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Forest Science Education in Research Universities

Kevin L. O'Hara and Hal Salwasser

In recent decades, forest science education in North America has undergone a shift from being exclusively based at doctor of philosophy-granting universities to a high proportion of baccalaureates coming from colleges and universities where the bachelor of science or the master of science is the terminal degree. For example, in 1960, 100% of forestry graduates from programs accredited by the Society of American Foresters (SAF) in the United States were from PhD-granting universities, but in 2010 this number was only 72% (Figure 1) (O'Hara and Redelsheimer 2012). A related trend has been the decline in the number of PhD-granting universities offering an SAF-accredited BS degree. In recent years, several undergraduate programs have closed (University of Illinois, University of Wisconsin–Madison, and University of Alaska–Fairbanks) or have closed and are currently attempting to restart (University of Washington and Washington State University). This trend is evident not only in the United States and Canada: long-running undergraduate forestry education programs at Oxford University in the United Kingdom, ETH Zurich in Switzerland, and Australia National University (ANU) and the University of Melbourne in Australia have also closed in recent years, resulting in a reorganization of forestry education in countries around the globe.

This reorganization of forestry education has implications for forest science education at the baccalaureate level and also the capability for conducting forest science research in the United States, Canada, and countries facing similar trends. This in turn affects our ability to produce researchers and academics in the forest sciences, and our capacity to generate and update the scientific foundation of contemporary forestry. Without educational programs in professional forestry at high research universities, institutional support for forest science research and postbaccalaureate forestry education can erode rapidly. PhD-granting universities are therefore of critical importance in forest science education and maintaining forest science infrastructure in the United States, Canada, and elsewhere.

Forest science is also changing at rates that may be unprecedented in the history of North American forestry. Forestry is now focused on ecosystems that are analyzed at multiple spatial scales to produce a wide range of ecosystem benefits and services. Forest science education must embrace these ongoing changes into the curri-

cula and be inclusive of the broader range of faculty expertise needed to encompass the rapidly evolving character of contemporary forestry.

The Forest Science in Research Universities subgroup of the Berkeley Summit attempted to address the difficulties faced by forest science education at research universities in the United States and Canada. Research universities were defined as those that produce PhD graduates or as “doctorate-granting universities” in the Carnegie Foundation (2010) Classification of Institutions of Higher Learning. A table of classifications of universities with forestry programs can be found in O'Hara and Redelsheimer (2012). However, smaller universities and colleges face problems similar to those of the larger research universities such as the trend to consolidate forestry programs with other academic units. There are also cascading effects where the changes in larger programs have implications for smaller programs including a potential for smaller programs to assume a greater role in applied forestry research. Hence, the fate of forestry programs at large and small universities are intertwined. Our discussions focused on the organizational structure of forest science programs at large universities and the implications of the changes in organizational structure on the teaching and research missions of these programs. We also provide recommendations for maintaining forest science education at research universities and how these programs might be structured.

Organizational Challenges at Research Universities

Many forestry programs in research universities have undergone a transformation in their organizational structure. Two primary re-organizational trends have occurred, sometimes simultaneously within a single institution: forestry programs have moved from colleges or schools to departments; and forestry academic units have been combined with other units to form larger units with a broader environmental or natural resources focus. The University of Washington recently moved from a College of Forest Resources to a School of Environmental and Forest Sciences in a larger College of the Environment. Other examples include forestry at Pennsylvania State University which moved from a school to a Department of Ecosystem Science and Management. The University of Minnesota forestry and forest products program has transitioned from a division to a school to a college to its present status as a Department of Forest Resources, with forest products and wildlife in separate departments. Some programs have seemingly gone in the other direction: The University of British Columbia's Faculty of Forestry was formed in 1951 from a smaller Department of Forestry. The University of

