or universities as 'forestry', and thus those data may underestimate the total number of completions associated with forestry and forest science. Thirdly, as we note in the text, we have been forced to make assumptions about the relationship between research expenditure and the research workforce. Future studies should seek to address these issues to the extent possible.

<sup>2</sup>A3P = Australian Plantation Products and Paper Industry Council; NAFI = National Association of Forest Industries

## Results—completions

### Undergraduate completions

The number of universities offering undergraduate forestry degrees (by a variety of names) in Australia has fluctuated over the past decade; for example, in 2005, six universities offered such degrees (Kanowski 2005); by 2009, only two—the Australian National University and Southern Cross University—continued to offer undergraduate forestry programs. The structural changes at the University of Melbourne that terminated the undergraduate forest science degree and introduced a professional Masters of Forest Ecosystem Science postdate the data used here; and enrolments at the other universities that had offered a forestry degree in 2005—Edith Cowan, Queensland and Tasmania—were low. The results reported here should be interpreted in this context.

Over the seven-year period studied (2001–2007), there was a decline of about 55% in undergraduate pass degree completions, to a total of about 30 per year (Table 1). In contrast, honours degree completions increased but by a lesser proportion and from a very low base (Table 1).

### Research higher degree completions

The number of PhD completions in the period 2005–2007 was substantially more than in 1994 (Table 2). Within the 2005–2007 period Master degree completions declined although PhD levels were maintained. In 2007, however, there was a decline in Master degree completions to below 1994 levels, whereas PhD completion numbers were maintained over the period. In 2007, the total number of research higher degree completions in forestry, of 20, was split more or less equally between Master and PhD degrees.

### VET completions

Data represent completions under the ‘Forest and Forest Products’ Training Package; given our focus on ‘forestry’, completions for

the Pulp and Paper Manufacturing Industries Training Package were excluded. During the reporting period, the Forest and Forest Products Package comprised both one general, eponymous, course offered at each of Certificate 1–4 and Diploma levels, and 10 specialisations—in Forest growing and management, Forest operations, Harvesting and haulage, Sawmilling and processing, Timber manufactured products, Timber merchandising, Timber processing, Saw doctoring, Wood machining and Wood panel products—offered variously at Certificate 2–4 levels. Almost all (93%) forest sector completions in the period 2004–2007 were recorded in the general course; most specialisations had no recorded completions in most years, reflecting the recording of completions against the general course.

Total course completions in VET forestry programs over the four-year period were around 2000, but there was a substantial decline over the period of analysis from 667 completions in 2004 to 344 in 2007 (Table 3), that is a 48% reduction. There are two caveats to these results: firstly, they predate the establishment of ForestWorks as an Industry Skills Council, in December 2007; secondly, they should be interpreted in the context of differences between participation and completion rates in the VET sector, which we discuss further below.

Most completions were at the Certificate 2 (46%) and Certificate 3 (48%) levels (Fig. 1), and there was a substantial decline in completions at both levels over the study period. Certificate 4 completions comprised only 4% (76 over the four years), and Diploma completions only 0.5% (11 over the four years), of the total over the study period.

Within the Forest and Forest Products Package, there was a reasonable spread of course completions over the period

**Table 1.** The number of undergraduate completions in forestry from Australian universities for the years 2001, 2004 and 2007

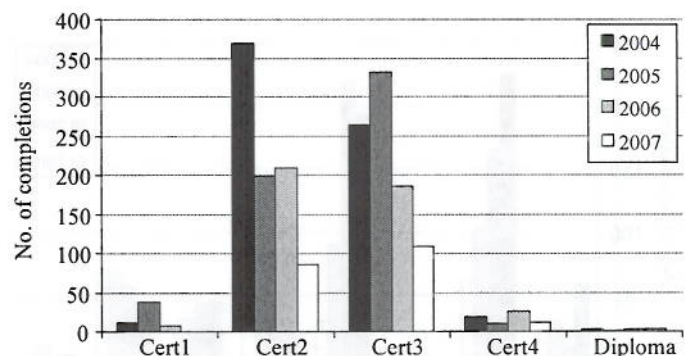
Year	Pass	Honours
2001	50	6
2004	27	7
2007	23	8

