The Value of Long-term Silvicultural Research Studies

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Abstract.—Reductions in research operating budgets and recent trends in research management philosophy have in many instances forced Forest Service scientists to realign their research programs to compete for short-term grants and other sources of funding. This approach may prove detrimental in silviculture, a discipline where long-term research is critical for: (1) research in the regeneration and establishment of forests, (2) testing management alternatives in established stands, (3) retaining research installations for future remeasurement; using them as laboratories for other disciplines, and adapting them to meet current and future needs. We present specific examples from our own experience where long-term studies have been utilized in these capacities.

INTRODUCTION

Neither of us confess to being dedicated followers of Forest Service policy, but our keen scientific minds and combined 50+ years of experience with the agency have enabled us to perceive what we consider to be disturbing trends in Forest Service Silvicultural Research. First of all, we've noticed that we simply don't have as much money to spend on our research as we once had. With smaller budgets, we can't afford to do large-scale experiments in a time of increased emphasis on landscapes and ecosystems. We have also noticed that a lot of our colleagues have disappeared too. We now compete with our academic friends in seeking soft money to fund research.

There are several changes in management philosophy within the Forest Service that have affected our discipline. There has been a movement away from commodity-oriented management with an accompanying emphasis on other resource values during the past few years. We are not suggesting that this has been wrong, but do wonder if the pendulum has swung so far that some basic principles of forestry have gotten trampled in the process.

Another contributing factor is the need for quick answers in today's crisis-to-crisis management environment. Managers simply don't have time to wait for the results of long-term studies to become available. As a result there is a perception that the need for silvicultural research has been reduced. The arguments for this position is that silviculture research is no longer pertinent to current management needs (e.g. we aren't growing timber anymore, we already know everything we need to know about growing trees, we need to learn more about ecosystems, etc.).

The scientific culture of rewarding scientists for the number of scientific publications produced is also detrimental to long term studies. Neither the scientist or the supporting agency are eager to initiate research efforts where investments are slow in producing rewards. This is especially true for scientists performing silviculture research where it may take years for trees to respond to treatment.

We feel that subscribing to these attitudes overlooks several critical issues. Trees are the defining component of forested ecosystems and we do still need to learn more about their biology, care and management. This is especially true as we seek new ways of maintaining and managing these ecosystems for purposes other than commodity production. For example, we know a lot about managing forests to produce wood fiber, but need to learn more about managing trees to maintain old growth, provide wildlife habitat, and reduce the risk of catastrophic disturbance in urban-interface and other high-value environments. We have learned much about the biology of tree species that have been utilized for wood products, but know little about many "non-commercial" species in our forests. We have well developed silviculture techniques for managing even-aged, single-species, forests, but need to refine un-even aged management techniques in mixed species forests and at landscape scales. The word "forest" is still in the name of the agency and as long as it is, we need to concern ourselves about trees as well as other natural resources.

Because trees are long-lived and grow slowly in some environments, silviculture is a discipline where long-term research is critical. Since the Forest Service has been managing trees for a long time and has established an infrastructure of facilities where long-term studies can be maintained, we feel Forest Service researchers are uniquely capable of conducting such studies. Our scientists have access to the largest network of experimental forests in the world, many of which have on-going studies that have been in place for decades. This gives us a tremendous advantage over our academic and industry colleagues, whose access to long-term study sites is limited, or driven by production forestry goals. We should not forsake these resources because of changes in public land management philosophy.

Our theme here is to remind our colleagues that silviculture is still a viable discipline, and that management of trees will still be done in the future. Although it may not be commodity-based as in the past, silviculturists are uniquely qualified and positioned to take the lead in planning and applying that management. Furthermore, we advocate that silviculture researchers should utilize existing and new long-term studies and installations to develop vegetation management techniques that can provide the attributes desired for our public lands.

