

Silviculture in a Complex Management Environment: A Forest Supervisor's Perspective

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ABSTRACT.—Managing vegetation with silviculture on national forests in the 21st century will be far more complex than at any time in the hundred plus years of the agency's history. Silviculture will take place in an environment of great uncertainty. A changing climate, unprecedented rates of change to biological communities from invasive species and pests, the likelihood of continued capacity limitations to treat acreage, changes in land use and forest management on surrounding lands, and business models of timber companies will challenge managers and silvicultural practitioners to make tradeoff choices and determine optimization outcomes that will have far reaching and long-lasting effects. Practicing silviculture with humble confidence will become even more imperative. Four attributes essential to facing these practical realities are given to highlight the kinds of dilemmas managers will face and how silviculturists can best contribute to informed decisionmaking.

A PERSPECTIVE ON OUR HISTORY

USDA Forest Service silviculturists, as well as many others in tribal, local government, university, and private sector agencies and businesses, have a long, deservedly proud, and important history in the now hundred plus years of managing national forests and other forested lands in the United States. The science and practical implementation of silviculture helped restore and reforest not just what are now national forest lands, but also profoundly influenced the management of tribal, state, county, town, industrial, and non-industrial private lands. Those private lands now play an increasingly important role in the accumulation of broad social benefits and values that go beyond the desires and values of individual landowners.

Silviculture has afforded the means for managing national forests so that they can provide the many social and economic benefits of wood fiber in its many forms with reasonable assurance that those same forests can sustain the removal of trees and provide the same suite of benefits again and again. Think how different this is from the great logging era when extraction of wood fiber was maximized to great detriment of other values and without thought of stewardship or long-term sustainability. This idea of sustainable forestry may sound simple and almost a given, but consider what it is we are doing—inserting ourselves into complex biotic communities we call forests that are still reassembling after the most recent glacial presence, climatic fluctuations, loss of megafauna and other species that had been there for thousands of years, and multiple incursions of humans after the last glacial period. Then, recently we disturbed these forests again, significantly, a hundred or so years ago when their trees became the raw material that helped build cities and towns of America and in the process disturbing them greatly and shocking them from the canopy to the soil and then allowing them to recover to some semblance of their original productivity, vigor, and future resilience. Today through silviculture, we are planning to disturb these forests to a lesser degree but again and again in the same places. At least we hope that is what is occurring. And theoretically, we are doing this with “humble confidence.”

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The management of national forests has been based on ever-evolving paradigms of sustainable forestry and ecosystem management influenced by science, social trends, popular opinion, and politics. The business model of national forest management is therefore almost unexplainable if one considers the millions if not billions of decisions made every day from places in the woods, laboratories, offices, and halls of Congress. One constant theme throughout, nonetheless, is that decisions are made and implemented, thereby setting in motion a multitude of trajectories on millions of acres of land, trajectories which influence each other and natural processes, and in turn are influenced by the forces, large and small, of Nature and of humans. In my simple way of thinking, *“It is impossible to describe exactly and precisely what is going on out there and why.”*

Managers want to know what is occurring and the public expects it. There are many important and sometimes conflicting values we want from public lands, and perhaps most importantly the ecosystems services needed to support human society. Yet, predicting the future condition of forest vegetation remains challenging despite decades of research into reasonably undisturbed and significantly human-altered systems, and similar decades of management, measurement, experiments, and observation.

Despite these uncertainties, we manage. We observe, measure, record, analyze, plan, model, predict, implement, monitor, evaluate consequences, project scenarios, make choices to change or stay the course, and keep managing. Our fundamental principle is that many lands in the National Forest System should be actively managed to account for ecological disturbance factors that no longer occur in form, intensity, or periodicity and to optimize social, economic, and ecological benefits to be derived from these public lands with raw material in the form of wood fiber as one of the important outcomes. Silviculture continues to be the gas in the engine of implementation on these acres with commercial timber sales as the vehicle to make it happen, those sales being a most fortunate business arrangement on many acres, the desired management subsidized to a degree by the demand for wood-based products and a set of laws and policies that allow us to sell these products.

Political, social, and ecological factors have directed national forest managers to either manage lightly or not at all in other places like federally designated Wildernesses, Wilderness Study Areas, Research Natural Areas, old-growth designated areas, and similar places. There, the forces of both humans and nature occur, as none are large enough nor can they be bounded effectively to keep out the effects of what is occurring everywhere else. In these places we do far less observing, monitoring, evaluating, predictive modeling, scenario projecting, and evaluating of consequences of management actions, and the like, perhaps naively and to the detriment of our ability to manage actively elsewhere. Our foundational principle has largely been to let these places be with the idea that perhaps nature will show us what happens in the absence of human management, and in turn we can learn how to manage the other areas and national forests as a whole more successfully.

At our best, research and management silviculturists have responded to these challenges with “humble confidence”—managing actively or lightly, always recognizing the complexity of the ecological, social, political, and economic systems that converge around our work, applying what we’ve learned with keen eyes and ears for change, and adapting our understanding as we continue to learn.