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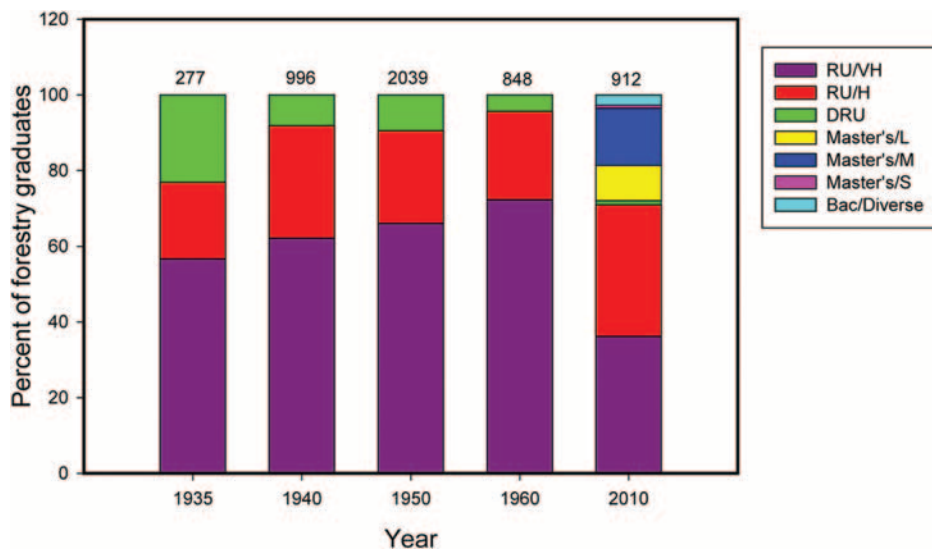


Figure 1. Percentage of graduates from SAF-accredited and candidate forestry programs in the United States by year and Carnegie class using the 2010 Carnegie Classification. Total graduates each year are shown above each bar. Carnegie classes are defined as follows: RU/VH, doctorate-granting universities with very high research activity; RU/H, doctorate-granting universities with high research activity; DRU, doctorate degree/research universities; Master's/L, M, and S, large, medium, and small master's degree colleges and universities; Bac/Diverse, baccalaureate degree colleges (from O'Hara and Redelsheimer 2012).

Montana went from a School of Forestry to a College of Forestry and Conservation with undergraduate forestry education housed in a Department of Forest Management.

These transformations of forest science programs are consistent with transformations of agricultural programs (National Research Council [NRC] 1996, p. 14–18, 2009, Chapter 1) and other natural resource programs such as range, wildlife, or fisheries management (Wolter et al. 2011). These programs are often interconnected and, in the United States, share the same land grant function. Indeed, the organization of these programs has been linked historically, and often the newly reorganized programs combine agriculture, forest science, and other natural resource disciplines into new structures that have included programs in biology, geography, horticulture, and others. However, these new structures are often placed under an environment label, such as environmental science, ecosystem conservation, or environmental conservation, and place reduced emphasis on applied sciences associated with the management of natural resources.

The source of these changes lies in large part with the dynamics of large universities where the leadership may see institution status as a function of contemporary college or program naming, ever increasing test scores

of new freshman and corresponding improved graduation rates and increased research program visibility. Together with the changes in state support at public universities in recent decades, from funding institutions to increasingly funding numbers of students, the competition for students has increased. In addition, the individual colleges and departments involved often have little influence on the overall dynamics of large institutions.

Another concern is a lack of control over forestry curricula when forest science faculty become a minority in larger units. Curricula are generally developed at the department level and larger interdisciplinary departments, by definition, include faculty from many nonforestry disciplines. Unless other procedures exist, these structures could result in nonforestry faculty determining curricular direction for forestry majors. This potentially affects the content in forestry curricula and whether these curricula meet accreditation and other professional standards (Redelsheimer et al. 2015). Similar problems may develop in relation to faculty evaluation. A forest science faculty member may have important service or research functions related to technology transfer or working on applied problems. However, these activities may not be valued in academic units that include diverse disci-

plines and a dominant emphasis on fundamental research. Faculty in these departments may be discouraged from doing applied work or it may adversely affect advancement and tenure.

Often the changes in organizational structure have downsized long-running schools or colleges. At the University of Washington, forestry was housed in a college for more than 100 years until the formation of the current School of Environment and Forest Science. Duke University went from a School of Forestry to a School of Forestry and Environmental Studies to having forestry housed in a School of the Environment. These changes may result in a disconnect from the history or traditions that were associated with long-running schools or colleges. Likewise, these changes may alienate alums who identify with a college or school. This may also affect relationships with constituents such as employers, donors, or research collaborators.