**Table 2.** Research higher degree completions in forestry from Australian universities for the period 2005–2007 relative to 1994

Year	Doctorate	Masters by research
1994	5	14
2005	9	15
2006	11	10
2007	11	9

**Table 3.** Total course completions in VET programs in forestry across Australia, 2004–2007

Year	Completions
2004	667
2005	579
2006	439
2007	344



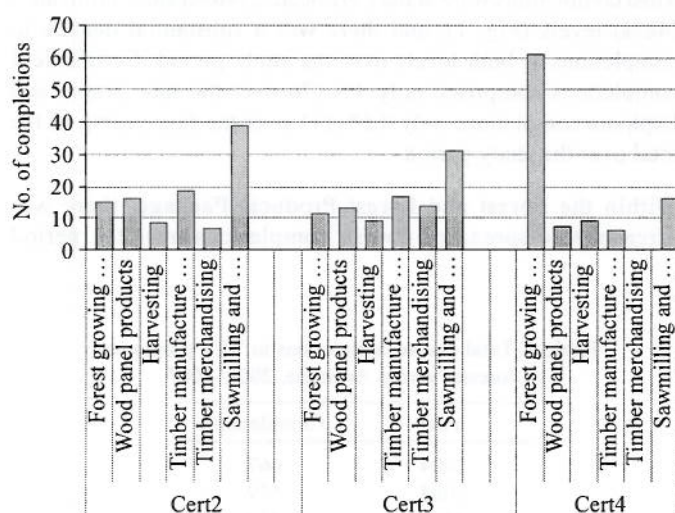
**Figure 1.** Number of VET course completions in Forestry in Australia by course and level, 2004–2007 (\*‘Cert1’ = Certificate 1 etc.)

2004–2007 (Fig. 2). At Certificate 3 and 4, the sawmilling option represented 39% and 31% respectively of completions at those levels, whereas forest growing represented 61% of completions at Certificate 4 level.

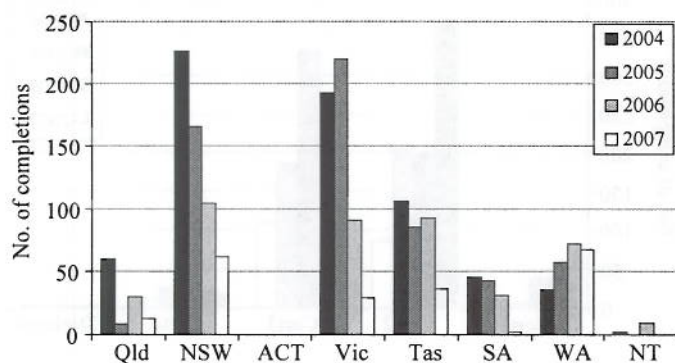
In terms of geographic distribution of training, VET forestry courses were offered in all states (Fig. 3). Most completions were in NSW (30%) and Victoria (27%); Tasmania represented 16% of completions and Western Australia 12%, whilst Queensland and South Australia represented about 6% each. There was a noticeable decline over the four years in completions in NSW, Victoria and Tasmania, whilst completions in Western Australia increased in each year of the study period. The latter presumably reflects, at least in part, the expansion and maturing of the eucalypt plantation estate in SW Western Australia.

#### *Caveat: participation and completion in the VET sector*

We have noted above that completion rates for formal qualifications underestimate participation in VET-sector training. This is a consequence of several factors, including the VET-sector requirement that training participants enrol in a ‘whole’



**Figure 2.** Course completions at Certificate 2, 3 and 4 levels within the Forest and Forest Products Package, 2004–2007 (\*‘Cert2’ = Certificate 2, etc.)



