

Communicating the role of silviculture and Forest Service silviculture research in the Interior West.

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Abstract.—Silviculturists create desired forest conditions across the landscape and over time. Our job is to synthesize knowledge from many disciplines to develop prescriptions that produce desired forest conditions. In turn, forest conditions result in products and values for society. Silviculture and silviculture research help provide the scientific basis for land management decisions. Crucial roles for research silviculturists are mensurative studies that quantify resources, manipulative studies that test hypotheses, synthesis, and publication; without these, new knowledge will not be generated and the science of silviculture will progress slowly. Silviculturists are central to implementing Ecosystem Management, and they must communicate the importance of their profession to clients, other natural resource disciplines, policymakers, and the public. A checklist is provided highlighting important points about silviculture and silviculture research.

INTRODUCTION

The following is from an actual job announcement with a USDA Forest Service ranger district in the western United States.

Series/grade: GS-0460-11

Title: Forester (biomass administrator)

Duties: The incumbent serves as a silviculturist with primary responsibility for the development, planning, and application of silvicultural methods and practices.

The duties for this job are clearly that of a silviculturist, but the parenthetical title of biomass administrator suggests a reluctance to use the words silviculture and silviculturist. This job announcement is not an isolated case; rather, it reflects a trend to avoid the "S" word because of perceptions that silviculturists and the practice of silviculture are biased toward the single-minded production of wood products. Too many people think silviculture means tree culture.

At the same time, the profession is experiencing a decline in the number of silviculturists and research silviculturists in the Forest Service. Exact numbers are not available because silviculturists are included with foresters and research silviculturists are counted as research foresters. Nationwide over the past 10 years, the number of research foresters in the Forest Service has declined 61 percent from 350 to 138 positions (Stout 1996). In the Interior West², the number of research silviculturists declined 59 percent from 17 in 1980 to 7 in 1997 (Fig. 1). As Figure 1 shows, there has been a steady decline in research silviculturists.

Reduced numbers of silviculturists and research silviculturists brings several questions to mind. Is the vitality of the profession of silviculture in jeopardy? Have silviculture and silviculture research matured to the point that the number of people in the profession can be reduced? What is being lost when silviculture and silviculture research are deemphasized?

The purpose of this paper is to discuss the role of Forest Service research silviculturists and their interactions with the profession of silviculture, land managers, the scientific community, and the public. The authors' perspective is shaped by working in the Interior West, but the situation may be similar in the rest of the United States. The points discussed in this paper can be used to communicate the role of silviculture and silviculture research to the many and varied publics that we all serve.

EVOLUTION OF SILVICULTURE AND SILVICULTURE RESEARCH

In the Interior West, the profession of silviculture has evolved for nearly 100 years from emphasis on individual trees to emphasis on the components and processes of forests. Silviculture research has prompted changes in silviculture and visa versa. Synergism between silviculture research and the practice of silviculture has advanced the art and science of the profession.

Early silvicultural practices in this country focused on individual trees because of their economic and social importance. Fernow (1916) defined silviculture as the production of wood crops. The economic production of wood for society was the goal of silviculture. Silviculture research investigated the silvics of commercial species, natural and artificial regeneration, tree growth, and relationships between the environment and tree growth. Research logically started with the emphasis on individual trees, but gradually there was increasing research on insects, diseases, fire, non-tree vegetation, soils, and other components of forests.

The advances in knowledge about silvical characteristics of species and growth of trees allowed emphasis to shift to stands of trees. Tourney (1928) and Baker (1934) expanded the definition of silviculture to include methods for establishment and development of forest stands for sustained production of wood crops. Now the emphasis was on stands of trees, but the goal was still wood production to benefit society. Silviculture research also expanded by conducting investigations at the stand level. Yield tables were developed for normal stands, as were stocking tables, thinning guides, and planting guidelines.

Next, silviculture was defined as the theory and practice of producing and tending a forest that best fulfills the objectives

¹see appendix for author's affiliation

²Eastern Washington, eastern Oregon, Idaho, Montana, Wyoming, Utah, Colorado, Nevada, New Mexico, and Arizona.