DISCUSSION

Long term studies are critical to several areas of silviculture research and will be a key element to the development of

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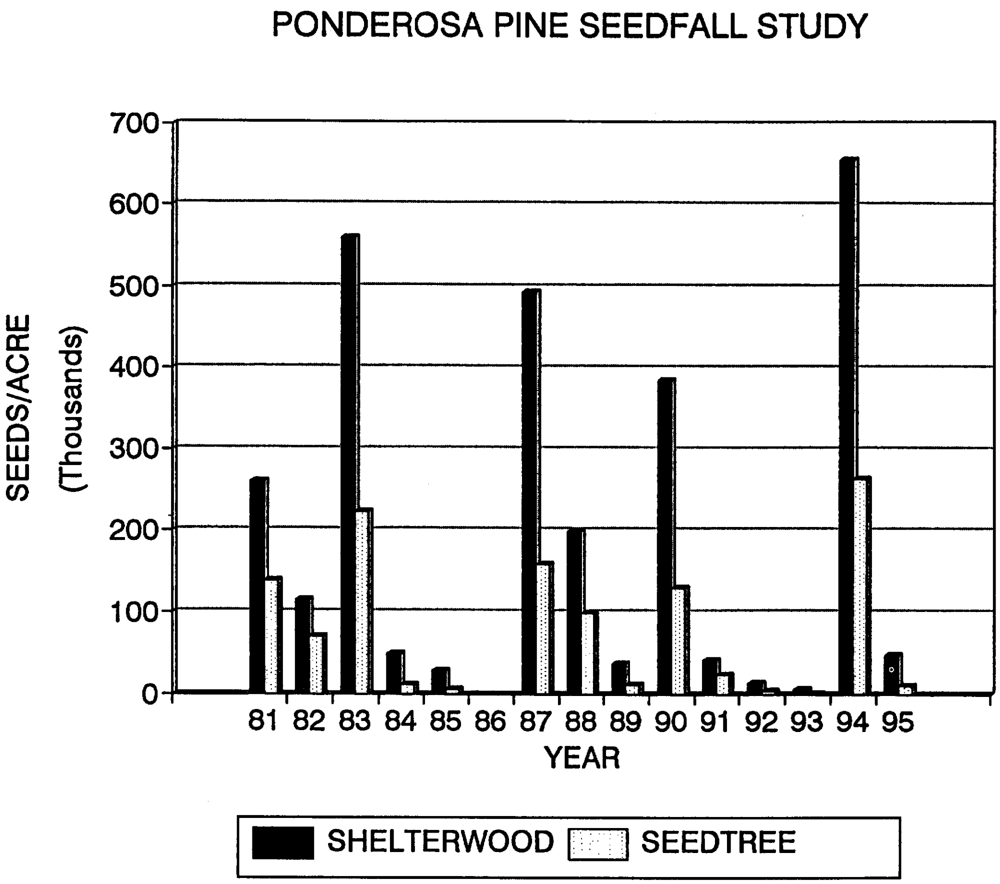

Figure 1.—Annual seedfall of Front Range ponderosa pine under shelterwood and seedtree overstories, 1981-1995.

new vegetation management techniques. For example, research in the regeneration and establishment of previously unmanaged species cannot be adequately done without long-term studies of the factors that influence growth and survival over time. No other method can furnish the necessary data. Similarly, long term studies are useful to test new management alternatives in established stands. Measuring growth responses to thinning and other density and structure control techniques over time is the only reliable way to collect the data needed to develop and refine growth and yield models. This kind of long-term research can be useful not only to forest management, but also to other disciplines such as basic ecological research. Long-term studies can provide data on tree biology that would be useful in developing process-based models in addition to growth and yield models. Long-term studies could also be useful in the science of developing monitoring protocols.

Our agency has adopted an adaptive management philosophy; a similar adaptive approach is needed in the management of long-term research installations. Retaining these research installations as field laboratories and adapting them to new uses is another way of utilizing these extremely valuable resources in answering new research needs. Installations that were established for one purpose can often be used for new research, with the existing data providing a critical historic reference to set the context of the new research.

To underscore the continued need for long-term research within our agency, we would like to present several examples from our own experience to illustrate how long term studies can meet these needs.

