

TECHNOLOGY TRANSFER: TAKING SCIENCE FROM THE BOOKS TO THE GROUND AT BENT CREEK EXPERIMENTAL FOREST

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Abstract—Technology transfer has been an important part of the research program at Bent Creek Experimental Forest (Bent Creek) since its establishment in 1925. Our stated mission is to develop and disseminate knowledge and strategies for restoring, managing, sustaining, and enhancing the vegetation and wildlife of upland hardwood-dominated forest ecosystems of the Southern Appalachian Mountains.

Over the years, disseminating knowledge has taken many forms to address the needs of many different user groups. The diversity of user groups make disseminating knowledge challenging. Groups range from professors and scientists, graduate and undergraduate students, resource managers and foresters, to garden clubs, and Boy Scout troops. Bent Creek communicates research findings interpersonally—through tours of the demonstration forest, workshops, and presentations—and visually—through websites, publications, interpretive signs, and other written and electronic material.

Since the 1980s, Bent Creek has included a technology transfer specialist on staff. As a technology transfer specialist, there are many rewards and challenges. Some of the challenges are internal, and some are external. But the rewards are great when study results connect with individuals who understand, support, and are excited about the work being conducted by U.S. Forest Service Research and Development scientists.

INTRODUCTION

Congress established the Bent Creek Experimental Forest (Bent Creek) in 1925 originally on 1,100 acres of National Forest land set aside to conduct research on a variety of topics. Bent Creek is located on the Pisgah National Forest near Asheville, North Carolina, and is operated by the U.S. Forest Service, Southern Research Station (SRS). It is part of a network of experimental forests and ranges across the United States. Experimental forests were created to conduct scientific research in-house, apply research findings on National Forest System lands, continue long-term research, and demonstrate research results to cooperators and resource managers.

Each experimental forest is located strategically within ecosystems that represent the area. Bent Creek represents the Southern Appalachian Mountain region. The experimental forest is located within a watershed that reaches elevations from 2,100 to 4,000 feet and contains a rich diversity of flora and fauna. An additional 5,200 acres were added in 1935 bringing the total area to 6,300 acres. The research conducted at Bent Creek changes over time to address ecological issues affecting forests. Early 1920s work focused on fire control, surveying and mapping, creating 50-acre compartments for research on degraded stands, and reforestation planting. Our focus changed in the 1950s to large scale studies of hardwood stand management, even-aged versus uneven-aged forest management, long versus short rotations, tree grades, soil moisture, seed sources, managing woodlots, reclaiming land with laurel thickets, and white pine (*Pinus strobus*) plantations.

Today research includes replicated small plot research, long-term growth and yield, hardwood regeneration, site classification, mast and forest fruit production, restoration of American chestnut (*Castanea dentata*), effects of climate change on forests and wildlife, sustainability, and carbon sequestration. The research unit also added a wildlife component to examine bird, bat, small mammal, reptile, and amphibian community response to both silvicultural treatments and natural disturbances.

Though research topics at Bent Creek Experimental Forest have changed over the years with the emergence of new challenges and issues, the end products are still the same: valuable long-term data and research findings. A major challenge is to take the 90 years of research findings and make them accessible and relevant for today's resource managers. This paper discusses technology transfer and how it has become successful at the Bent Creek Experimental Forest.

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TECHNOLOGY TRANSFER

Technology transfer can be seen as science unto itself. Dr. Everett M. Rogers (2003), in *Diffusion of Innovations* defines technology transfer as the process of communicating a technology from a source organization to a receptor organization.” There are three components in this process: knowledge, use, and commercialization. For example, the U.S. Forest Service Research and Development branch that includes the Southern Research Station is a source organization, world leaders in producing scientific research. The source can be the whole organization, or specific units within an organization. Receptor organizations are the groups that receive the information from the source organization. We call these receptor organizations our user groups. Scientists who create knowledge through research comprise the knowledge component in the technology transfer process, while the second component is the “use” component that is made up of methods and formats that facilitate the use of that knowledge. The last is the commercialization component which is the process of how the knowledge is packaged and “sold” to the receptors. “Sold” in this use refers to persuading the use of an idea, not making a monetary exchange.

A technology transfer specialist can help organizations move their science from the knowledge stage to the use and commercialization stages. The job of the technology transfer specialist is to transfer this knowledge to different user groups through a variety of methods and formats. Over the years, technology transfer has evolved to become not just an art and skill, but a science as well.

METHODS

Technology transfer has evolved over the years at Bent Creek, and throughout the scientific community, in the way research results are disseminated to user groups. The knowledge component is still the same in that scientists still conduct research to obtain knowledge, but the way knowledge is transferred has radically changed over the years. Early transfer methods included interpersonal communication such as face-to-face contact between scientists and groups who participated in field trips to view and discuss research results. Nonverbal communication was in the form of written research papers published in peer-reviewed scientific journals and in-house publications (Muth and Hendee 1980).

In the 1980s, Forest Service project leaders began to see the importance of having a technology transfer specialist on staff, though the title “technology transfer specialist” was not yet an official job title. Technology transfer specialists were listed mostly as research foresters performing technology transfer tasks. The specialist at Bent Creek served as the go-between for scientists and user groups. Their duties included promoting Bent Creek science by creating partnerships and outreaches, developing materials such as brochures and booklets, and organizing tours and events. The specialist also helped develop a hiking trail system that included metal signs on a variety of natural resources subjects and a demonstration forest installed in 1991 to show forest management treatments side-by-side.