Number of USFS silviculture researchers in the Interior West, 1980 - 1997

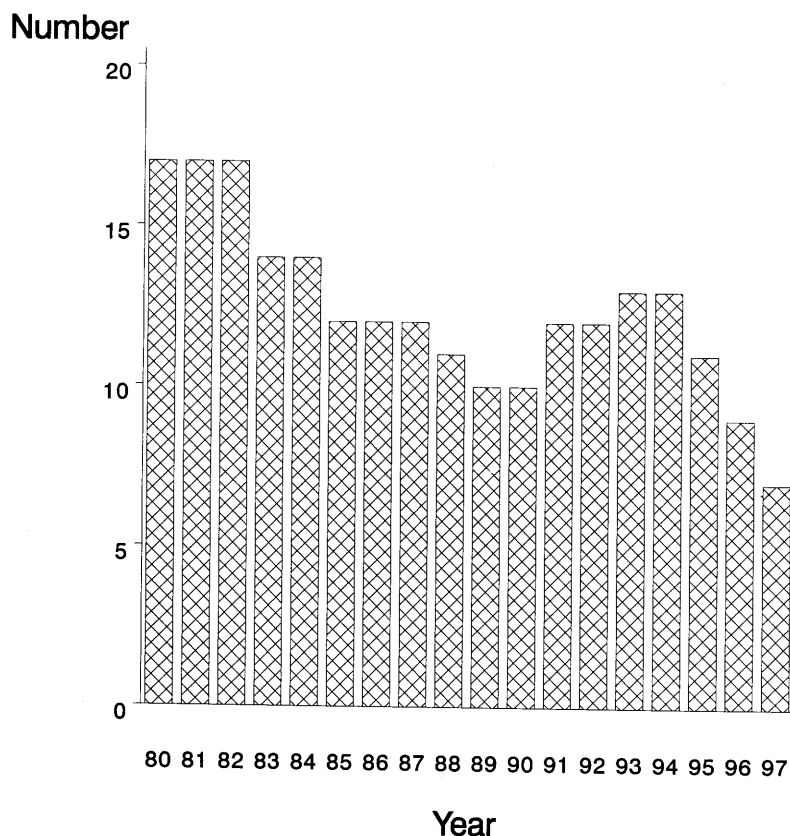


Figure 1.—Number of research silviculturists in the Interior West from 1980 to 1997.

of the owner (Smith 1962). It was no longer assumed that the landowner's objective was the production of wood. This important shift in emphasis recognized that landowners have a wide variety of objectives. Silviculturists developed prescriptions to meet many objectives, which could be as diverse as creating habitat for wildlife, providing clean water, or using genetically improved trees for wood production. The role of silviculture research expanded to use ecological community classifications (for example, habitat types and successional plant communities) that become available in the Interior West (Daubenmire and Daubenmire 1968; Pfister and others 1977; Wellner 1989). Forest growth models were developed, and they were being linked to models that predicted other forest attributes such as shrub cover, impact of insects and diseases, and wildlife (Edminster and others 1990; Moer 1985; Stage 1973; Teck and others 1996). Silviculture researchers started integrating more ecosystem processes into their studies.

Today, silviculture is defined as "the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis"

(SAF 1994). Silviculture is the management of vegetation and creation of forest conditions to meet landowner needs and objectives. Silviculture researchers now explore forest ecosystem processes, structures, and functions.

Where is silviculture in terms of its evolution? Interestingly, silviculture has progressed to meeting the intent of its original definition. The root word 'silva' is Latin for an area of woodland or forest (Glare 1968). The literal translation of silviculture is forest culture. Silviculturists prescribe management for all components of the forest to achieve a wide variety of objectives. The current evolution in silviculture to fully implement forest culture in the Interior West is possible because of the collective experience, tools, and scientific knowledge developed over the past 100 years.

CREATING DESIRED CONDITIONS

If silviculture is the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands, how does the silviculturist influence the vegetation to meet needs and values? The answer is that vegetation is managed directly and indirectly to favor the desired outcomes. The kind, amount, intensity, and duration of vegetation manipulation depends on the objective.

Silviculturists create and maintain forest structures and processes that result in the desired forest conditions. Forest conditions result in products. Traditionally, products have been wood, water, wildlife, range, and recreation. Products can be easily quantifiable, like the traditional products, or products can be values such as biodiversity, scenery, and spiritual values. Today's silviculturists are dealing with a wide array of products that the public demands.