Manitou Experimental Forest Ponderosa Pine Regeneration Study

This study was established in 1981 to compare seed tree and shelterwood regeneration methods in Front Range ponderosa pine in Colorado. As part of the original study, we installed a grid of 900 seed traps and 450 6 x 6 ft. plots to monitor seedfall and seedling establishment. Fifteen years of monitoring have given us a very good picture of the periodicity of seedfall in Front Range ponderosa pine as well as a much better understanding of the growth and survival rates of natural pine seedlings. It is becoming increasingly apparent that good seed crops occur every 3-4 years in this environment, but usually not sequentially (Fig. 1) and that seedling survival follows a similar trajectory, regardless of the year of germination (Fig. 2). Our observations of differential seedfall and establishment from plot to plot have prompted us to initiate new research on the site to identify micro-climatic, soil, or topographic features that might be responsible. We have also mapped the position of overstory trees in an effort to identify and characterize those which produce consistently good seed crops. None of this research would have been possible using short-term studies.

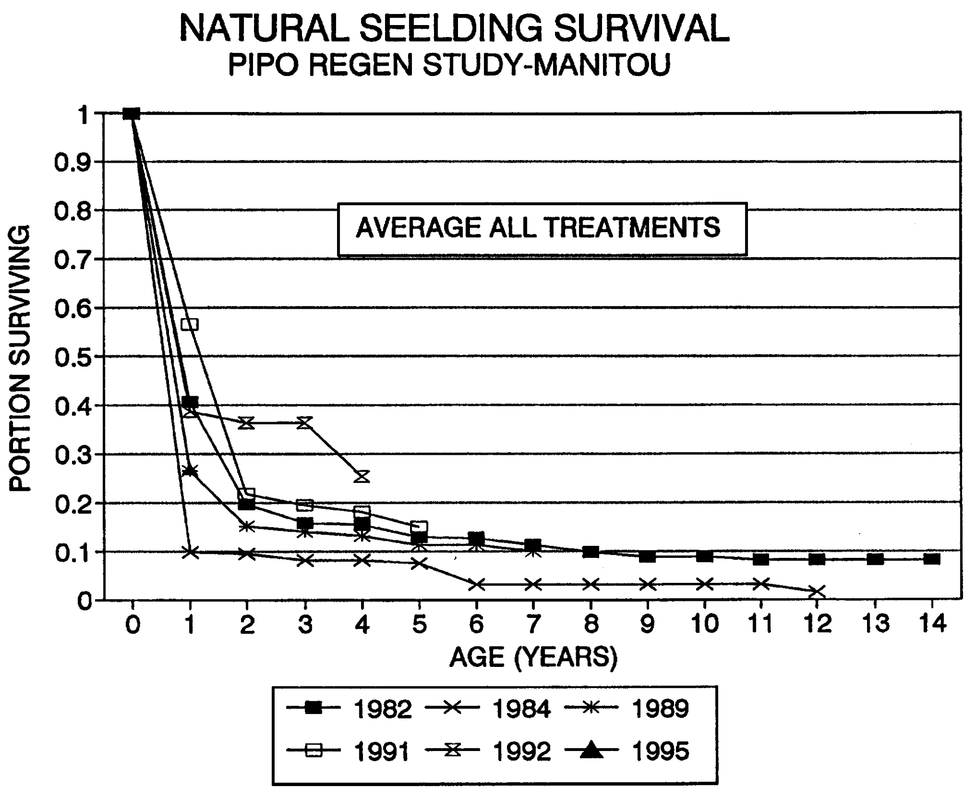

Figure 2.—Portion of ponderosa pine seedlings surviving to a given age, by year of germination.

Fraser Experimental Forest Engelmann Spruce Seed Production Study

This long-term regeneration study was installed in 1969 specifically to monitor seed production in natural high-altitude spruce stands (Alexander and Noble 1976). Although our continuous record of seed production is unique, perhaps the most valuable aspect of this study is the repeated inventory of the thirteen undisturbed old-growth stands surrounding our seed traps. This data will soon give us a thirty year record of mortality, recruitment, and growth in these stands. This study is an excellent example of adapting an existing long-term study for new, unanticipated uses.

Engelmann Spruce Provenance Plantation

This study was planted in 1970 as part of a national test of Engelmann spruce seed sources collected from throughout the natural range of the species (Shepperd and others 1981). Not only has the 25 years of survival and growth records given us valuable information about genetic variation within the species, it has also served as an excellent demonstration of the long-term value of using proper planting techniques at high altitudes. Following guidelines developed by former Rocky Mountain Station scientist Frank Ronco (Ronco 1972), we have achieved an overall survival of nearly 70%, 25 years after planting, and have clearly established that most mortality occurs in the first few years after planting. Such long-term quantitative planting records are unique in our experience and are invaluable in training new generations of reforestation specialists.

