SOME SILVICULTURAL IMPLICATIONS OF UPDATING THE SOUTHERN REGION'S OLD-GROWTH GUIDANCE

Don C. Bragg

ABSTRACT

The U.S. Department of Agriculture, Forest Service's Southern Region, in conjunction with the Southern Research Station (SRS), has chartered a formal team of managers, planners, and scientists to update the Southern Region's 1997 guidance document on old-growth management and restoration. There are several silvicultural implications associated with old growth for the Region's national forests. For example, regional-scale restoration initiatives have been established for several important but declining species, including longleaf pine (*Pinus palustris*), shortleaf pine (*P. echinata*), and white oak (*Quercus alba*). Open pine- and oak-dominated old-growth forests were once very common across the region, and their restoration focuses on thinning overstories, greatly reducing midstories, and the application of frequent prescribed fire. These treatments are usually designed to reduce arboreal richness, encourage certain shade-intolerant overstory species, and reduce stand densities to enhance the cover and diversity of grass- and forb-dominated understories. However, these treatments also diminish certain stand conditions (e.g., high stocking and biomass, arboreally rich stands) often mistakenly assigned to all old-growth forests. Other questions related to silvicultural practices in old stands, from determining the degree of maturity for candidate stands to allowable treatments and the long-term sustainability of old growth, will be addressed by this update. Ultimately, the team's goal is to produce updated old-growth guidance by fiscal year 2024, thereby providing Southern Region managers and planners better, more scientifically robust information.

INTRODUCTION

As the 20th century progressed, the silvicultural practices of Federal agencies faced increased scrutiny. Socioeconomic issues, cultural differences, and environmental concerns led to increasingly contentious planning and management activities by these agencies. This was particularly true for the U.S. Department of Agriculture, Forest Service lands in the Western United States. In these national forests, many of which were still widely logging old-growth forests, concerns were raised about endangered species associated with older forests, such as the northern spotted owl (*Strix occidentalis caurina*) and marbled murrelet (*Brachyramphus marmoratus*). By the 1980s, disagreements had become outright controversies and even conflict, and the Federal Government sought a new approach to the management of their old forest resources that were not already wilderness (or otherwise protected).

In October of 1989, Forest Service Chief F. Dale Robertson issued a formal position statement to provide a "generic" definition and description of old growth and directed national forests to develop region-specific old-growth definitions for their major forest cover types (Robertson 1990). This statement was largely in response to the immediate controversy at that time (the logging of mesic old-growth in the Pacific Northwest) and so perhaps unsurprisingly the generic description of old-growth attributes best matched forests from that area. For instance, large trees were (and are still by many) considered a fundamental component of old growth; the same is also often said for high amounts of dead wood, high arboreal diversity, multiple tree size and age structures, and gap-phase stand dynamics (fig. 1).

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Figure 1—Much of how old growth is considered today comes from peoples' experiences with the enormous western conifers, such as these coastal redwoods (*Sequoia sempervirens*) in northern California. (USDA Forest Service photo by Don C. Bragg, August 2014)

Such considerations also affected the choices of possible silvicultural treatments.

Robertson's directive prompted the Southern Region, the Eastern Region and the Southern, Southeastern, North Central, and Northeastern Forest Experiment Stations to produce a guidance document (Gaines and others 1997) and supporting science materials (for example, Batista and Platt 1997, Murphy and Nowacki 1997) related to the management and restoration of old growth. Although the Gaines and others (1997) guidance represented the best available science and sought to achieve a balance between requirements to protect a vastly diminished resource and the need to manage and restore southern forests, it represented a snapshot in time and contained a number of fundamental limitations and flaws that quickly proved challenging. For example, the available "characteristic" examples of old growth from the Southern Region often mentioned in the supporting science documents were based on the few examples of contemporary old growth that remained, most of which had been protected from harvesting and fire decades earlier. This means that in the case of the xeric pine and pine-oak forests (Murphy and Nowacki 1997), stands that were once nearly pure and often open shortleaf (*Pinus echinata*), pitch (*P. rigida*), or Table Mountain (*P. pungens*) pines historically were now increasingly dominated by fire-intolerant hardwoods and conifers, with much higher stocking. Furthermore, the supporting science document for "wet" pine-dominated forests [which included longleaf (*P. palustris*), slash (*P. elliottii*), and pond (*P. serotina*) pines] was bereft of modern examples because of how few had been described (Harms 1996).

