

National Graduate Education Needs and Priorities in Natural Resources

An Assessment by:

**The National Association of Professional Forestry Schools and Colleges
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Compiled by Daniel E. Keathley

Background

The National Association of Professional Forestry Schools and Colleges (NAPFSC), in cooperation with the National Coalition for Sustaining America's Nonfederal Forests, received funding from USDA to convene a group of educational leaders and natural resource professionals, including experts for 1890 institutions, to address the specific need of enhancing graduate education in natural resources in order to identify developing areas of shortage in the national research capacity in forestry and natural resources fields.

This effort actually began at the NAPFSC's General Assembly meeting in October, 2002, which involved a workshop that explored workforce and graduate education needs. Participants included representatives from most of NAPFSC's 69 institutions, as well as many agency and industry partners. Many themes emerged. The need for disciplinary integration at the graduate level was emphasized, including the need for Ph.D.'s who combine specialized knowledge with an ability and inclination to place their work in a larger context and make connections to other disciplines. NAPFSC also recognized the challenge of developing such new programs and called for new graduate education funding that could support the development of the courses, experiences, workshops, etc. that are needed to add this integrative component to natural resources graduate programs, as well as lead to greater diversity in the students enrolled in graduate programs. However, a major dilemma was apparent. Even though better integration of disciplinary knowledge is needed, we have several important disciplines that are dramatically under represented at our schools and colleges, and a developing shortage of research capacity in those fields.

NAPFSC's analysis of the need to strengthen natural resource graduate education was based on conclusions from the recently published (2002) NRC report entitled National Capacity in Forestry Research, and our own Fall 2002 workshop at the annual NAPFSC General Assembly. These conclusions are also in line with the recent findings of the National Agricultural Research, Extension, Education, and Economics Advisory Board.

The NRC report and NAPFSC discussions served as a philosophical framework for the meeting convened at Michigan State University, and provided a summary of the changes taking place in the natural resource fields and the need for “comprehensive and integrated approaches that emphasize ecologic and social sustainability.” These approaches need to focus on maintaining and restoring ecosystem integrity and long-term forest productivity, while guiding appropriate human uses of natural resources. The report calls for natural resource graduate programs that provide specialized, focused education and, at the same time, interdisciplinary system thinking, with the goal of achieving both disciplinary integration and the application of the resulting knowledge to complex social and biological problems. That is, natural resource graduate programs of the future must achieve a balance between greater breadth and greater depth. The report also recognizes that this new integrated emphasis at the graduate level is a challenge because most faculty are discipline-focused, existing curricula are often fragmented rather than integrated, and there is a tradition of reductionism in conducting research.

NAPFSC’s assessment of specialization needs reflects not only the fields that have dramatically declined in numbers, but the emergence of new types of expertise and developing analytical and data acquisition technologies. At a time when concerns about invasive species detection and management and the value of biodiversity are especially heightened, the availability of forest entomologists and forest pathologists who support these fields is at an all time low. Similarly, there is a decline in forest biometricians at a time when our need and desire to quantify and monitor the health and productivity of the forest resource is expanding. Forest protection, which has a central component of the integration of forest entomology and pathology with other disciplines, is critically important to sustainable forest and ecosystem management. The same is true for biometry, which with unfolding new satellite-based technologies offers the best potential for monitoring and analysis of the complex natural resource issues. In truth, at no time in our history has the integrity of our nation’s forests and rangelands faced so many challenges. Yet nationally our capacity to respond is declining and has reached a level where it is questionable whether or not the needed critical mass of scientists still remains. The loss of human scientific capacity in these fields has resulted in a manpower shortage that has reached a critical stage.

Beyond this there are emerging areas where specialization needs to be developed and which also reflect the need for researchers and scholars with a more integrated understanding of natural resource problems. New emerging areas of need that were identified by NAPFSC include:

- ❖ Landscape analysis
- ❖ Spatial analysis and information management applications
- ❖ Watershed science and planning
- ❖ Forest ecosystem health and restoration
- ❖ Risk analysis including ecological and economic components

Panel Meeting

Based on this assessment by NAPFSC, and with the support of USDA, experts from throughout the United States gathered on the campus of Michigan State University on September 9 - 10, 2003 to discuss developing areas of research capacity shortage in natural resources, with the

objective of developing a list of priority areas and formulating possible solutions that need to be implemented in order to reverse this trend. Those attending the meeting were:

Dr. C.P. Patrick Reid,	University of Arizona
Dr. James Burchfield,	University of Montana
Dr. John Duplissis,	University of Wisconsin-Stevens Point
Dr. David Field,	University of Maine
Dr. Jo Ellen Force,	University of Idaho
Dr. Alan Ek,	University of Minnesota
Dr. George Hopper,	University of Tennessee
Dr. Becky Johnson,	Oregon State University
Dr. Eric Young,	North Carolina State University
Dr. Carl Niedziela,	North Carolina A&T State University
Dr. Oghenekome Onokpise,	Florida A&M University
Dr. Gary Lemme,	Michigan State University
Dr. Deborah McCullough,	Michigan State University
Dr. Ray Hammerschmidt,	Michigan State University
Dr. Dan Hayes,	Michigan State University
Dr. Thomas Coon,	Michigan State University
Dr. Daniel Keathley,	Michigan State University

The meeting focused on developing answers to four questions concerning national research capacity in natural resources:

- What fields appear to have critical shortages developing?
- What are the causes of the pending shortages?
- How can we develop more integrative graduate education programs?
- What approaches should be pursued to resolve these problems?

Areas of Developing Shortages

Due to the expected turnover of scientists at USDA and at universities nationally, the panel anticipated that shortages of scientists will develop in many fields. In some cases, such as forest pathology and forest entomology, this situation appears to be exacerbated by a current low level of graduate students seeking advanced degrees. Additionally, there are areas of developing need in fields such as wood fiber engineering, bioremediation, and modeling ecosystem processes, where new technologies have enabled a broadening of disciplines. In these fields additional scientists need to be trained and positions created to enable the potential of these new fields to be fully realized. However, beyond any of these issues, the panel saw a need for enhancement of quantitative analysis skills among scientists in all disciplines. This was seen as a pervasive area of shortage that broadly impacts natural resources research. The overall listing of critical areas identified by the panel is presented on the following page.

Areas of Developing Critical Capacity Shortages

- **Decision Sciences**
 - Risk Management
 - Regional Economic Analysis
 - Public Policy/Urban Sprawl
- **Land Use and Landscape Analysis**
 - Environmental Economics
 - Business/Financial Analysis
 - Foreign Trade
 - Globalization
- **Ecosystem Processes and Forest Health**
 - Pathology
 - Entomology
 - Physiology
 - Population Genetics
 - Fire Ecology
 - Water Resources
- **Utilization Technology**
 - Forestry Operations
 - Wood and Fiber Engineering
 - Materials Science
 - Bioremediation
- **Quantitative Analysis-** (This was seen as an overarching area of need that should be a needed component in all areas.)
 - Biometry

Apparent Causes

The Panel identified numerous causes to the current situation that can be grouped in several major themes. One major issue is an ongoing change in student interests. Undergraduate students are increasingly more interested in urban fields (law, medicine, education, engineering, etc.) and less interested or aware of natural resource and forestry professions. This causes a decrease in the available pool of graduate students and results in student professional career direction being established prior to their even becoming aware of potential interest areas in natural resource fields. Another major concern was that it appears that many students are poorly

prepared for quantitative fields before they reach college. The quantitative foundation that is laid during high school often will not readily support continued pursuit of these disciplines at a university, and the result is that students have a tendency to avoid quantitatively rich undergraduate and graduate programs. Even when students are prepared to pursue degrees in these areas, the names attached to many natural resource fields and classes, such as “Biometry,” do not convey a clear meaning that will attract students who are not already familiar with the discipline. However, beyond any of these issues, the Panel saw a lack of stable base funding for research in these fields as the primary cause of the developing shortages.

As the cost of research and graduate education has increased, availability of funding in many of these fields has effectively decreased. In part this reflects the continuing difficulty of cultivating pools of funding for complex natural resources research questions, but it also is simply a reflection of the broadening of the scope of research endeavor in natural resources while the pool of available dollars has remained relatively constant. Funding has also become increasingly issue driven, which is appropriate in targeting dollars to pressing societal questions, but does not necessarily align well with training the next cadre of scientists in the full spectrum of disciplines required to address future issues in all of the important fields of research. Developing a stable base of research funding in broad disciplinary areas for natural resources, rather than funding of constantly shifting sub-fields and hot issues, was seen as an essential need in reversing this trend and correct the developing shortage of scientists in many natural resource disciplines.

