

## Graduate Programs in Forest Engineering and Forest Operations: Working Towards Extinction!

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### INTRODUCTION

Courses in forest engineering, forest operations, and harvesting are taught at many colleges and universities across the United States and Canada. At some universities, these disciplines have evolved into programs with advanced studies offering the M.S. and Ph.D., with an emphasis in forest operations or forest engineering. Programs offering a Ph.D. in forest engineering include Oregon State University, University of Washington, Auburn University (Listed as Agricultural Engineering or Forestry), University of Maine, State University of New York, and University of New Brunswick. Programs that emphasize forest operations include Virginia Tech and the University of British Columbia. Other universities also offer programs in these fields, but typically offer education in this discipline as a component of a larger program, usually in forestry, forest resource management, engineering, or wood science. Most accredited forestry programs in the United States and Canada offer courses in forest operations, taught by a faculty member with at least some graduate level education in forest operations or forest engineering. In fact, this component of undergraduate education is typically recommended by accrediting forestry associations, such as the Society of American Foresters (SAF), the Society of Wood Science and Technology (SWST), and the Canadian Institute of Forestry [8, 9].

Three recent surveys have focused on forestry education, although only one survey, conducted by Brock, examined forest engineering education directly [2, 3, 4]. The survey conducted by Brock identified 13 university-based programs that focused specifically on forest engineering education for undergraduates [2]. Brock also identified 29 programs that were involved to some extent with forest engineering research. However, he did not examine graduate research in his survey. Hartsough and Stokes [4] in a later study, indirectly identified 26 university-based programs that reported some involvement with forest engineering education through graduate research.

Opportunities for doctoral graduates in forest operations or forest engineering have been very promising over the last ten years. Universities prefer to hire faculty members with a Ph.D. to candidates with an M.S. or B.S. The limited number of programs offering a terminal degree in this discipline has resulted in a

### ABSTRACT

The availability and employment potential of doctoral graduates in forest engineering and forest operations across North America is explored in this paper. Past graduation rates, along with current and future employer needs for these graduates were examined through a survey of University-based programs, private companies, and public agencies. The survey suggests that graduation rates for doctoral students are low across North America. Currently, academic openings exist at several Universities and suitable candidates for these positions are not currently available. The survey showed that only half of the students who graduated in the past ten years pursued an academic career after graduation. Based on noted graduation rates, the need for qualified doctoral graduates will steadily increase at many University-based programs.

Survey results of companies and public agencies suggest that the predominant public employer for graduates over the last ten years was the USDA Forest Service, although current attitudes within this agency may limit future employment opportunities. Private companies provide some opportunity for additional employment, although only the largest forest product companies seem willing to hire doctoral graduates. In this survey, only three of the surveyed companies had employees with a doctorate in forest operations or forest engineering.

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low graduation rate and doctoral graduates in this field are easily placed, due to the large number of openings in the academic community in recent years. Many faculty members hired in the seventies are now retiring, and universities are hoping to fill these vacancies with bright young Ph.D. graduates who will forge new careers at their institutions.

In fact, extended vacancies at several forestry schools in the U.S. and Canada suggest there is a significant shortfall in the number of available Ph.D. candidates in forest engineering and forest operations. At the University of British Columbia, the Forest Management Department recently hired a lecturer with a B. S. to fill a position that had been vacated by an Assistant Professor having a Ph.D. As indicated by a faculty member on the search committee, no qualified applicants responded to the position announcement [5]. The Wood Industries program at West Virginia University is currently receiving applications to fill a forest operations position for the second time in two years. The first search yielded no qualified applicants [1]; A second search is currently underway. A similar situation exists at Auburn University [10]. At Virginia Tech, a lecturer with an M.S. was recently hired for a forest operations position originally advertised as requiring a doctorate degree [7].

In many cases, tenured faculty already established in these programs made the decision to relocate to another university. These relocations, combined with the low number of available applicants, lead to a "domino" effect on hiring efforts. A person relocates, their position opens up, and a faculty member at another university is hired away to fill the position. In essence, no new faculty members have been introduced into the system.

What are the factors that have helped to create this situation? First, faculty retirements have increased as professors hired in the academic "boom" of the seventies reach the end of their careers. In addition, recruitment for both graduate students for this discipline has become much more difficult. Many students now prefer "environmentally friendly" careers rather than those that focus on timber production management, reducing the pool of potential graduate students each year. Additionally, external funding to support research in this field has declined, particularly through the forest industry and federal agencies, leading to less support for graduate students.