It can be a bit unnerving to think about our forests in North America as constantly reassembling and recovering, and our past, current, and future actions, designed to restore and sustain, as adding another disturbance factor into them. We know not to what end the forests are evolving, but we know that the complex interrelationships of soil, water, air,

sunshine, shade, plants, and animals are what comprise the forest at any one time, and that there are thresholds and tolerances determining if the future is a community that might still be called a northern hardwood forest or a spruce-fir forest or something else.

While silviculture has always been an evolving and adaptive practice, I wonder if and I fear that the pace of adaptation in our “humble confidence” may now not be rapid enough. As author and renowned conservationist Aldo Leopold wrote in his essay, *Arizona and New Mexico: Thinking Like a Mountain* (Leopold 1949), “We all strive for safety, prosperity, comfort, long life, and dullness.” I think in two words he meant we all strive for certainty and stability. How wonderful it would be for the science and practice of silviculture to be occurring in a relatively stable world, one where we had time to learn, try, adapt, and find the ideal set of practices for all forest types and conditions where commercial timber sales and other stewardship activities are to occur. With forestry as a long-term proposition, one in which we will not likely have careers or lives long enough to see the fruits of our labors, we would benefit greatly from a century or two at least of such stability and certainty to really see if what we are doing is working. At best, we see the first few strides out of the gate of what we do, the middle hurdles of those who came before us, and the last strides to the finish line of what those who began long ago, such as the Civilian Conservation Corps workers planting trees or early foresters tending regenerating aspen or hardwood forests.

THE PRESENT AND FUTURE PROJECTIONS

We are living in far more interesting times than Sir Austen Chamberlain was referring to 75 years ago when he said in a now famous speech: “May you live in interesting times. There is no doubt that the curse has fallen on us. We move from one crisis to another. We suffer one disturbance and shock after another” (The Yorkshire Post 1936). This is our fate as land managers and scientists in the times we are living in. We live in a world of less certainty, other than the high probability of change in pace and intensity and form, that will challenge our established science and practices.

What will this future look like and what roles will research and practicing silviculturists have in it? The “Northern Forest Futures” project (from the Forest Service’s Northern Research Station) uses predictive modeling and scenario projections as “a window on tomorrow’s forests, revealing how today’s trends and choices can change the future landscape of the Northeast and Midwest. Using the latest inventory data and scientific projections, the Northern Forest Futures Project helps visualize what’s here today and what to expect tomorrow. Ultimately, this project informs decisionmaking about the sustainable management of public and private forests in the northern United States” (Shifley and Moser 2016). A scenario projection results when certain assumptions about such factors as harvest rates, climate, land-use change, and others are fed into a model of future forest conditions. Similar bodies of work in the South and West provide a glimpse through the window to the future in those parts of the country.

The Northern Forest Futures Project provides predictions for a number of factors. For forest productivity, of particular relevance to silviculturists, key findings include:

- Forest area by age class is concentrated in the 40– to 80–year age category, resulting in a lack of structural forest diversity that would take decades to alter.
- Under all projections for northern forests:
 - o The growth-to-removals ratio would be <1.0 (indicating an unsustainable situation over the long term) from 2035 to 2055; by 2060, the ratio would increase to 1.2 if harvesting rates observed in the recent past (2003 to 2008) continue into the future.

- o The trend of steadily increasing live wood volume that characterized northern forests in the past century would level off from 2010 to 2050; after 2050, volume is projected to decrease if harvesting increases to satisfy demand for bioenergy.
- o The area of the maple-beech-birch forest-type group would increase and the area of nearly all other forest-type groups would decrease; projections are mixed for the white-red-jack pine forest-type group.
- For the North as a whole, projected forest removals resulting from land-use changes are likely to average about 13 percent of total removals, with the remainder resulting from harvesting; in populous eastern States—including Massachusetts, Maryland, New Jersey, and Rhode Island—removals resulting from land-use changes would be >50 percent in some decades.

Other factors addressed by the Northern Forest Futures Project are of relevance and importance to national forest land managers and to silviculturists who support the work because of the Forest Service's multiple use–multiple values mission. Predicted futures for biodiversity, ecosystem health, soil and water conservation, and the global carbon cycle indicate trends of change and threats to current values of forests and to their long-term sustainability. While some projections offer less concerning trends and conditions, there are a number of threats to forests already occurring and likely to increase and expand.

- Present-day and likely future challenges to forest ecosystem health, diversity, and resilience are unprecedented.
- Existing forest threats already causing major changes to forests are likely to increase with the potential to decimate a variety of tree species in urban and rural areas.
- Decline-disease complexes, such as oak decline, are causing negative ecological and economic effects and are expected to continue.
- Invasive plants will continue to affect habitat loss, ecosystem degradation, and decreasing species diversity.
- Deforestation and fragmentation will contribute to worsening forest health conditions, which provide increased opportunities for invasions to spread.
- The ability of forests in the Midwest and Northeast to store carbon is likely to decrease.

