COMMENTARY

Long-Term Forest Ecosystem Research: A Programmatic View

Wayne T. Swank and James M. Vose

Long-term research provides the building blocks of knowledge needed to address natural resource and environmental issues. "Long-term" has frequently been considered to span decades with a time frame that usually encompasses at least one generation of scientists and frequently two or more generations. In the rich history of forest science, the origin of long-term studies can be found in many different forms, ranging from a dedicated lifetime of investigation by a single or small group of scientists on specific topics to large interdisciplinary studies of forest ecosystems comprised of collaborative partnerships between universities, federal and state agencies, and other institutions. Scientific advances in many specific disciplines of forest science (e.g., forest genetics, biometrics, etc.) are well established over time, but interdisciplinary forest ecosystem studies are of more recent origin (20–40 years).

The ushering in of the 21st century coincides with the centennial celebration of the US Forest Service Experimental Forests and Ranges (EFRs). The current network of 81 EFRs has provided a significant core of information on long-term patterns and processes for a diverse array of forest and grassland ecosystems. Lugo et al. (2006) provide an overview of long-term research at EFRs and highlights some of the past, present, and potential future contributions of EFRs to address environmental and natural resource issues. Celebrations commemorating milestones of existence have been initiated at many EFRs along with vignettes that feature select sites and success stories both at the national (USFS 2009) and station level (Southern Research Station 2009). Site-specific activities are also planned; for example, in Nov. 2009 the Coweeta Hydrologic Laboratory in North Carolina will host a Science Symposium celebrating 75 years of research. This event will complement research findings documented for the first 50 years of research at the Laboratory (Swank and Crossley 1988).

The watershed-based EFRs are of special interest because water resources and forest management issues have strong historical links. A synthesis of forest and wildland watershed lessons learned over the past century highlights the importance and contributions of long-term research across different regions of the country (Ice and Stednick 2004). The first several decades of land-use and hydrologic research at sites like Coweeta, Hubbard Brook, Fernow, and H.J. Andrews provided a solid foundation for forest ecosystem studies at a watershed scale. Subsequently, pioneering research by university and Forest Service scientists at Hubbard Brook (Bormann and Likens 1967) demonstrated the utility of the small watershed approach for studying the structure and function of forest ecosystems as related to biogeochemical cycling processes and a variety of environmental issues.

At Coweeta, Forest Service scientists began interdisciplinary, collaborative ecosystem research with the University of Georgia (UGA) in 1968 through funding from the National Science Foundation (NSF). The focus of the initial effort was to study forest productivity, nutrient cycling, and terrestrial and aquatic insects on four watersheds including one undisturbed reference hardwood-covered watershed and three near-by treated experimental watersheds with different vegetation cover types. By 1971, the US International Biological Program (IBP) had been established and funded through NSF. Coweeta, still in collaboration with UGA, became part of the Eastern Deciduous Forest Biome, and in the next 4 years the breadth of interdisciplinary expertise increased, measurements of atmospheric nutrient inputs and stream outputs were expanded to 15 watersheds in the basin, and the number and type of process-level studies were substantially expanded. At the same time, Coweeta investigators provided scientific and program leadership in IBP. The H.J. Andrews site was also a major IBP research area.

When the IBP was concluding in the mid- to late 1970s, the Coweeta ecosystem research team saw the need to more rigorously examine ecosystem structure and function from a nutrient cycling standpoint. Additional NSF funding supported a study on biogeochemical responses to a commercial clearcut, cable-logging treatment. The research included practical questions related to forest resource management and fundamental hypotheses on hydrologic and ecological processes. The transfer of findings to management was immediate, and continuing research on the watershed over the past 32 years is providing new information on forest and stream responses to disturbance.