Students who do graduate from forest operations and forest engineering programs are highly sought by the forest products industry. For example, sur-

veys of graduates from the Wood Industries program at West Virginia University indicate that most of the graduates from that program, over 92 percent, typically find employment in their career field (1). This is significantly higher than placement percentages for many other natural resource programs.

These factors have resulted in a situation where fewer undergraduates are pursuing careers in forest operations or forest engineering. Many students no longer consider graduate education an attractive option, since the financial opportunities available through immediate employment are so lucrative. Moreover, most important, few graduate stipends will compete effectively with salaries offered by most forest product companies.

However, there has been little hard evidence to support the assertion that the discipline faces a decline in the number of qualified doctoral graduates. Nor can we predict how this decline, if it exists, might affect the future of the discipline. Because of this uncertainty, a survey was conducted in the fall of 1998 to clarify the current situation in academia relative to forest engineering and forest operations. The survey also addressed future academic demand for professors in these fields, as well as demands for these specialists from the private and public sector.

## SURVEY RESULTS

Representatives from twenty forestry programs at well known universities across the United States and Canada were contacted and asked to complete a survey addressing forest operations and forest engineering programs. Survey results are summarized in Tables 1 through 4. Programs were assigned to one of four regions in North America; North, South, Central, and West.

### Graduates

Results indicate that the 20 surveyed programs generated approximately 34 doctoral graduates over the last ten years (Table 1). While this figure is not compared with other forestry-based disciplines, the number of graduates over this period seems low at less than four graduates annually across North America.

The number of graduates produced by specific programs ranged from zero to six over the ten-year period from 1988 to 1998. Each listed region contained at least one program that produced a large

Table 1. Summary survey statistics on Ph.D. graduation levels from Forest Engineering and Forest Operation programs in North America over the last ten years.

Academic Institution	Ph.D. Offered?	Region <sup>1</sup>	Graduates Since 1990	Where Employed?		
				University	Private	Other
				Unknown		
U of British Columbia	Yes	W - CA	0	NA	NA	NA
Auburn U (AL)	Yes	S	0	NA	NA	NA
U of California (Davis)	Yes	W	1	0	0	0
Clemson U (SC)	No	S	NA	NA	NA	NA
U of Florida	No	S	NA	NA	NA	NA
U of Georgia	Yes	S	1	0	1	0
U of Idaho	Yes	W	1	0	0	0
U Laval	Yes	M - CA	1	0	0	0
Lehigh Univ.	No	S	NA	NA	NA	NA
U of Maine	Yes	N	2	0	0	2
U of Minnesota	Yes	M	1	0	0	0
Mississippi State U	Yes	S	4	2	1	0
U of New Brunswick	Yes	N - CA	4	3	0	1
State U of New York	Yes	N	5	4	1	0
North Carolina State U	No	S	NA	NA	NA	NA
Oregon State U	Yes	W	5	0	0	0
Purdue State U	Yes	M	2	0	1	0
Virginia Tech	Yes	S	6	0	2	1
U of Washington	Yes	W	1	0	0	0
West Virginia U	Yes	S	0	NA	NA	NA
<b>Totals</b>			<b>34</b>	<b>13</b>	<b>11</b>	<b>4</b>

<sup>1</sup> Programs in Canada are designated with a CA.

number of doctoral graduates over the ten-year period. However, no program produced more than six doctoral graduates over the surveyed period.

The North, with three programs, generated 11 Doctorates over the ten-year period. Southern programs, with nine Universities surveyed, also produced 11 Doctorates over the same period. Five programs from the West produced eight Doctorates, while the Central region programs generated only four. At the national level, three Canadian programs generated five doctorates, while 29 students graduated from programs in the United States.

Where did these graduates find employment? Only 13 actually returned to an academic program, presumably as an Assistant Professor. Eleven graduates went on to private employment. Another six found other employment opportunities, probably with federal or state agencies. Finally, placement arrangements for four graduates were unknown.

Placement of such a large number of graduates into private industry indicates that significant employment opportunities exist for doctoral graduates in North America. The strong ties, academically and through research, between faculty in these programs and local forest products companies also help to create job opportunities for them with the forest industry. University-based programs should realize that these job opportunities will continue to draw potential candidates away from academic careers.

It is difficult to determine if graduates at the doctoral level can expect comparable employment opportunities with state and federal agencies. At least one federal agency in the U.S. refocused its mission over the last ten years to significantly reduce job opportunities for graduates from forest operations and forest engineering programs [6]. State agencies may also refocus their mission and may reduce job opportunities in these fields. This survey was not of sufficient detail to provide specific information about past employment by doctoral graduates with federal and state agencies.