THE FUTURE ROLE OF SILVICULTURE

This moment—the National Silviculture Workshop—and this place, Bemidji, Minnesota, are right for pondering imminent changes on the horizon. For anyone managing a national forest in Wisconsin, the approach of emerald ash borer (EAB) is a case study in managing under 21st century uncertainty. EAB has worked its way from lower Michigan around Lake Michigan and up and around the part of northern Wisconsin where most public forest lands and the greatest abundance of upland ash and black ash forested wetlands occur. What we do or don't do in the next 5 years will not only determine the fate of the majority of black ash lowlands in Wisconsin, but it is likely the final place EAB will invade before it sets course for the last great stronghold of ash in the East and Upper Midwest here in northern Minnesota. While EAB has been and remains on the radar screen of major forest health issues, it is likely not the last one. We need to be better prepared for rapid and unpredictable invasions of insects and diseases that threaten the viability of forests and their many values; we must be ready to project scenarios and make informed decisions that are understood as experiments.

Silviculturists must practice their craft with even more humble confidence. Silviculture is a science and practice of probabilities and consequences versus likely certainty. The prescribed trajectory for a treatment decision has a high probability of not being consummated. That thinned or regenerating or maturing forest stand is likely to be overbrowsed by those big and small who would eat leaves, bark, and twigs; subject to severe drought and episodic rain; exposed to variable winters with more freeze-thaw cycles; and enduring higher heat and perhaps colder cold. Water tables may rise and fall beyond normal variability. Species expected to be part of the future stand may disappear suddenly. Soils may have altered functions as nonnative earthworms dine their way deeper into forests.

Silviculturists may create thresholds and scenario options but it is imperative for those who succeed them to understand trigger points and options for when prescriptions and desired future conditions need to be changed. Research scientists already are and need to continue and accelerate science around uncertainty and scenario projections.

Silviculturists must be strident advocates and practitioners of integration of values and treatments. Silviculturists must play an increasing and adaptive role in the future of forests and forest management. They can neither go it alone nor can they represent a singular or narrow position or value set. Silviculture must be woven into the complex problems for current and future forests that go beyond prescribing treatments for forest stands that support commercial timber harvests. Forests always have and always will provide values beyond commercially valuable wood fiber. There will not be enough land to parse out to singular or dominant outcomes and values. Designing forests that can accommodate and provide increasingly overlapping value sets will be necessary. Silviculturists play a difficult and special role in land management for not only do they need to integrate for land outcome values; they also need to interface successfully with business practices of commercial timber operations, which also change to respond to other values including an increasingly difficult financial bottom line.

Silviculturists must be increasingly innovative and forward thinking with the ability and motivation to develop options for unforeseen circumstances for managers and decisionmakers. A classic example is the lack of capacity to implement prescribed ideal silviculture regimens on national forests due to shortages of funding and staffing. Stands projected for treatment every 15 years may end up on a 25–30 year regimen. The reality for silviculturists is like that for doctors. You may have less time for meeting with and treating your patients. Identifying in advance what can be done under a different treatment model will be invaluable to managers.

Research and practicing silviculturists need to spend less time and focus on planning and consequence evaluations and more on monitoring, evaluation, and predictive modeling and scenario projections. The world has changed in national forest planning under the 2012 planning rule. We are expected to keep constant attention on the relevance of the national forest Land and Resource Management Plans versus comprehensively redoing the Forest Plans every 15 years. Monitoring and evaluating must expand and be better designed on not just what the on the ground results are, but to constant evaluation of the assumptions used to do modeling and scenarios and predictions of results.

Silviculturist cannot do this alone, but they need to be an advocate for management as an experiment with a willingness to be wrong and to adapt. For too long, management direction, prescriptions, and desired outcomes have been looked at as social contracts or promises. In a world of rapid and sometimes unpredictable change and uncertainty in the places we manage, the outcomes from that management is what we hope for, but with less

certainty from both the ability to reach that outcome, and from the possible need to change management direction because outcomes and conditions planned for in other areas are no longer possible or from shifts in knowledge, desired outcomes, or local conditions. Our research experimental forests will increase in importance, but not all needed silvicultural experimentation can occur there. Adjustments to both management and research design need to be made so that important science findings occur more where national forests are being managed and increase in both number and rate.

Ultimately, achieving these future roles will require research and practicing silviculturists to become forest druids—lore keepers, forest health professionals, and effective and influential advisors to those who are delegated and authorized to make informed decisions. Silviculturists have the same challenges as human health professionals who have to adapt to a different holistic approach to medicine. The skills to summarize, synthesize, effectively communicate not just in words on paper or verbally—but to communicate inherently complex concepts and to help explain probability and scenarios with tradeoffs, consequences, and complex interactive effects—will be key. These skills generally are not taught in forestry schools and trends in higher education suggest that these skills may not be taught in the future. This important skill must be learned and honed on the job. Those who can span management and science and communicate effectively will be the primary influencers of the future.

The land we have the privilege of stewarding has always needed adaptive management. Now those of us who steward need to be adaptive as well, to evolve professionally as quickly as the imminent changes around us.

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