Perhaps the greatest loss from forest science programs moving from the college or school status to smaller departments is the loss of control over budgets, faculty hiring, and, therefore, long-term planning. These changes affect how a program functions and competes for resources within the university. University funding is typically allocated at the college- or school-level and then reallocated to departments. Some universities also maintain control over faculty positions to maintain certain numbers of faculty at the college or school level. Usually, faculty vacancies in departments revert to the larger unit, leaving departments to compete with other departments for new faculty hires. When departments lose the ability to control budgeting and hiring, there is a loss of autonomy that affects long-term planning. As departments, forestry programs also lose their ability to control their destiny. When programs fall below the department level, such as forestry at the University of California at Berkeley, which is housed in a Department of Environmental Science, Policy and Management, forestry programs are under the complete control of the broader department, which may have little interest in forestry. In some cases, however, a larger college as the program home can provide more resources and greater freedom to operate and grow for a department focused on forestry than was the case in a smaller college focused solely on forestry (e.g., at the University of Minnesota).

Research universities in the United States and Canada receive research support from a variety of sources including federal and state/provincial governments, much of which is designed to encourage applied research. In the United States, one source of federal funding is provided through the McIntire-Stennis Cooperative Research Program that was designed to stimulate forestry research with an emphasis on training future forestry researchers (Westveld 1963). McIntire-Stennis funding is distributed to all public and some private forestry programs using formulas that vary by state (Bullard et al. 2011). The land grant system in the United States was also designed to support agricultural and other natural resource research and development through instruction, agriculture-related research, and extension services at land grant universities. Today, these functions are still largely supported by state and federal funds and demonstrate long-term commitments to applied forestry research.

One of the most common criticisms of forestry education in recent decades has been the lack of emphasis on social systems or managing forests for people (Sample et al. 1999, 2015, Bullard 2015). There are also criticisms about written and oral communication skills and the lack of breadth of ecosystem sciences in forest science programs. However, forest science education has expanded to include computer technologies and geographic information systems, as well as social values and ecosystem processes that were beyond the scope of forestry in the past. Forestry curricula can be easily overloaded with the material that is important. These issues are discussed in separate themes concerning forest science curricula (Bullard 2015) and whether master's degrees should be part of forest science education models (Innes 2015). Although these issues are related to designing curricula, they also reflect, and determine, the very nature of the forestry profession because the organization of forest science at research universities and the organization of forest science-based curricula are interrelated. To achieve the full range of objectives of contemporary forestry, science education must be more inclusive.

Forestry education, specifically forest science, faces a critical conundrum: there is a need to integrate the science of forestry with other related disciplines in ways that support sustainable management of forest ecosystems. Contemporary forestry is a multidisciplinary enterprise for which society is de-

manding a broad array of ecosystem values and services from our forests. Alternatively, forestry is about managing forests to achieve objectives related to these values and services. Forestry is the vehicle whereby the more fundamental sciences are applied. An organizational structure, in which the applied management sciences that are the foundation of professional forestry can coexist with the more fundamental biophysical sciences, is needed in academia. Ideally, this structure would maintain applied forestry and forest science education programs, but in such a way that encourages collaboration between applied and fundamental scientists. Such a system is also needed to recognize the important integration and translational roles of scientists engaged in research on forestry issues.

Insights and Recommendations

- Forestry defines itself as embracing science (Helms 1998): hence it is important to maintain science-based curricula that prepare students to understand and apply this science. A science-based education is also important for encouraging the “continuing process of self-education and re-education” (Bachelard 1994) and developing innovative land managers. Research universities are important places to accomplish these goals. The value of a research university is exposure to scientific enterprise with the explicit goal of discovery and innovation. An education in the technical aspects of forestry is important, but, in general, may not promote the value of science and long-term innovation in forestry. Research universities are a critical part of the forest science education infrastructure in the United States and Canada.