**Figure 3.** Total course completions in VET programs in Forestry in Australia by state and territory, 2004–2007

qualification even though they may be seeking to complete only a small subset of units of competency related to their particular skills needs (M. Hartman, ForestWorks, *pers. comm.*, April 2010). For example, ForestWorks data record participation in a total of 5446 units of competency in the forest sector in 2008, 99% of which were at Certificate 2 and 3 levels (Hartman 2009). Completions data consistent with our 2004–2007 data were not available for 2008, but the pattern of completions—in terms of almost all being at Certificate 2 and 3 levels (94% of 2004–2007 completions)—is comparable to that for participation which ForestWorks reports for 2008. Assuming, in the absence of better information, that 2007 and 2008 completions were similar, formal completions would represent around 6% of overall participation in VET-sector forestry training.

#### **Workforce estimates**

The two principal sources of relevant workforce data are the Productivity Commission’s 2005 report on Australian Agriculture and the 2006 Census. The Productivity Commission reported a total of about 12 000 people employed in the ‘forestry and logging sector’ in 2003–2004; about 3500 of these were in NSW, slightly fewer in Tasmania, and about 2000 in Victoria (Table 4). The difference between this number and the  $\approx 77\ 000$  reported for the ABS categories of ‘forestry, logging and manufacturing’ (2007–2008 figures; DAFF 2010) reflects the majority employment in the manufacturing category.

#### **Professional foresters and forest researchers**

The 2006 Census reports workforce data separately for professional and labour workforce components. The total number of ‘forestry scientists’ (i.e. those reporting a professional forestry qualification) was  $\approx 1500$ ; the highest degree and gender of those so identified are shown in Figure 4. The largest category (40%) had a Bachelor degree; 11% had a postgraduate degree. Some 18% have qualifications outside that recognised by the Census process, most likely representing international qualifications. Women comprised 16% of the workforce in this category, but held 24% of the higher degrees and 28% of the Bachelor degrees.

Estimates of the Research and Development workforce in forestry can be derived from ABS data based on organisation reports on RFCD expenditure (Table 5). These include both scientists and technical support, and thus require some assumptions to

**Table 4.** The distribution of the forestry and logging workforce in Australia in 2003–2004, according to the Productivity Commission (2005)

State or territory	Number ('000)
Queensland	0.3
New South Wales	3.6
Australian Capital Territory	<0.1
Victoria	2.1
Tasmania	3.4
South Australia	1.3
Western Australia	1.4
Northern Territory	0.1

enable interpretation, as noted in Table 5. Some 40% are listed in the university sector and about 25% in the government sector. Although not listed in Table 5, there are an estimated 138 in the business sector as well but their areas of specialisation are not provided. The overall number, of ≈500, accords well with results of the research provider survey undertaken for the national *RD&E*

*Strategy for the Forest and Wood Product Sector*, which estimated ‘500 FTE researchers, technicians and other support staff were ... involved in research in the forest and wood products sector’ in 2007–2008 (Anon. 2010).

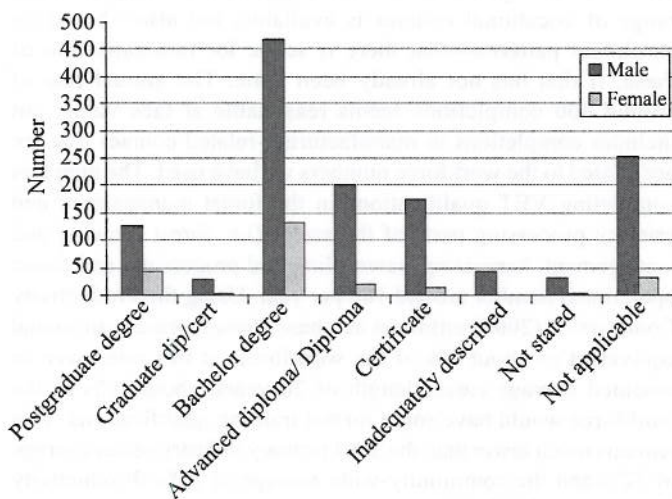
**Forestry and logging workers**

There were 3378 people categorised as ‘forestry and logging workers’ in the 2006 Australian Census (Table 6). Those identified as the category ‘Forestry worker’ comprised nearly 58% of those listed, followed by ‘Tree fallers’ at ≈26%. Some 19% had Certificate qualifications, and around 6% had qualifications higher than Certificate level (Table 7). The educational qualifications of about two-thirds were categorised ‘not applicable’: that is, no formal qualifications. The workforce was predominantly (93%) male.