Silviculturists create desired conditions across the landscape and over time. They develop knowledge and tools for managing forest vegetation. The job of a silviculturist is to integrate knowledge from many disciplines (ecology, pathology, entomology, mensuration, wildlife, watershed, recreation, genetics, soil science, sociology, economics, and so on) to develop prescriptions that produce desired conditions. Not only are silviculturists skilled at creating desired conditions, they are also trained to understand how historic conditions have shaped current forests and how forests will change over time -- 10, 20, 50, and 100+ years into the future. This knowledge can help create desired conditions for today and for decades to come.

Silviculturists and silviculture researchers consider consequences of their actions in the short-term and long-term. Appropriate silviculture that creates desired short-term conditions may have undesirable long-term consequences. An example would be maintaining continuous tree canopy coverage in a scenic area. Short-term goals can be reached by using uneven-age management. Long-term results will be a shift in species composition from shade-intolerant species to shade-tolerant species. The species, amount, and quality of shrubs, forbs, and grasses will change. Associated with the shift to shade-tolerant species will be changes in animals, insects, fungi, and so on. These changes may be good or bad depending on the objective. Silviculturists communicate information about short-term and long-term consequences, describe alternatives, and develop prescriptions that best meet short- and long-term objectives.

VOLUNTARY AND INVOLUNTARY SILVICULTURE

An important point about little or no silvicultural management is that forests are involuntarily changed by human activity. A lack of planning for the future care, development, and replacement of forests becomes a kind of rudderless drifting (Smith 1962). Humans have changed natural cycles in forests, especially wildfires in the Interior West. Cultivation of land adjacent to forests and extinguishing wildfires have changed the frequency and intensity of fires. Human activity has also affected atmospheric CO₂, high altitude ozone, air temperatures, air quality, wildlife migration routes, gene flow, and the introduction of exotic species of insects, diseases, and plants. We cannot dismiss the existence of involuntary silviculture. It exists and it does have unintentional effects on forests.

Natural resource professionals must consider all consequences of alternative ways that forests can be managed. An example of clear thinking is the discussion about the supply and demand for wood, wood alternatives, and how local and national demand for wood is linked to global supplies (Dekker-Robertson, these proceedings). America is a net importer of wood and Americans use wood at a rate nearly 3.5 times the global average. Alternatives to wood (steel, aluminum, brick, concrete, and plastic) are expensive, consume large amounts of energy during the manufacturing process, and result in CO₂ release into the atmosphere. When demands for wood are not met locally or nationally, forests in other parts of the world are harvested. Ecologically sensitive tropical rainforests or forests in Siberia are much less productive than forests in the United States. In addition, environmental laws in many foreign countries are weak.

Even if the American people decided not to harvest wood from public lands, there are major health concerns for forests in the Interior West. Ecosystems are constantly changing; they do not and cannot remain static. More wood grows per acre per year in Interior West forests than can be decomposed by natural processes (Oliver and others 1994; Olsen 1963). The right combinations of moisture and temperature do not exist long enough each year for wood to

decompose as fast as it grows. Fires, insects, and diseases are the disturbance agents that historically recycled excess biomass in the Interior West.

Large amounts of fuel are present in Interior West forests because of fire suppression efforts that began in the early part of this century. Forests that historically burned with low intensity ground fires are now experiencing stand replacing fires. Unacceptable loss of resources and lives are an added expense of fighting wildfires and rehabilitating burned forests. The choices are to manage forests before wildfires or after wildfires; doing nothing is an example of involuntary silviculture.

SILVICULTURISTS ARE INTERDISCIPLINARY GENERALISTS

Many of the disciplines in forestry are specialties that evolved from silviculture, so it is natural that there is a good deal of overlap between silviculture and other forestry specialties. For example, a forest entomologist must understand the habitat that supports insects and how that habitat influences life cycles, predators, hosts, and so on. But, silviculture is the one discipline where knowledge from many other disciplines is deliberately brought together to develop management prescriptions that meet owner's management objectives. Necessarily, a silviculturist is a generalist who must interact with others to develop the best possible prescriptions.

The integration of knowledge from many disciplines also means silviculturists work in an interdisciplinary manner with many people. Decisions concerning any one discipline in forestry cannot be made independently from other disciplines. Since most decisions will directly or indirectly involve vegetation management, the silviculturist is a key person on interdisciplinary teams. One job of the silviculturist is to help people understand the consequences of proposed alternatives. By collaborating with other disciplines, results of various alternatives can be described and displayed over time. Then, landowners can make more informed decisions.