The decade of the 1980s ushered in a new era of ecological research with the establishment of the Long-Term Ecological Research (LTER) network funded by NSF. Forest Service scientists provided strong leadership in the formation, establishment, and subsequent development of the program. The first six sites were established in 1980 and included H.J. Andrews and Coweeta; Hubbard Brook, Bonanza Creek, and Luquillo were added later. The network now consists of 26 sites representing a diverse array of ecosystems (LTER Network 2007). The mission of the LTER network is to provide the scientific community, policymakers, and society with the knowledge and predictive understanding necessary to conserve, protect, and manage the nation's ecosystems, their biodiversity, and the services they provide. In the first decade of Coweeta LTER, we continued to focus on long-term responses to natural and human-caused disturbances on reference and managed watersheds. In 1991, LTER was expanded from the watershed to the landscape scale and then further broadened to the regional scale to develop a predictive understanding of

the socioeconomic and environmental factors that drive land-use change in the southern Appalachians and the ecological consequences of those changes. Further details of the development of long-term ecological research at Coweeta are given by Swank et al. (2002).

By all measures, forest ecosystem research conducted by watershed-based EFRs and their collaborators over the past 20–40 years has been successful. Findings have had a significant impact on many forest management and environmental issues. We predict that the value of long-term research will only increase in the coming years. For example, watershed-based EFRs will be increasingly relied on to provide baseline comparative information to detect and predict ecosystem responses to climate and landscape change, impacts on water resources, carbon and nutrient cycles, and other ecosystem goods and services. In addition, long-term research sites have long played a role in educating and training future ecosystem scientists. The hundreds of students trained and educated at long-term research sites such as the EFR and LTER networks occupy research and policy positions in federal and state agencies across the United States and research teaching positions in universities across the globe. The return investment in research, education, and training at long-term research sites has been substantial, and we contend that their contribution to addressing the challenges of the 21st century will be even more valuable in the upcoming years.

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LETTERS

"Forest Health"

I have been reading the *Journal of Forestry* since 1974 and never have I read an article that pleased me more than that produced by Kenneth F. Raffa et al. in the July/August 2009 issue. This piece should be copied and shoved under every forester's desk glass, it should be taped to the dashboards of their trucks, fastened to the outside of their hard hats, glued to their saddle horns. They should be forced to memorize the essay until they GET IT. I am hoping that soon I will see another piece by Raffa and his crew explaining the proper use of the terms "forestry" and "restoration." It is discouraging to read and hear foresters using the broadly inclusive terms "forestry" when they are referring only to forest exploitation or logging and "restoration" when they surely must realize that we cannot restore very much at all. That is nature's job over time.

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A Basically Useless Book Review

I appreciate the book reviews in *Journal of Forestry* because I don't have time to look over the many new titles published every month. Having respected professionals provide their feedback and insight helps me decide which books are worth taking a look at and which are not worth a second glance. Unfortunately, that was not the case with Timothy La Farge's review of *The Bridge at the Edge of the World* by James Speth (June 2009 issue). La Farge's main criticism is that Speth's arguments are not backed up with valid scientific findings, yet the only claim he criticizes is the now well-founded and (nearly) universally supported finding that climate change is being caused by increased greenhouse gas emissions. I simply cannot believe that *JoF* continues to give credence to such marginal contrarian viewpoints. Nothing else La Farge discusses in his review has any credibility, and as such it is basically useless. I have no quarrel with La Farge's own professional expertise and accomplishments as a plant geneticist or even his personal beliefs about climate change. If enough SAF members continue to write letters to the editor expressing such viewpoints, then I have no problem seeing them published as such. However, I expect more of a book review. I realize book reviews are not necessarily peer-reviewed scholarly works, but allowing the publication of such a review is a deliberate editorial decision that reflects poorly on the *Journal* and on SAF as a professional organization.

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photo by Ciaran Nugent

An Ancient Round Tower and Monastery at Ratoo, County Kerry, Ireland, as Seen from a Newly Established Forestry Plantation

for details, see "Afforestation and Local Residents in County Kerry, Ireland"

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