**Indicative workforce planning: likely education and training needs**

**Foresters and forestry scientists**

Focusing first on those engaged in research and development, our estimates of total R&D personnel, and those of the national RD&E Strategy, were each ≈ 500; the latter estimated a research scientist workforce of around 290. The 2006 Census data suggest an active professional workforce of around 1500 foresters and forestry scientists in Australia, 11% (≈ 165) of whom have degree qualifications higher than bachelor level. Assuming for simplicity that most of those with higher degree qualifications are engaged in R&D, augmented by some with undergraduate degrees and others with qualifications outside the Australian system of qualifications (18% of total), Census-derived estimates of the number of forestry scientists appear to be of the same order of magnitude as those derived by other means. Pratley and Copeland (2008) estimated workforce needs in agriculture based in the average length of a graduate in a career. On this basis, assuming a 20-year career for research scientists and a current research scientist complement of 290, an annual research higher degree completion rate of



**Figure 4.** The number of professional foresters in Australia, based on the 2006 Census and qualifications indicated (ABS 2006)

**Table 5.** Human resources devoted to forestry R&D in 2006–2007 (derived from ABS data)

Field	University	Government
Forestry sciences	1	0
Nutrition and physiology	21	2
Tree improvement	25	40
Pests, health and diseases	40	3
Management and environment	69	45
Fire management	22	11
Agroforestry	20	5
Forestry sciences not elsewhere classified	27	37
<b>Total forestry science</b>	<b>225</b>	<b>143</b>

Caveats: As human resources devoted to R&D are not collected by RFCD, this information is derived using the RFCD relationship to total R&D expenditure. For example, if an organisation reports multiple RFCDs with varying percentages (which relate to total expenditure), they have been applied in the same ratio to human resources. All reported RFCDs are represented against the reported human resources values for an organisation, which may or may not be wholly accurate. Thus these estimates should be used with caution, and with the following caveats: that the user must be aware of the derivation method; and that these data may be ‘published’ elsewhere only with the annotation ‘Derived from ABS data’.

**Table 6.** The number of forestry and logging workers as identified by the 2006 Australian Census

Category	Number
Forestry and logging workers nfd*	99
Forestry worker	1942
Logging assistant	472
Tree faller	865

\*nfd = not further defined

**Table 7.** Education qualification levels of forestry and logging workers according to the 2006 Australian Census

Gender	Postgraduate degree	Graduate diploma or certificate	Bachelor degree	Advanced diploma or diploma	Certificate	Other*
Male	14	6	118	176	1190	4776
Female	0	0	52	20	84	320

\* ‘Other’ includes inadequately described, not stated or not applicable

around 15 would maintain current capacity. This gross estimate does not take account of the differentiation between research areas—for example, a graduate in forest hydrology is unlikely to fill a vacancy in forest genetics—nor of growth, or diminution, in research needs, but it does give some sense of the overall numbers likely to be required. On this admittedly crude basis, the level of supply of higher-degree graduates in forestry—at around 20 in 2007—would seem to be of the right order.

Assuming—again simplistically—that professional workforce demand remains at the 1500 foresters or forestry scientists identified by the 2006 Census, and that they must first attain a Bachelor-level degree or the equivalent in ‘forestry’ regardless of whether they work in forest management or research, and using the same logic and caveats as those described above, one can derive simple estimates of requisite graduate numbers. For example, assuming an average 20-year professional career suggests a requirement for 75 undergraduate completions annually. If careers in forestry were to average 30 years instead of 20, workforce replacement would require 50 graduates per year.