Integrative Graduate Education

One of the major concerns that was discussed was how to develop graduate programs that prepare individuals to address complex research questions, while at the same time enabling them to develop the necessary depth of knowledge in a particular discipline. Graduate education in many natural resource fields needs to be adjusted to reflect the multi-disciplinary nature of the issues with which research funding is typically linked, as well as to assist the students in gaining an understanding of the need to stay focused on the overall impact of the work. USDA programs, such as IFAFS, were seen as desirable in enabling students to conduct graduate research with an integrative perspective. In addition, the Panel recommended expanding research methods courses to include quantifying and identifying the impact of the research. The Panel recommends that USDA develop a Challenge Grant program that will focus on redesigning graduate curricula to address this issue and which will lead to greater student exposure to multi-disciplinary projects, increased exposure to problem solving, use of distance technology to link strengths in specialized graduate courses between universities in order to avoid duplication, and greater awareness of the importance of research impacts by the students. IFAFS was seen as the model for this type of research.

Recommendations

Clearly reversing the developing trend of a lack of research capacity in many of these natural resource disciplines must be a long-term effort. The problem did not arise quickly, and given the need to train groups of scientists, it cannot be quickly resolved. Moreover, new areas of needed research constantly expand as new technologies develop, which in turn lead to new and ever more complex problems becoming accessible. With that in mind, along with the anticipated retirement of scientists in USDA and the universities, it is time to address this problem.

Recommended actions are:

- Develop and publicize USDA targeted graduate fellowship programs for students interested in graduate education in the areas identified as areas of need in natural resources. Funding always helps in recruiting students, but more importantly, the visibility of a targeted, advertised program by USDA will increase student awareness of these fields and assist in attracting capable students who simply are not aware of the opportunities for graduate education in natural resource fields.
- Increase the percentage of NRI funds devoted to natural resources research to 35% and create NRI panels specifically for the areas of Decision Sciences in Natural Resources, Ecosystem Health and Processes, and Utilization Technology. Require that graduate students, not post-doctoral fellows, be included in each proposal, and make a multi-year, long-term commitment to the programs in order to increase university commitments to research in these fields.
- Using IFAFS as a model for research problem identification, develop a challenge grant program for integrated graduate education in natural resources that emphasizes multi-disciplinary projects, increased exposure to problem solving, use of distance technology to link strengths in specialized graduate courses between universities, and greater awareness of the importance of research impacts by the students.
- Universities should explore the use of distance education to make specialized graduate courses in spatial statistics and other quantitative methods available to a broader range of students throughout the US, rather than only to those students on a select number of campuses that have resident faculty expertise in those fields.
- USDA and universities should work jointly to develop a retraining grant program that will enable existing scientists in fields closely allied with the areas identified as areas of need to seek retraining and shift their expertise into the research fields where expertise is most needed.

Conclusions

The current national focus on forested lands and other natural resources, which has been highlighted by the impact of wildfires, invasive species, population growth, drought and other environmental concerns, points to the broad impact on society of neglecting to maintain the needed research capacity to address broad-scale ecosystem function and health issues, risk management and other decision science questions, and issues involving the development of new utilization technologies as they pertain to forest and other natural resource systems in this nation, including our urban areas.

In a recent letter to Secretary Veneman, the National Agricultural Research, Extension, Education, and Economics Advisory Board stated that: “In consideration of the critical need for an *adequately prepared* and a *readily available supply* of workers for all levels of agriculture from senior scientists to managers, domestic/global marketing specialists, sales and service representatives, environmental managers, farmers and more, USDA needs to raise workforce preparation to a *higher priority* level.” Their report stresses the urgency of workforce planning in fields where shortages are developing or are projected and indicates that it is imperative that we identify what “motivates (or discourages) individuals to prepare to work in sectors of the food and agricultural systems, be it lack of knowledge of career opportunities, diverse learning styles, aptitudes or interests” and that “educational and recruitment programs must be evaluated to determine why some are more effective than others.” In addition their report recommends that USDA take steps leading to the “identification and fostering of model programs and other mechanisms through which it can support a collaborative, dynamic, responsive workforce development system for agriculture and the food and natural resource industries.”

As we look at issues of workforce planning in forest resources, giving strong consideration to the nation’s need for healthy forests and rangelands and to watershed protection, clearly there is a need to rectify the developing shortage of scientists and graduate students in the critically important areas identified in this report. We also need to explore ways to address the need for integrated graduate education that results in the necessary depth of scientific expertise along with the breadth of understanding to address complex societal issues. Due to the length of time necessary to identify candidates, cultivate, and train new scientists, it is important to act quickly to implement the recommendations of this report before any further diminution of our national capacity occurs.