Fraser Experimental Forest Cutting Methods Study

Originally established to test and compare the efficiency of harvesting Engelmann spruce and lodgepole pine under even- and uneven-aged management, this study's most important role has been as a demonstration area where professional and lay visitors can view examples of correctly-applied silviculture, see first-hand the differences between even- and uneven-aged management, and discuss the benefits/trade-offs for other resources. It has been especially beneficial to natural resource professionals who do not have a forestry background. The uneven-aged sites have also benefited silviculturist trainees who can view diameter distribution Q curves applied on-the-ground.

The Fort Valley Experimental Forest Levels of Growing Stock Study

This ponderosa pine research was initiated to study the effects of stand density management on the development of second-growth stands. The Taylor Woods installation at Fort Valley Experimental Forest near Flagstaff, Arizona, is the oldest of four similar installations west-wide. The area at Taylor Woods was commercially harvested in winter 1923-24 and contained an understory of saplings established in 1914 and smaller seedlings established in 1919. This aspect of the study certainly qualifies as research in the regeneration and establishment of forests and illustrates the value of having long-term data from a site.

The second-growth stand that developed from these saplings was initially thinned by Gilbert Schubert in 1962 (Schubert

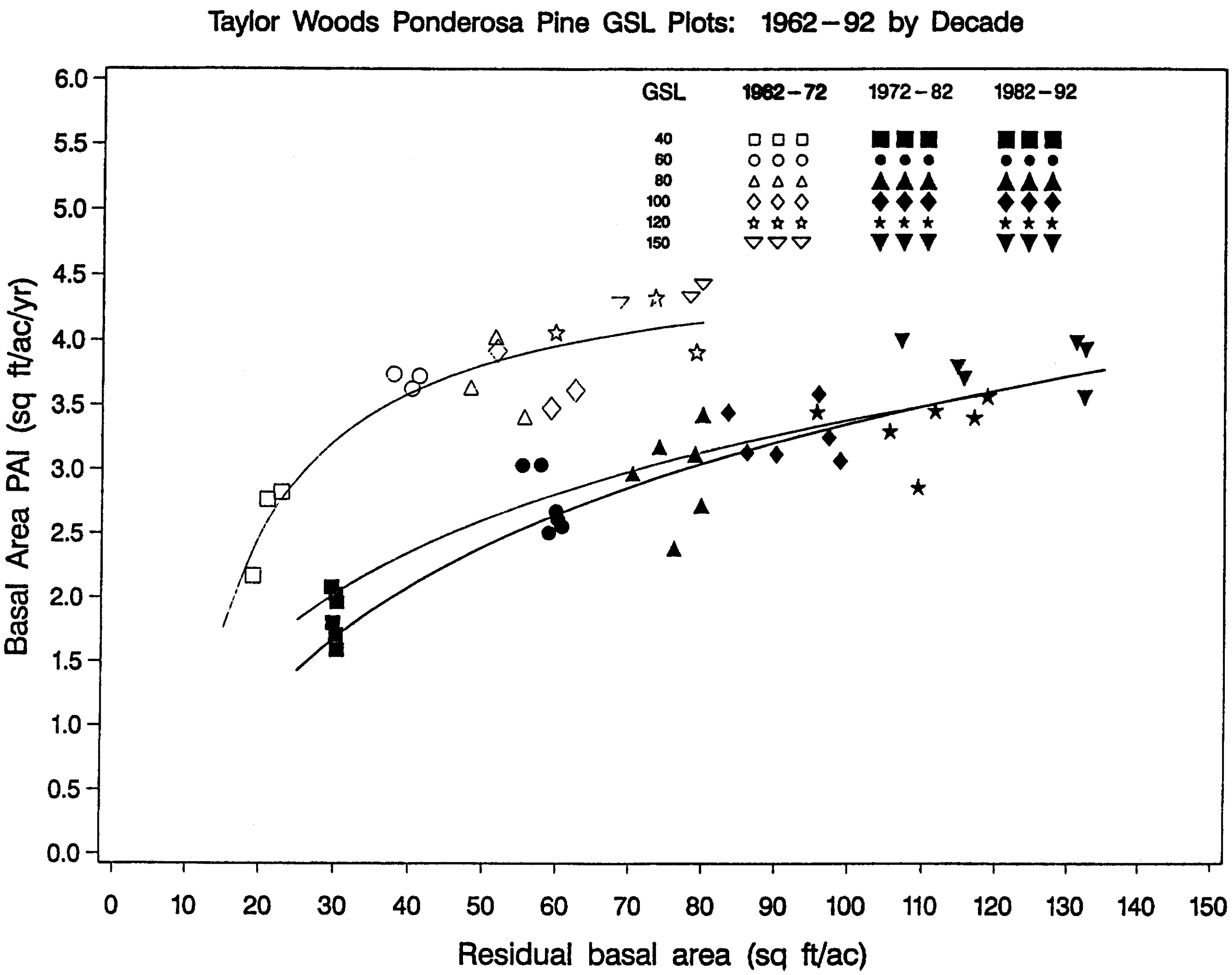

Figure 3.—Basal area growth by growing stock level (GSL) calculated prior to thinnings at 10, 20, and 30 year intervals, Taylor Woods levels of growing stock study.

1971) under a study plan written by Clifford Myers (both former RM scientists). All the large trees remaining after the 1923-24 cut were harvested in the early 1960's, prior to the study initiation.

Basal area annual growth rates varied by stand density as would be expected, but growth also varied for each 10-year remeasurement period after thinning (Ronco et al. 1985). Note how the growth was different during the initial period showing an adjustment to growing space after the first thinning, and fairly consistent during the next two periods (Fig. 3). This is an excellent demonstration of why permanent installations are a most effective tool for researching and demonstrating long-term stand dynamics. A ten year study would have given much different results that the thirty-year study has revealed.

Taylor Woods has not only been a test of management alternatives. It is also an excellent example of how long-term research installations can be retained as field laboratories and adapted to new uses. Taylor Woods has been used to study the effects of density management on wood quality of harvested trees, mushroom production as a food source for Abert's squirrels, understory herbage production, resin production and photosynthetic rates, and canopy cover. While there has been a shift away from even-aged management in the Southwest, the study provides an excellent example of how the rates of tree development can be controlled by managing stand density to obtain variability in tree sizes in even-aged forests. Standing and discussing the real thing is better than a conference room any day. Permanent research installations are critical demonstration areas and an important communication tool for both research and management.