More recent data on undergraduate completions from ANU and Southern Cross University, the two Australian universities still offering undergraduate forestry degrees, suggest that completions are continuing to decline, averaging 18 for 2008–2009; only 10 undergraduates accepted offers of places in undergraduate forestry degrees in 2010 (ANU and SCU internal records), corresponding to the approximate number of graduates likely in 2013. Given the larger changes underway in professional education, epitomised by the replacement of the University of Melbourne undergraduate degree in forest science by a professional Masters, graduates of professional Masters coursework degrees in forestry and forest science should also be included in this graduating cohort for workforce planning purposes. Participation in the National Forestry Masters Program averaged 27 students in 2008–2009, 70% of whom were enrolled at the University of Melbourne. Together, these data suggest a current graduating cohort, of undergraduate and professional Masters students, of around 45 annually. However, declining undergraduate enrolments suggest that the number of professional Masters students will have to grow, by around another third, if current graduating numbers are to be maintained; this also emphasizes the need, as Bull and Kanowski (2009) have argued, for the forestry sector to support coursework Masters programs. Based on the indicative estimates above, an annual graduating cohort of at least 75 seems likely to be necessary to sustain the current professional workforce. Given that not all forestry graduates will work in the forestry sector, in practice additional graduates will be required to cover this ‘leakage’. Nor do these simple estimates include the potential growth of the workforce that might be associated with, for example, the expansion of carbon forestry. It is clear, therefore, that the data suggest that the current graduating numbers of professional foresters, of undergraduate and professional Masters students combined, are well below likely industry needs.

#### Vocational-level workforce requirements

In the vocational-level workforce, there is a substantial discrepancy between the estimates of the Productivity Commission (2005), of around 12 000, and the data reported by the 2006 Census. The latter included those listed in combined categories

such as ‘Farm, Forestry and Garden Worker,’ who have not been included in this analysis because of attribution difficulties. These total about 5100, bringing the total Census estimate for the forestry sector to around 8500. There are also differences in the proportion of the workforce recorded as having vocational qualifications. Further research is necessary to interpret these data sets and understand their differences.

The VET Package and course data suggest that a comprehensive range of vocational courses is available, but also—based on enrolment patterns—that there is scope for rationalisation of these, if that has not already been done. The annual rate of around 400 completions seems reasonable at face value, but includes completions in manufacturing-related courses that are not related to the workforce numbers we have used. The numbers completing VET qualifications in the forest management and primary processing parts of the sector (i.e. forest growing and management, harvesting, sawmilling and processing, and forest operations) number around 160 per year. Using the Productivity Commission (2005) estimates as a base, these represent an annual equivalent of about 1% of the workforce; at this rate, over an assumed average career length of 20 years, about 20% of the workforce would have some formal training qualifications. This remains much lower than the 2004 primary industry sector average of 32% and the community-wide average of 35% (Productivity Commission 2005: 108).

As noted previously, we recognise that the VET sector is characterised by significant participation in training in units of competence that do not necessarily lead to completion of a formal qualification under the AQF framework, and that this training contributes to building a more skilled workforce. While acknowledging the importance and value of this training, we also note that the progression of individuals to higher levels of qualification, and the development of a more qualified workforce, are contingent on the completion of formal qualifications, as well as on participation in training in particular units of competence.

#### Conclusions

In summary, the indicative and necessarily limited analysis and workforce planning exercise reported here suggests that the rate of research higher degree completions in forestry appears to match current workforce needs in aggregate, although our analysis has not considered the needs for particular, non-interchangeable, specialisations. The rate of graduation of professional foresters, from undergraduate and graduate coursework degrees combined, seems—at best—at the lower end of numbers required to maintain the current workforce, and at least around 50% below replacement rates. This result is similar to findings in relation to agriculture, which showed graduation rates well below half of those required by industry to maintain a professional workforce (Pratley and Copeland 2008). The level of qualifications, and the rate of completion of formal qualifications, in the vocational-level workforce engaged in forestry and primary processing suggest that this workforce will remain less qualified than the primary industry sector and the community more generally. These conclusions underline the need for the forestry sector to continue to focus on, and invest in, the education and training needs of its workforce, at all levels.

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