depth of knowledge students learned in their silviculture course, but it allowed them to creatively express themselves, demonstrate critical thinking, and improve their verbal communication. This is but one example of educating future silviculturists to develop the skills demanded by their profession but also resonates with their beliefs and learning strategies. All educators should be thinking about similar creative ways to integrate technologies students use daily into silvicultural learning. Such strategies have the potential to spark enthusiasm and lead to deeper comprehension.

Technology is not only changing how students learn and interact but increasingly becoming part of daily tasks in their future careers. Forestry employers are rapidly adopting technologies that increase the efficiency of silviculturists, including for example field computers with real-time mapping and inventory capabilities for regeneration inspections and development of thinning prescriptions. Combined with restricting operating budgets and steady-to-declining graduation rates, these technologies facilitate an individual silviculturist in managing thousands of acres of forestland within the context of more complex management objectives. Generation Z's affinity for technology in their daily lives should allow them to quickly pick up these skills once they graduate. Universities can facilitate this transition by integrating these technologies into our courses that will both increase comprehension of concepts by the students and also expose students to various technologies they may one day use.

Of course, integrating technology into our courses and figuring out how best to engage with our students are just a part of educating 21st century silviculturists. Even though generation Z students prefer to work by themselves, that is not the reality of silviculture—or any career for that matter. We often must engage with colleagues to critically evaluate alternative solutions to problems. These group discussions foster individual creativity but also lead to collective outcomes that minimize irrational decisionmaking. It may be uncomfortable, but students should work within groups during college, especially in silviculture when they must determine appropriate treatment sequences for complex management objectives. Group discussions among the students help prepare them to communicate with people that may have different viewpoints than their own. No matter how much they complain, it is part of our role as instructors to guide them through uncomfortable situations by providing critical feedback on ways to interact with each other (and their supervisors) inside and outside the world of social media.

Change is inevitable. We see it in the next generation of students, technology, and silviculture. Society has moved in a direction where a person is expected to obtain a college degree to succeed professionally. Even though a college degree has been the norm in forestry for many years, students are more demanding of their educational experience partially due to their expectations but also due to rising costs of tuition. It behooves us to educate students to be future silviculturists that embrace their ability to multitask and solve complex problems when developing complex solutions to multiobjective silviculture. The result will hopefully be a new generation of silviculturists to continue the sustainable management of our forest resources.

Andrew S. Nelson is Tom A. Alberg and Judith Beck Endowed Chair in Native Plant Regeneration, Forest, Rangeland, and Fire Sciences Department, University of Idaho, Moscow, ID.

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21st Century Silviculture: The Best-Kept Secret?

John M. Kabrick and Lauren S. Pile

We read Jain's commentary "The 21st Century Silviculturist" with great interest. It largely reaffirms our experience—it is an exciting time to be a silviculturist! The 21st century may prove to be the "golden age" of silviculture. Today's silviculturists are having to meet increasingly complex management objectives, and address new management problems and emerging challenges unseen in the past. However, the extensive knowledge base from our strong roots as applied forest managers and the inherent adaptive and innovative nature of our work will help to address these challenges.

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Jain points out that during the past century silvicultural objectives have evolved and have become much more complex, having grown beyond the single-focus of producing a reliable and sustainable supply of timber to include producing suitable habitat, sustaining biodiversity, and enhancing ecosystem services. Today's silviculturists are still working within the multiple resource objectives of the recent past but are now dealing with ever increasing complex problems related to uncertainties in climate, dramatic shifts in forest composition and structure, and loss to wildfires, invasive species, and insect pests (Millar and Stephenson 2015, D'Amato et al. 2018). To some these issues may seem daunting. However, most silviculturists view these as intriguing challenges to tackle and unique opportunities to be active stewards in the forests of tomorrow that will require a sophisticated understanding of many disciplines to resolve.

As Jain's commentary suggests, today's silviculturists are ideally positioned to deal with these complexities. Silviculturists today have a phenomenal broad-based knowledge and understanding about forest regeneration and stand developmental processes for the forest types and ecoregions in this country. Much of the knowledge was developed and gained through partnerships with Forest Service research scientists and through experiments conducted on our nation's Experimental Forests and Ranges (EFRs). Although EFRs are maintained by the US Forest Service, much of this valuable work is conducted with close collaboration with universities and state agencies. Maintaining these partnerships and establishing new research on emerging issues, EFRs—to borrow some words from Raphael Zon—will "furnish the most valuable, instructive, and convincing object lessons" (Pinchot 1947, p. 309) for addressing the silvicultural challenges of the future. Unlike a century ago, today's silviculturist has access to a broad spectrum of information and resources. This includes forest inventory data afforded by the Forest Inventory and Analysis program, digital soil information provided by the National Cooperative Soil Survey, and a variety of computer software and new tools for enhancing ecological insight needed for resolving management problems during this golden age of silviculture. In addition, inherently broader thinkers will comprise this new generation of silviculturists, with university natural resource programs seeking to provide a greater breadth of learning opportunities, an increased importance on collaboration and coordination with diverse specialty areas, user and interest groups (Underhill et al. 2014), while also maintaining our core foundations in applied forest management (Sample et al. 2015).