Programs also include some foreign doctoral graduates. It is likely that several of these graduates fell into the last category of employment listed in the survey. These graduates typically have close ties to their home country, and in some cases receive obligated funding from their government to pursue their graduate education. These ties and obligations have probably encouraged some doctoral graduates to return to their home country, further reducing the number of

potentially employable doctoral graduates in North America.

### Faculty

A total of 61 faculty members with responsibilities in teaching and research in forest operations or forest engineering were identified in the twenty surveyed programs (Table 2). Again, select programs have significantly greater numbers of faculty than most of the other programs. A total of 24 faculty members were concentrated in only three programs. Many programs had one to two faculty members in this discipline area; just enough to provide the minimum needed to fulfill accreditation requirements.

The survey results also indicate a skewed distribution in rank for the faculty in these programs. Eight lecturers, faculty without a doctoral degree and typically no research responsibilities, are currently employed across the twenty programs. Only eight tenure-track faculty members, Assistant Professors working to obtain tenure, were reported. Finally, 45 professors were classed as tenured, where the professor is tenured and has the rank of either Associate or Full Professor.

The eight Assistant Professors reported in the survey were relatively young, with a reported average age of 37 years. Fourteen Associate Professors were reported with an average age of 46 years. Finally, the 20 programs reported 31 Full Professors through the survey, and they averaged 51 years in age. The distribution of faculty for the twenty surveyed programs is extremely skewed (Figure 1).

The proportion of faculty at the rank of Full Professor is significantly greater than all other categories. Over 51 percent of all faculty members reported in the survey fall into this category. And, while many of these professors are a long way from retirement, several programs will probably have significant numbers of faculty retirements in the next five to ten years. At least three programs have a large number of full professors very near retirement age. These figures, in conjunction with other information developed from this survey, suggest that programs where retirements are imminent will have difficulty recruiting new faculty in this discipline, unless the programs are willing to hire lecturers instead of Assistant Professors - or develop contingency plans to address this problem.

It is obvious, however, that in the next ten to fifteen years, this discipline needs to address the low pro-