Today, technology transfer Specialist is recognized as an official job description and title. SRS administration includes a Science Delivery Group that is responsible for the commercialization or the conversion of an idea from research into a product or service, a process that includes the packaging, production, manufacturing, marketing, and distribution. Technology transfer specialists work with the Science Delivery Group to produce materials and design marketing strategies.

The advancements and use of mass media technology since the 1990s has allowed technology transfer methods to expand even further. A Web site, an online forest encyclopedia, modeling simulators, webinars, and an introductory film on Bent Creek were created over the past 15 years. The adoption of social media such as Facebook, blogs (CompassLive!), and Twitter are now common formats for instantly posting events, new research findings, and other information, making it available to anyone.

The Bent Creek Research Work Unit created a week-long *Upland Hardwood Silviculture Workshop* in 1991 as a result of numerous requests from State forest agencies for application of research results to the forest. Participants working in upland hardwood ecosystems came to learn from experts how to manage forests using the most up-to-date research available through indoor lectures and field trips (fig. 1). The workshop covers 16 topics under 7 modules by 10 or more experts in their respective fields of study. The topics ranged from management objectives, stand management on existing stands, stand management for regenerating new stands, forest health, site classification, restoration of American chestnut and other species, and wildlife. The first class was so successful that the week-long workshop became an annual event adding topics over the years to meet the needs of land managers. In 2007, the workshop was filmed to create an online course (available on DVD) that gives continuing learning credits.

Technology transfer duties still include tours on the demonstration forest and publications but also community events, information panels on the forest, research notes, brochures, fact sheets, educational programs, and interpretive signs. Scientists and technology transfer staff participate in speaking engagements at symposia, meetings, and other events such as the North Carolina Science Expo and the Forest Festival Day to promote science.

In earlier years, user groups (receptors) were mostly forestry students and professors, scientists, land managers, and an occasional visiting government official who contacted us for information and tours. The early user groups represented just a small percentage of the population from universities and professional forestry agencies that used our research. Because of the specialty of the research, just a small percentage of the public was being reached.

One goal of Bent Creek's technology transfer program was to expand the user groups and make this knowledge available to more people. With the experimental forest located within 10 miles of the city of Asheville, it has become a popular site for recreationists. Most people in the local area did not know the purpose of the experimental forest or about the research being conducted. If they did know, they did not know how to take the information and apply it on their own land. A new goal became reaching recreationists and local user groups. This required "selling the idea" or promoting our research by actively letting people know about the research, why the research is important, and how it affects them. The challenge was how to convey this knowledge to these new users groups.

With the nature of user groups changing, the technology transfer specialist must study and know the audience and use appropriate language to help people understand the information presented. Making contacts and gathering information on potential user groups and using different media to show research results expands the user groups.

A two-year Visitor Use survey conducted on the forest in 2005 and 2007 helped us assess who visits our forest and why. The survey collected data on education levels and also other demographic information, which helped us determine the education level to use for preparation of materials.

One method used was the installation of 33 interpretive signs (fig. 2). The signs have catchy titles and pictures with captions to pull the visitor in. Each sign has a "Research Shows" section with quick bullets, a "Did you know?" question and answer section, and a longer piece describing the research being done at that location. To have the most visual impact, the signs are strategically placed at trailheads where people congregate. The objective is to familiarize general public user groups with ongoing research at Bent Creek and why it is important to support this research. Educating the public about our research promotes good relationships and support.

Educational programs for children were added in 2000, with outreach to local schools offering classroom and field trip experiences to explore forests; teach forestry concepts; and learn about tree identification, forest ecosystems, tree growth, and other natural resource subjects.

Today we are reaching out not only to professional foresters and forestry students, but also State agencies, nonprofit organizations, international visitors, college students within other disciplines, along with recreationists, children, clubs, the media, and the general public.

CHALLENGES

My job is to take research results and disseminate (share/ package) the information in useable and understandable formats—a challenging task. Some of the challenges are internal, such as budget constraints, breakdown in communications within departments, changes in priorities, and limited personnel. Leadership changes can change the support for technology transfer services. Another leader might not necessarily share the same view. Some challenges are external, such as not knowing your audience or how to get information on the audience. One of the biggest challenges is writing clearly about complex issues for all levels of communication.

Another challenge is forming partnerships and exchanging information within the organization and to outside user groups. This requires a lot of outreach and sitting down with resource managers to see what formats work best for their organization and finding out what they need from the scientific community.

A technology transfer specialist needs to understand the scientific community and also the audience. There is a gap between the two. Scientists create their own community subcultural language made up of scientific jargon and terminology that is not used by other community groups within their organization and the outside user groups. Creating materials in other languages to reach ethnic and specific user groups is important if you want to effectively diffuse the information.

Another challenge is the fact that scientists are sometimes thrown into technology transfer tasks and do not have the skills to format and commercialize their products in the most effective way to meet diverse audiences. Scientists and technology transfer specialists need to work together.

CONCLUSION

There are new avenues to explore in the area of technology transfer. Communication technology changes almost daily. The good news is that new formats can create new paths to disseminate knowledge to a wider and more diverse community. Being creative and understanding audiences and technology transfer principles are key to taking science from journal articles and getting it into the hands of managers to use on the ground.

LITERATURE CITED

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Figure 1—Managers and students interact with scientists in field trips showing ongoing research.



Figure 2—Interpretive signs are an important means of communicating with recreationists on the Bent Creek Experimental Forest.