Jain also describes the qualities of a successful silviculturist with terms such as a good listener and communicator, an integrator and synthesizer of information, and a leader. Clearly, these are qualities of the discipline's brightest and most capable people, which reminded us of another important problem that silviculture is facing. Namely, silviculture appears to be one of the best-kept secrets in the profession. Although many young people are eager to tackle the host of challenges facing forest managers, few realize that silviculturists have the training and knowledge to help resolve these challenges. Therefore, it is imperative for those who have this broader perspective and viewpoint about silviculture to share it widely, particularly with young people who potentially will become the next generation of silviculturists. We must impart to our students interested in careers in natural resources that silviculture is not just timber management, but the management of healthy, resilient forested communities (Sharik et al. 2015). It truly is a fun time to be a silviculturist and we need to ensure that we continue enlist the best and the brightest minds to carry out our increasingly broadening mission. Let's spread the word and not keep silviculture one of the best-kept secrets!

John M. Kabrick and Lauren S. Pile are a Research Forester and Research Ecologist, respectively, at USDA Forest Service, Northern Research Station, Columbia, MO.

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Avoiding Irrelevance in the 21st Century

Don C. Bragg

The very same day that I was asked to respond to Jain's discussion article I heard about the termination of General Electric's (GE's) CEO John Flannery, who had failed to turn around the slumping fortunes of one of America's largest and most influential companies. This was the latest in a string of corporate indignities for GE that included years of shedding assets, "refocusing on their core mission," and their removal from the Dow Jones Industrial Index (GE was the last of its original dozen companies). Now, don't get me wrong—GE still has thousands of employees, billions of dollars in sales, and plays a significant role in American industry, technology, and even politics. But their fall from prominence was not an unforeseen event—signs of problems had appeared years ago as GE struggled to maintain its relevance in these rapidly changing times.

I worry that silviculture faces a comparable relevance challenge. At one level, silviculturists tend to be introspective on our history. As a whole, I think most of us now recognize that management focused on a single objective (timber) has failed to deliver other desired goods and services. Societal expectations of providing multiple forest resources has spurred the need to renew—and perhaps even reissue—our social license to practice silviculture. At the same time, many silviculturists continue to insist upon the supremacy of a limited suite of options based solely on *perceived* maximum economic return. This is particularly true in the southeastern United States, where fealty to intensive pine-plantation silviculture continues to dominate. But at what cost? A recent exposé by *The Wall Street Journal* (Dezember 2018) recounted the experiences of many landowners that embraced production-focused silviculture and invested heavily in planted pine. What once seemed intuitive—the replacement of less productive natural stands, the use of improved pine genetics, refined planting techniques, and density management for volume gains—has produced a slew of unintended environmental and social consequences. Furthermore, a persistent slump in the lumber-dominated housing industry following the 2008 recession (Ince and Nepal 2012) put many landowners in a financial bind and, when coupled with the widespread and continuing decline of once-formidable consumers of southern pine (e.g., paper, newsprint, and plywood mills; Latta et al. 2016, Wear et al. 2016), has dimmed once bright prospects.

What do these have to do with the relevance of silviculture in the South? As a "wall of wood" (oversupply) keeps stumpage prices persistently low, many landowners are turning away from silviculture and looking to other nontimber options. How do we keep them engaged and forests as forests? In the short term, silviculturists can help landowners find value in less conventional products. For example, *The Wall Street Journal* article mentioned more financially rewarding options such as southern pine telephone poles or the long-neglected hardwood component of otherwise pine-dominated landscapes. In the long-term—and forestry is all about the long-term—we need to expand our notions of what constitutes good silvicultural practices. We must reject formulaic approaches to our profession because forests represent a broad portfolio of ecosystem services from which to choose (Sills et al. 2017). Although the valuation of ecosystem services beyond commodity production is still a developing field and some do not readily translate into cash terms (Sills et al. 2017), opportunities to better optimize all services abound if we are aware of them! Silviculturists have a duty to listen to those they work for and communicate *all* of the possibilities. Carefully implemented, carbon credits, wetlands and/or species mitigation, forest-based recreation, agroforestry, and even water credits are increasingly viable options that silviculturists can help deliver to forest owners. As an example, I recently attended a field tour of a private holding in southwestern Louisiana on which the owner raises both livestock and longleaf pine in a manner tuned to the ecological needs of his land. In doing so, he promotes a wide range of ecosystem services that features commodities (cattle and wood) while simultaneously including habitat for endangered species, water management, and soil development.

I agree with Jain that 21st century silviculturists face socioeconomic and ecological complexities, rapidly advancing tools and technologies, numerous communication issues, and the need for a clear vision of the future—these are the enduring challenges of forestry.

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