THE ROLE OF FOREST SERVICE RESEARCH SILVICULTURISTS

The future is always uncertain; however, several things seem clear. The world's population is continuing to grow and people will increase their standard of living whenever possible. Current alternatives to wood are not as economical, are not renewable, and their production uses more energy and creates more pollution. Therefore, the demand for wood products will remain high. At the same time, greater demands are being placed on forests for other products such as clean water, wildlife, recreation, biodiversity, and forest health. The public expects science-based management of forests. Increasingly complex silvicultural prescriptions will be required to achieve multiple goals from forests.

Forest Service research silviculturists help envision and create the future forest under different management options. They need foresight to keep ahead of issues. Following are

general areas of research in Interior West forests where silviculture research expertise is needed. Most of this research will require an interdisciplinary approach with researchers in mensuration, entomology, pathology, wildlife biology, social sciences, and so on. It will also require collaboration with user groups, universities, and other research organizations.

1. Forest development, naturally and with management.
2. Silvicultural systems for forest health and sustainability, and for resistance and resiliency to pests.
3. Management of biomass accumulation.
4. Silviculture for threatened and endangered plants and animals.
5. Silvics of previously unmanaged species.
6. Linking terrestrial and aquatic ecosystems.
7. Techniques and tools for communicating with each other and the public.

Forest Service silviculture researchers most often seek answers to applied, rather than basic, research questions. This pragmatic approach to research lends itself to close collaboration with user groups to identify research topics, conduct the research, and transfer research results into application.

The ability to conduct long-term research is a strength of Forest Service Research. There are two types of long-term research. First are studies where variables are remeasured over long time periods. Examples are measuring permanent sample plots, monitoring the flow of watersheds, and testing genetically improved trees. The second type of long-term research deals with a series of interrelated studies that must be conducted to gain knowledge about large, complex problems. For example, whitebark pine (*Pinus albicaulis*) is a keystone species in high elevation ecosystems. Seeds from whitebark pine are very important in the diet of grizzly bears (*Ursus arctos horribilis*), Clark's nutcracker (*Nucifraga columbiana*), and red squirrels (*Tamiasciurus hudsonicus*), but whitebark pine is being decimated by white pine blister rust (*Cronartium ribicola*). Research is needed to understand many things about whitebark pine, including more about silvics, reproduction, growth, nursery practices, planting methods, competition, genetic variability, and mechanisms of resistance to blister rust.

A relatively stable research program makes it possible to conduct both types of long-term studies. With stable funding, it is possible to plan and carry out long-term studies. Scientific and technical staffs provide continuity of research and safekeeping of records. But, long-term studies should be designed to give interim results that can be applied as soon as possible. Interim results are needed to help managers who must make decisions using the best available knowledge. Scientists working on both long- and short-term studies is a good balance.

Forest Service research silviculturists also conduct short-term studies very well. A trained and experienced workforce is well suited to conducting studies that can be complex and comprehensive. Forest Service research silviculturists also

have opportunities to conduct research in a variety of ecosystems, which provides a breadth of knowledge and expertise.

The interaction among today's Forest Service silviculture researchers, colleagues, and clients is surprisingly complex. Studies are designed to answer complex questions about how biological systems function and how processes and structures interact. Collaborative efforts are essential to accomplishing the research. It is important that administrative boundaries do not impede cooperation among researchers because scientists need the freedom to pursue avenues of investigation that will provide answers to important management questions. The best collaboration begins at the grass roots level; generally a group of scientists and clients define a research need, decide upon a course of action, gather the necessary resources, and conduct the research. Grass roots collaboration needs to be protected and nurtured.

Forest Service research silviculturists have many clients. In the Interior West, users of Forest Service silviculture research include the Forest Service National Forest System, Forest Service State and Private Forestry, private industry, universities, state forestry departments, other Federal agencies, private landowners, Indian tribes, other scientists, environmental groups, and extension and consulting foresters. Research topics are chosen after consultation with clients, but research is not directed by user groups.

Independence of Forest Service silvicultural scientists is necessary. Autonomy is important because scientists are judged on their objectivity and independence to pursue the truth. While maintaining independence, silviculture researchers must work collaboratively with user groups to be familiar with their needs and to conduct high quality research. Unless scientific investigation is sustained, there will be no new technology to transfer (USFS 1995).

There are three main tasks in a Forest Service research silviculturist's job.