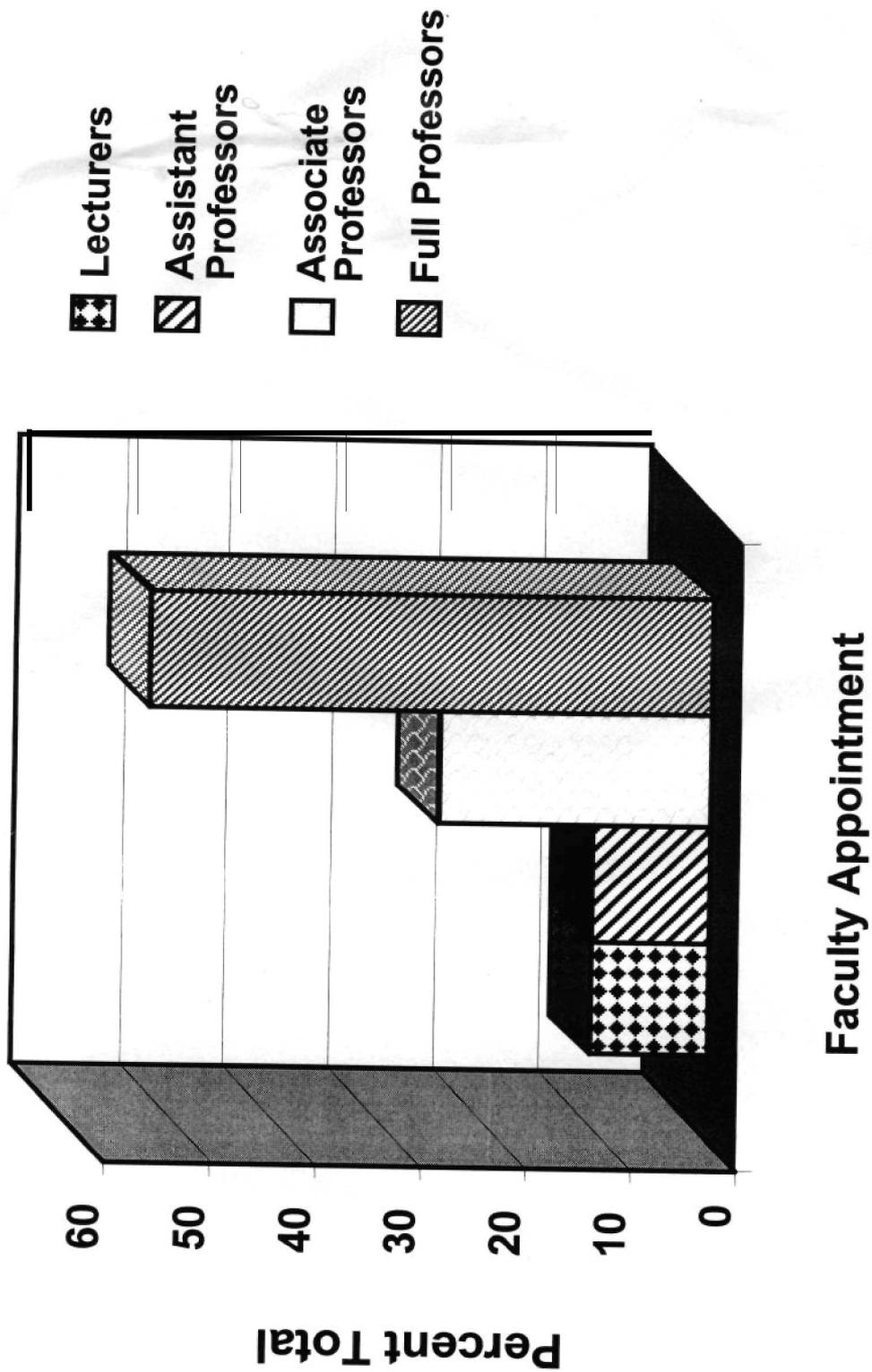


Figure 1. Distribution of faculty from surveyed programs based on rank.

**duction** of doctoral graduates, The survey results point to the obvious conclusion that few graduates will ever be available in any given year. Most important, the lack of available candidates to fill future openings will most certainly affect the potential of this discipline to survive or expand over time. It could, in fact, affect the decision to maintain specific programs within some universities.

If some programs are reduced or eliminated, survey results suggest that doctoral graduation rates could plummet even further. Since one or two programs generate a large proportion of the doctoral graduates in a region, reductions in these programs could dramatically reduce Doctorate graduation rates. In a "Catch-22" type conundrum, programs will be unable to fill faculty openings, the discipline will fail to meet minimum University standards for faculty staffing, and the program will eventually be eliminated.

Some programs are already preparing for problems. At least four programs forecast that, after the senior faculty members in this discipline retire, the program will not continue (Table 3). While these are relatively small programs, the question remains, -will this trend continue, particularly if we factor in the problems associated with suitable faculty replacements? When asked about the possibility of hiring new faculty in the near future, five programs responded affirmatively. With the small applicant pool known to exist, what options will these programs really have?

Nine programs indicated that, in the long term, they would seek new faculty. Who will they find? It is impossible to tell under the circumstances. However, without a concerted effort at promoting graduate education in this discipline, the future looks somewhat bleak for academic programs trying to hire new doctoral graduates.

### Public and Private Sector

Thirteen representative groups were surveyed to determine the number of employees with a Doctorate in Forest Engineering or Forest Operations (Table 4). Survey results suggest that the predominant public employer for graduates over the last ten years was the USDA Forest Service, although current attitudes within this agency may limit future employment opportunities. In Canada, the Forest Engineering Research Institute of Canada (FERIC) employed only one person with a doctorate in this discipline. The Canadian Forest Service has no forest engineering responsibilities, deferring to FERIC.

Limited opportunities were noted for additional employment through private companies, and only the largest forest product companies seem willing to hire doctoral graduates. In this survey, only three of the surveyed companies had employees with a doctorate in forest operations or forest engineering. In addition, few of the companies surveyed felt that employees with doctoral degrees would be sought in future hiring efforts. No Canadian companies were polled, although at least two western companies are known to have research programs where applicants with doctoral degrees in this discipline might find employment. In contrast, some companies like Weyerhaeuser Corporation and MacMillan Bloedel Ltd. have reduced or eliminated their research emphasis in forest engineering and forest operations over the past ten years.

### CONCLUSIONS

Graduation rates for doctoral candidates in forest engineering and forest operations are very low. Several academic programs across North America are now having difficulty filling vacant positions in this discipline. Survey results suggest that this trend will probably continue, unless steps are taken to encourage more students to consider an academic career in forest engineering or forest operations. This will require a concerted effort from the academic community and the forest industry to promote graduate education.

A predominant number of the faculty members at the twenty surveyed programs are Full Professors, and many are nearing the age of retirement. Certainly, within ten to fifteen years, we can expect more vacancies in this discipline. Without a higher graduation rate of doctoral candidates, positions will either not be filled, or filled with lecturers.

In either situation, the discipline could suffer. If a position cannot be filled, many universities will probably examine retiring the program, rather than hire individuals from affiliated or marginally related disciplines. If programs choose to hire lecturers, there is rarely any assigned research responsibilities. Rather, the lecturer typically has only one responsibility -to teach. Consequently, university driven research in the discipline will suffer under this alternative.