- Forest education provides fundamental and unique knowledge related to the management of forests. It must integrate all the sciences (social, economic, and ecological) to promote the science of forest sustainability. These fundamental subjects will not be addressed if not in a forestry program. This corresponds to a recommendation from the 2002 NRC report on maintaining forest science research capacity in the United States:

To achieve an adequate knowledge base, forestry and natural-resource education and research programs in government and academia should dedicate resources to the foundation fields of forestry science while engaging in efforts to develop emerging education and research priority areas. (NRC 2002, p. 41)

- The ideal organizational structure of a forest science education program should maintain an applied forestry focus while also broadening the scope to the biophysical and social sciences. It will provide some autonomy for forest science for budgeting, long-term planning, faculty evaluation, and curricula design. However, no single organizational structure will be appropriate at all universities because each university will have unique circumstances related to the organizational history and structure of related fields in the natural and social sciences, budgeting of programs, or relationships to extension programs. For example, land grant and non-land grant universities can have different budgeting mechanisms and different expectations for applied research and extension. Private and public universities often form a similar dichotomy. This is consistent with a recommendation from the 2002 NRC report on maintaining national capacity in forest science research:

University programs should assume a renewed commitment to the fundamental areas of scholarship and research in forest sciences that have diminished in recent years, and adopt an enhanced, broad, integrative, and interdisciplinary programmatic approach to curricula at the graduate level. (NRC 2002, p. 102)

- The structure of forest science education at research universities will depend, in part, on the suite of degrees offered. Discussion of moving from 4-year to master's level entry degrees in forestry (see Innes 2015) can have significant implications for how programs should be organized.

- In addition to their importance in forest science education, research universities are integral to dealing with many forest-based research questions because of their facilities, research support, and potential for broad interdisciplinary collaboration. For example, research universities are best suited for dealing with broad emerging forestry questions associated with sustainability, adaptive management, restoration, carbon science in forests, technologies for observation of natural resources, green engineering and green materials in material science programs, or life cycle analysis of wood products.

- Forest science education programs face the difficulty of needing to encompass and maintain a broad array of discipline strengths, while also maintaining an identity. To maintain this identity, academic

units that house forestry science education should include the word *forest*, in some form, in their name. This can function to maintain a sense of identity and cohesion within the program and its history and promotes a greater recognition of the unit both on campus, and to potential students, collaborators, donors, and other interested parties.

- Whereas forest science programs are central to solving a vast array of forest-based problems, there needs to be a loosening on the traditional characterizations of forestry that will encourage, and even facilitate, the inclusion of other sciences in problem solving to address forestry issues. This may be the most difficult challenge facing forestry education in the future: maintaining both an identity as the key discipline for educating forestland managers and also including other disciplines in forest-based problem solving. One solution is for academic units in forest science to liberally invite colleagues in related disciplines to participate as adjuncts or affiliates to promote interactions and collaborations. Another is to promote minors in forest science for students in other areas, and another is to establish interdepartmental interest groups that facilitate research on interdisciplinary topics across departmental boundary lines.

- Forest science faculty should provide leadership on the development of forestry curricula, faculty recruitment, and faculty evaluation in forestry to avoid a programmatic drift or loss of interest in maintaining a curriculum that meets professional and science requirements (or expectations).

- Stakeholders, such as alumni, potential employers, or landowners, can play a significant role in guiding program development. Forestry programs should continually build relationships with stakeholders who can advocate for program direction, in particular with the increasing importance of private sources of funding, especially in public universities. Losing these connections can

adversely affect the currency of a program, its ability to place students on meaningful career paths, and long-term fundraising. We offer this message as dialogue so that leaders in these areas can appreciate the dilemma of forestry and forest science programs in large universities...and the opportunities.

- Forest science academic programs at research universities should continually work to build relationships with stakeholders who can support research, employ students, and endow faculty positions. These relationships maintain currency in academic and research programs, and stakeholders are more likely to serve as advocates for program direction when they are more involved.

- Forest science programs at all universities should be prepared and proactive with regard to pending changes in university organization and priorities. They should attempt to maintain as much control at the local unit level as possible while operating within the larger strategic direction of the college or university.

- Employers should recognize the value of research universities for maintaining research infrastructure and producing research scientists, as well as producing graduates. The forestry graduates from research universities are exposed to scientific endeavors with the explicit goal of discovery and innovation. They learn from their interactions with graduate students and faculty and their science-driven education develops innovation and problem-solving skills. Applied forest science research itself drives discovery and innovation in the profession and forest science education from research universities is important for maintaining a viable forestry enterprise and the many values our forests provide to society.

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