

# THE EARLY YEARS OF SILVAH

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## INTRODUCTION

I was delighted to learn that this meeting would focus on SILVAH, and that SILVAH is still being used and improved as a tool in the management of Allegheny hardwood and oak forests.

My task today is to tell you a little about the early years of SILVAH and some of the events that led to its development. The computer program we call SILVAH was preceded by many years of research into four main factors that affect the outcomes of silvicultural treatments in Allegheny hardwood forests.

- The role of well-developed advance reproduction for ensuring regeneration success.
- The impacts of protracted browsing by white-tailed deer.
- Effects of interfering plants such as ferns and understory beech on regeneration survival and development.
- Better ways to assess stand conditions and prescribe appropriate silvicultural treatments. This involved assimilating the findings from the research into silvicultural guidelines and then into a system of stand inventory, analysis, and prescription writing. That system was originally used without the benefit of computers.

## Research That Led to SILVAH

The story begins with a regeneration problem that appeared with the shift during the 1950s and 1960s from a regionwide emphasis on uneven-age management to even-age management in most eastern hardwood types. It worked fairly well in many forest types. Adequate advance reproduction, good seed sources, and other factors generally resulted in satisfactory natural regeneration after clearcutting. But this was not so everywhere. Less-than-satisfactory species composition and outright regeneration failures occurred in some situations. These failures were severe and widespread in the Allegheny hardwood type.

The Northeastern Forest Experiment Station earlier recognized the regeneration problem in the Alleghenies and the need for research. This resulted in the construction of the Forestry Sciences Laboratory in Warren, PA, in the early 1960s. Warren Doolittle, the assistant station director in charge of silvicultural research, moved a few people from other locations to Warren, but lack of funding prevented any significant impact.

A late 1960s Society of American Foresters meeting publicized this problem and focused public attention on the need for additional research in this forest type. That meeting galvanized forest landowners to contact their representatives in the U.S. Congress. Norm Tuttle of Hammermill Paper Company and Art Bennett of Armstrong Forests led this charge for the forest industries. Tuttle was chairman of the Forest Resources Committee of the Pennsylvania Chamber of Commerce. He testified at appropriation hearings in Washington, D.C., about the need for expanded federal research into this problem.

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Supplemental funding bills for expanded research in northwestern Pennsylvania were introduced in Congress several times in 1968 and 1969 but did not pass. Then in late 1969, a supplementary appropriations bill passed with funds for the Warren research unit. I was appointed as research project leader, although I was at Yale working on a Ph.D. at the time. During 1970, I was able to design and install several large studies aimed at the Allegheny hardwood regeneration problem and use those studies to satisfy my dissertation requirements.

Over the next several years, we greatly expanded the research staff at the Warren Laboratory. Some were funded from the new appropriation, and some funding was transferred from other units. For most of the next 20 years, seven or eight scientists worked there, along with technicians and other support staff. The scientists included experts in silviculture, ecology, soil science, plant physiology, wildlife biology, and mensuration. We initiated a wide range of experiments aimed at all aspects of the regeneration problem and soon began to work in other areas of hardwood silviculture.

## **Research Planning**

We found a lot of general information in the literature about the regeneration problem but not much that was specific and useful to a forest manager. For example, researchers generally agreed that most hardwood stands would regenerate satisfactorily if abundant natural regeneration occurred on the ground before cutting, and if only limited interfering plants such as ferns or beech root suckers grew. But the literature held no information about how much advance regeneration was enough or how many interfering plants were too many. Likewise, there was general knowledge that thinning would benefit yield in dense stands but no specific information on what density warranted treatment and no adequate method of evaluating relative stand density in Allegheny hardwoods stands with their wide range of species. So we created a decision chart that incorporated all the general information we had about the conditions that affect silvicultural treatments. Whatever specific information we could find on decision points was noted on early versions of the chart. Decision points for which data were inadequate or totally lacking became our priorities for research, and we added them as information became available. This approach worked very well, and we were soon able to develop guidelines and recommend practices. Our planning decision chart for research looked very similar to the final silvicultural decision chart that SILVAH uses.

## **Long-term Studies**

We received a big boost from work that Ash Hough and others had started on the Kane Experimental Forest in the 1920s and 1930s. Although it was shut down during World War II and not reopened until the early 1960s, Hough had been transferred to Northeastern Forest Experiment Station headquarters, and he spent summers at Kane remeasuring those study plots at 5-year intervals into the 1960s. We picked up those studies in the 1970s, providing long, continuous records of stand growth and development of 40-60 years (including development of stands after clearcutting). That information greatly facilitated the early development of silvicultural recommendations for SILVAH.

Among the advances resulting from the availability of these long-term data were the development of a measure of relative stand density that accounted for differences in species composition, stocking guides for Allegheny hardwoods, and algorithms to predict stand growth. These advances greatly benefited the development of the SILVAH system.

## Training Sessions

By 1976 we had enough information on both regeneration and thinning that we thought it important to distribute it to forest managers without waiting for a more complete version of SILVAH. We set up several 2-day information sessions at the Kane Experimental Forest where we could demonstrate how to apply the guidelines and understand their effects in real stands. Ben Roach, who was a researcher at the Warren Laboratory by that time, devoted 1 day to evaluation of stocking and thinning, and I devoted the second day to regeneration. The only place that was available to meet for the lecture portion of the training was the garage at the experimental forest. That venue lacked even the most basic audiovisual equipment. It did not even have a chalkboard, so we had to use chalk on the garage walls to present pertinent data. Each session was limited to 12 participants. At that time we still had significant gaps in our decision chart and had not yet assimilated our research findings into a prescription writing system.