The conventional wisdom of old growth being well-stocked, diverse stands of big (and, hence, presumably old) trees also did not match particularly well with some of the best surviving and most intact remaining examples of old growth. For instance, the open and stunted post (*Quercus stellata*) and blackjack (*Q. marilandica*) oak-dominated forests of the Cross Timbers in parts of Oklahoma, Texas, and Arkansas often had trees more than 200 years old that were less than 50 feet tall and less than a foot in diameter (fig. 2). These hard-to-access, gnarled, and hollow specimens of oak were of very limited value for conventional wood products. Hence, these stands were often left as not worth the effort to cut, even if only to replace with more productive species, because land managers recognized the poor quality of these sites (Bragg and others 2012).

Over the years, the Forest Service also updated some of its more encompassing regulations, including the 2012 Planning Rule (USDA Forest Service 2012), that affected old-growth management on national forest lands while leaving the specifics on how old growth would be addressed to individual regions and even national forests. The remainder of this paper describes efforts over the past couple years to update the Southern Region old-growth guidance and the science that supports it, including that related to silvicultural practices.

Figure 2—An example of a 150- to 200-year-old xeric oak stand in the Cross Timbers of extreme western Arkansas with stunted and gnarly, uncommercial specimens. (USDA Forest Service photo by Don C. Bragg, January 2009)

DEVELOPING AN UPDATED GUIDANCE DOCUMENT

Organization and Directions for Teams

Since 1997, individual projects and even forest plans in the Southern Region have received increased scrutiny over their handling of old growth. Depending on local issues and constituencies, Forest Service units in the Southern Region developed forest plans and environmental impact statements with a range of detail related to addressing old growth, from very superficial (USDA Forest Service 2004b) to lengthy and intricate (USDA Forest Service 2004a), yet all were based upon the framework provided by Gaines and others (1997). After nearly a quarter-century of challenges and ambiguities plus scientific advances related to old forests, the Southern Region leadership decided to re-evaluate its old-growth guidance. With multiple Southern Region national forests starting the process of developing new forest plans (especially following the protracted plan development process experienced by the Nantahala and Pisgah National Forests, NC), addressing old growth and how it may be managed and restored would prove timely.

In 2020, a Southern Region leadership training project on the 1997 old-growth guidance produced multiple recommendations, including the formation of a team from both the Southern Region and the Southern Research Station to explore options. By April 2021, this informal team was assembled and virtually met weekly over the course of the next year. Discussions included what had been done in the quarter-century prior, the current (1997) guidance, and the interests of Southern Region leadership, as well as hearing from some Southern Region national forests that had experienced recent—even ongoing—challenges in managing old growth. By the spring of 2022, and following additional directions from Southern Region leadership, the informal team developed a set of alternatives for leadership to consider. These alternatives ranged from doing nothing (keeping 1997 old-growth guidance in place) to modest changes to that guidance to the development of completely new old-growth guidance. The decision was made to develop thoroughly updated old-growth guidance, and by May 2022 a team was formally chartered (largely composed of the same informal Southern Region and Southern Research Station team members) and directed to spend the next 2 years completing the following tasks:

- Update the Southern Region's 1997 guidance document on old-growth management and restoration
- Modernize the supporting science for this updated old-growth guidance document
- Create a database of relevant scientific, technical, and other supporting literature and resources
- Based on the aforementioned database, publish an annotated bibliography and a review/synthesis on what is known about old growth in the Southeastern United States
- Produce supporting materials for the Southern Region's old-growth planning, management, and restoration needs

Most of these tasks are related, at least partly, to forest management and related silvicultural practices.