Private and public sector hiring rates for doctoral graduates seem to have declined in recent years, particularly in the public sector. And public sector recruitment of doctoral graduates in this discipline will

Table 3. Summary survey statistics on future direction of Forest Engineering and Forest Operations programs relative to hiring and program growth.

ACADEMIC INSTITUTION	WHEN FACULTY RETIRES, WILL PROGRAM CONTINUE?	PLAN TO HIRE NEW FACULTY?		PLANS FOR FUTURE DOWNSIZING?	COURSES TAUGHT BY NON-TENURE TRACK PROFESSIONALS?
		Current	Future		
U of British Columbia	Yes	Yes	No	Yes	Yes
Auburn U	Yes	Yes	Yes	No	No
U of California (Davis)	No	No	No	No	No
Clemson U	Maybe	No	No	No	NA
U of Florida	No	No	No	NA	No
U of Georgia	Yes	No	No	No	Yes
U of Idaho	Yes	Yes	Yes	No	Yes
U Laval	Yes	Yes	Yes	Yes	Yes
Louisiana Tech	No	No	No	No	NA
U of Maine	Yes	No	No	No	No
U of Minnesota	Yes	No	No	No	Yes
Mississippi State U	Yes	Yes	Yes	No	No
U of New Brunswick	Yes	Yes	Yes	Yes	No
State U of New York	Yes	No	Yes	No	No
North Carolina State U	No	No	No	No	No
Oregon State U	Yes	No	Yes	No	Yes
Purdue U	No	No	No	No	No
Virginia Tech	Yes	No	Yes	No	Yes
U of Washington	Yes	No	Yes	No	Yes (courses)/No (programs)
West Virginia U	Yes	No	No	No	Yes

Table 4. Survey statistics summarizing private and public employment of doctoral graduates from Forest Engineering and Forest Operations programs in North America in 1998.

ORGANIZATION	NUMBER OF PhD's EMPLOYED	SPECIFIC DUTIES.....			Mean Age
		Field Research	Program Mgt.	Research Mgt.	
American Pulpwood Ass'n.	0	No	NA	NA	NA
Champion International Corp.	1	No	Yes	No	35
Dept. Natural Resources (WA)	0	NA	NA	NA	NA
FERIC <sup>1</sup> , Eastern Division	0	NA	NA	NA	NA
FERIC, Western Division	1	Yes	No	No	47.5
Georgia Pacific Corporation	2	No	Yes	No	47
International Paper Corporation	0	NA	NA	NA	NA
Tennessee Valley Authority	0	NA	NA	NA	NA
Union Camp Corporation	1	No	Yes	No	42
USDA FS, Auburn, AL	3	Yes	Yes	Yes	40
USDA FS, Houghton, MI	1	Yes	No	Yes	51
USDA FS Seattle, WA	1	Yes	No	Yes	42
Westvaco Corporation	0	NA	NA	NA	NA
<b>TOTAL</b>	<b>10</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>43.5</b>
<b>COUNT (Yes Responses)...</b>					
<b>Average per Organization...</b>	<b>0.77</b>				

<sup>1</sup> FERIC refers to the Forest Engineering Research Institute of Canada.

probably continue to decline over the next ten years, given current trends. Private sector hiring levels will depend on several factors, such as the need for expertise in this discipline, the appreciation of problems that these graduates are trained to solve, and the level of importance that this discipline might have in terms of corporate profitability. Currently, only the largest wood products companies seem able to afford the luxury of having a Ph.D. graduate in forest operations or forest engineering on staff.

Options do exist to remedy the problem of low graduate enrollment. At one level, the profession should spend more effort promoting itself as a viable career path for young professionals. University-based programs must do a better job of recruiting new students, particularly graduate students.

At another level, funding should be sought to help recruit promising graduate students and faculty from the forest products industry. Universities and forest products companies should work in collaboration to increase the number of doctoral graduates over the next decade, so that the trends noted through this survey can be reversed.

One example of effective collaboration would be the development of a work-study program for doctoral candidates where the student remains employed while working to attain the doctorate degree.

Finally, efforts should be made to develop more funding for graduate students and to recruit students, particularly at the doctoral level. Without a cooperative effort to expand potential opportunities for graduate education, academic programs will continue to have problems recruiting new faculty members in this discipline. The ultimate consequences of this trend will include reduced emphasis of forest operations and forest engineering in forestry education, continued erosion of research opportunities, and even fewer graduates, both at the graduate and undergraduate level.

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