Once we realized the strong interest in such training, we modified the house at the experimental forest to accommodate these sessions. We removed the partitions from the living room and dining room to create a larger and better-equipped meeting space. We were able to accommodate 18 people per session, and we expanded the sessions to 3 days to accommodate new research findings. During the next 5 or 6 years (1977 to 1984) we filled in many of the gaps in our decision chart and assimilated all the guidelines and recommendations into a coherent system, which we were then calling “A Stand Inventory, Analysis, and Prescription System for Allegheny Hardwoods.” At that time the inventory data were still summarized manually, and prescriptions were determined directly from decision charts. There was no computer program yet, but the decision system that would become SILVAH was being widely used.

The training sessions remained popular, and forest management agencies from throughout the Allegheny region and beyond were regularly sending their foresters for training. We finally realized that we had created a monster, and that it was likely to continue for the foreseeable future. So in 1985 we built a new building at the experimental forest especially for these training sessions. It held 32 attendees, at tables, and was well furnished with audiovisual equipment and other amenities. Training sessions were extended to a full week to accommodate the constantly expanding guides that our research was developing.

We thought that nearly doubling the capacity of our meeting space would result in fewer weeks spent at this activity, but we still needed 3 weeks each year to accommodate those wanting to attend.

## The SILVAH Computer Program

At about this same time, we wrote a Fortran computer program to use primarily in conjunction with the training sessions to do calculations from the class exercises. When personal computers began to appear in most workplaces, that program was expanded to handle the full stand analysis and prescription process, and we made it available to the public informally. It ran on an IBM two-floppy disk computer under DOS. The acronym SILVAH was used at that time to describe this computer program, but we intended SILVAH to refer also to the prescription system.

## Testing of SILVAH

About 1980 we decided to compare the recommendations generated by the SILVAH program to prescriptions of experienced silviculturists. We arranged with Hammermill Paper Company to do such comparisons on a large compartment of its land where the company was about to perform thinnings and harvest cuttings in stands that were ready for such treatments. Hammermill collected the inventory data needed for SILVAH in all stands. Then, several of its most experienced prescribers would decide the appropriate treatment for each stand based on usual procedures. Finally, Hammermill ran SILVAH on each stand and compared the results of the two procedures. The results were identical in most cases. Where the results differed, the prescribers agreed that the SILVAH analysis had picked up something they missed, and they chose to adopt the SILVAH recommendations.

We made similar but less formal comparisons on both public and private forest lands, but with prescriptions written by less experienced prescribers. In these cases, SILVAH frequently provided information that the prescriber missed or gave prescriptions more appropriate to stand conditions or management goals than those of the less experienced prescribers.

## SILVAH Publications

The first publication fully describing the Stand Inventory, Analysis and Prescription System for Allegheny Hardwoods, and citing the research background for those recommendations, appeared in 1984 (Marquis et al. 1984). It was revised in 1992 (Marquis et al. 1992). The first manual for use of the computer program SILVAH also appeared in 1992 (Marquis and Ernst 1992). A loose-leaf notebook containing all the lectures for the training courses, including all the slides, was published in 1994 (Marquis 1994). Then in 2014 the SILVAH User's Guide was updated with the latest information from the research and experience, and republished (Knopp and Stout 2014).

## Stand Growth Simulator Added to SILVAH

By the time the first SILVAH manual was published, a stand growth simulator had been added to SILVAH, making it capable of suggesting prescriptions for silvicultural treatments in Allegheny hardwood and oak stands and allowing projections of stand conditions so users could compare potential outcomes from different treatments. This combination of capabilities in a single model was, and I believe still is, unique.

## SUMMARY

The stand analysis and prescription system that form the basis of SILVAH benefited from:

- A well-funded research program and a great staff
- Research planning aimed specifically at providing silvicultural guidance
- Long-term studies installed in the 1920s-1930s and periodically remeasured
- Training sessions that explained the system, provided hands-on practice, and kept us aware of new problems and changing research needs

SILVAH will continue to evolve as managers face new challenges in managing their forests, and new information becomes available to address those concerns.

## LITERATURE CITED

- Knopp, P.D.; Stout, S.L. 2014. **User's guide to SILVAH**. Gen. Tech. Rep. NRS-128. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 122 p. <https://doi.org/10.2737/NRS-GTR-128>.
- Marquis, D.A., ed. 1994. **Quantitative silviculture for hardwood forests of the Alleghenies**. Gen. Tech. Rep. NE-183. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 376 p.
- Marquis, D.A.; Ernst, R.L. 1992. **User's guide to SILVAH stand analysis, prescription, and management simulator program for hardwood stands of the Alleghenies**. Gen. Tech. Rep. NE-162. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 124 p.
- Marquis, D.A.; Ernst, R.L.; Stout, S.L. 1984. **Prescribing silvicultural treatments in hardwood stands of the Alleghenies**. Gen. Tech. Rep. NE-96. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 90 p.
- Marquis, D.A.; Ernst, R.L.; Stout, S.L. 1992. **Prescribing silvicultural treatments in hardwood stands of the Alleghenies (Revised)**. Gen. Tech. Rep. NE-96. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 101 p.

The content of this paper reflects the views of the author, who is responsible for the facts and accuracy of the information presented herein.

Marquis, David A. 2019. The early years of SILVAH. In: Stout, Susan L., ed. SILVAH: 50 years of science-management cooperation. Proceedings of the Allegheny Society of American Foresters training session; 2017 Sept. 20-22; Clarion, PA. Gen. Tech. Rep. NRS-P-186. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 3-7. <https://doi.org/10.2737/NRS-GTR-P-186-Paper1>.