North Kaibab Ranger District Group Selection Study

This recent study installation for uneven-aged management of ponderosa pine on the North Kaibab Ranger District, Arizona is an example of how we envision long-term studies might be continued in the future. It seeks to determine the effects on stand dynamics when an unregulated large-tree component is retained with a group selection cutting method at various residual density levels, such as would be done for wildlife habitat. In this study, large-tree groups have been retained, where in traditional uneven-aged management many would have been harvested. The study will provide basic information on growth rates of smaller trees, such as those regenerated from a previous group selection treatment in the study site. In addition, the study is also investigating the effects of prescribed burning on the survival and growth of residual trees of all sizes, future regeneration establishment, and snag longevity.

By sharing resources and a study design such collaborative long-term research efforts are more cost effective than single discipline studies. In addition to research funding, Timber Management and the Kaibab N.F. also contributed funding and resources to facilitate plot establishment and treatment. Research collaborations such as the Kaibab study give silvicultural researchers the resources to provide leadership in adaptive management. Providing the site and resources to help establish this study has given Forest personnel a vested interest and feeling of ownership and responsibility for this study. This is extremely important in maintaining long-term studies, especially those established off experimental forests. Such partnerships are critical to the success of our research program and we advocate their use elsewhere.

CONCLUSIONS AND RECOMMENDATIONS

We feel that long-term silviculture research is an investment that pays real dividends over time. It will be beneficial for the Forest Service to continue to do long term research as public land management policy evolves. Our experience with the studies we have discussed here has convinced us that our agency has a unique advantage over other research organizations in that we have access to the facilities, control of the land, and the continuity of personnel to engage in such studies. Long-term studies have always been a key part of the Forest Service's research program. We feel they should be retained, adapted and strengthened in the future to meet our agency's changing information needs.

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