1. Scientific investigation.
2. Technology transfer.
3. Information and expertise.

Scientific investigation for a research silviculturist includes mensurative studies that quantify forest attributes (to answer "What is?"), manipulative studies that test hypotheses (to answer "Why?"), and synthesis of knowledge into recommendations (to communicate "How to"). Mensurative studies (Hurlbert 1984) provide information about forestry resources; for example, height-age relationships for regeneration or annual production of wildlife browse. Manipulative studies (Hurlbert 1984) that test hypotheses are crucial to explaining observed phenomenon and helping determine cause-and-effect relationships. Synthesis is a larger part of a research silviculturist's job than for other forestry disciplines. Research silviculturists integrate knowledge from many disciplines to develop and test systems, tools, and methods that can be used to meet a

variety of goals. Integration requires a fundamental knowledge of many other disciplines.

Publication of research results is the most important step in technology transfer, but it does not stop there. Scientists make presentations at meetings, participate in field trips, and provide training. Demonstration areas also show results of research. Advances in technology such as videos and the Internet provide new ways of getting information to users.

Information and expertise is exchange of ideas and knowledge. Other duties of research silviculturists include consulting, special assignments, or involvement in inventory and monitoring. Consulting may be adapting knowledge gained in one ecosystem to another ecosystem, interpreting the accumulation of literature on a particular subject, or reviewing recommendations that are based on the scientist's research. Today's special assignments involve participating on assessment teams, writing management guidelines for threatened and endangered species, and helping implement ecosystem management.

The fundamentally important parts of a Forest Service research silviculturist's job are mensurative studies, manipulative studies, synthesis, and publication. If these tasks are not done, the science of silviculture will advance slowly. Mensurative studies quantifying biological relationships. Manipulative studies test hypotheses and help determine cause-and-effect relationships. Synthesis is the process of integrating new knowledge with existing knowledge and practices to develop improved management strategies. And, of course, research findings must be published so that the new knowledge is available to current and future generations.

CONCLUSIONS

The number of Forest Service silviculturists and silviculture researchers has steadily declined despite the need for both. Demand for products from forests will remain high because of expanding populations, rises in the standard of living, and increasing demands for a variety of products. The products from forests can be traditional products (wood, water, wildlife, range, and recreation), newer products (such as yew bark, mushrooms, and beargrass), or values (such as spiritual values, biodiversity, and forest health).

The profession of silviculture has a very important role in helping achieve the goals of forest management. The importance of that role must be communicated both internally and externally in a variety of ways and to a variety of publics. No one approach will reach the various publics because different groups have diverse knowledge about natural resources, forestry, and silviculture. However, the messages that need to be communicated are the same. Following is a listing of points about silviculture and silviculture research that are important to communicate to each other and the various publics we serve.

- Silviculture means forest culture. Silviculturists plan and implement treatments with all components of forest

ecosystems in mind. Research silviculturists design research studies that consider all components of the forest.

- The choices are to silviculturally manage forests now or rehabilitate them later. This is especially true in the Interior West where wildfires, insects, and diseases have historically recycled accumulated biomass.
- Silviculturists realize that all forests are being managed because they are being managed either voluntarily or involuntarily. Involuntary silviculture occurs when there is a lack of planning for the care, development, and replacement of forests.
- Silviculturists are interdisciplinary generalists. Silviculture is the profession where knowledge from many disciplines is deliberately synthesized and applied.
- Silviculturists help achieve land management objectives. Objectives can be tangible products or less-tangible values.
- Desired conditions are created by manipulating vegetation to favor some species over other species. Conditions are created over time and across the landscape.
- The art and science of silviculture have co-evolved from growing trees, to stand management, to stand ecology, to landscape ecology.
- The profession of silviculture has accumulated enough tools, experience, and scientific knowledge to begin forest culture.
- And it is silviculturists who have the broad ecosystem-based training to do ecosystem management.
- Silviculture and silviculture research have short- and long-term perspectives. The consequences of short-term results must be considered in the context of long-term forest development.
- The fundamental roles of Forest Service silviculture research are mensurative studies, manipulative studies, synthesis, and publication. These four roles move the art and science of silviculture forward.
- Forest Service research silviculturists have many clients. Research topics are chosen in collaboration with clients, but research is not dictated by any client or user group.

Those of us in the profession of silviculture must be proactive in communicating the importance of silviculture and silviculture research. Good silvicultural practices will make people feel good about forestry and bring more credibility to natural resource management. Silviculturists *manage* to bring out the best from our forests.

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APPENDIX: Members of the Interior West Silviculture Group

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