Updating Old-Growth Science for the South

The science subteam focused most of their efforts during the first year on building a reference database that included scientific papers, technical reports, newspaper articles, historical photographs, maps, and other useful items relevant to old growth in the Southeastern United States. As a part of this literature and resource review, the science subteam made several decisions about what kinds of content to include in the database. For instance, the subteam elected to include descriptions of old-growth stands from States outside of the 13 that compose the Southern Region. Missouri—technically part of the Eastern Region—has good examples of shortleaf pine, oak-hickory (*Carya* spp.), and bottomland hardwood old growth that are very similar to those found in

the Southern Region. Other resources make only a passing mention of old growth in southern forests that contributes little to nothing of material value, and the subteam elected not to include these in the database. Additional sources will take more nuanced interpretation to be applicable to this effort, such as enhancing the conceptual or theoretical understanding of old growth, and hence may appear in a review/synthesis paper supporting the updated old-growth guidance but will not be part of the resource database or annotated bibliography.

Updating Other Old-Growth Guidance Components

While the updated science underpinning the Southern Region's old-growth guidance will support all aspects of this effort, other elements of this work could likewise impact the practice of silviculture in the Region. After all, a quarter-century of advances in knowledge, new management practices, and frequent policy changes will require many changes. As an example, Gaines and others (1997) applied the same forest type classification that most other contemporary efforts used (Tyrrell and others 1998) when developing their guidance—the Society of American Forester's forest cover types (Eyre 1980). However, starting in the early 2000s, Federal agencies started complying with a mandate to make their forest classification systems to comply with national standards established by the Federal Geographic Data Committee (FGDC) and published in 2008 as the U.S. National Vegetation Classification (USNVC) (Nelson and others 2015; see also https://usnvc.org/). Hence, the forest type classifications of the national forests of the Southern Region must now be crosswalked from those used in Gaines and others (1997) to those developed in compliance with the USNVC.

Additional updates (still in progress at the time of writing this article) will also be made on guidance related to aspects such as patch size, inventory and monitoring, field identification of candidate stands, management options, and planning documentation.

RESULTS AND DISCUSSION

Progress to Date

Over the past 2 years, a framework for an updated guidance document was developed, first by the informal team and then by the chartered team. During this process, potential consequences to silvicultural options for managers and planners have been considered. For example, shifts in Forest Service land management priorities from primarily timber production to predominantly ecosystem restoration over the past 25 years have dramatically altered silvicultural systems. However, active management of Forest Service lands outside of reserves such as wilderness areas is still expected. Though old growth in the Southern Region is found in both protected and unprotected public lands, the lessons learned could also be adapted to other lands not considered to be old forest and therefore treatments adapted to encourage old-growth attributes conducive to desired goods and services. Hence, old-growth science has evolved from developing a better understanding of historical forest conditions to include how certain stand structures and compositions are compatible with desired old-growth conditions and what silvicultural tools may be best suited to achieve managers' goals. In other words, it may not be desirable to simply set aside stands as examples of old growth if those reserves are not functioning as such, especially if treatments such as overstory reduction and the re-establishment of frequent prescribed fire are more effective silvicultural options (fig. 3).

To date, more than 750 references on old growth have been incorporated into the literature database (with more anticipated); some of these references date back to before 1900, but the vast majority are from the mid- to late 20th and early 21st centuries. Most of these sources have been qualitatively descriptive, providing examples with some insights into aspects such as stand structure, composition, function, and dynamics. A number are also relatively novel for such reference gathering exercises—the addition of photographs to provide examples and supplemental information should prove

Figure 3—Silvicultural treatments to the over-, mid-, and understory of national forest stands will likely be required in many mature or old forests to improve their contributions to ecosystem goods and services. In this example, (left) an old-growth longleaf pine (*Pinus palustris*) stand in southern Georgia from 1903 shows how open these fire-prone ecosystems were; in addition to limiting stand densities, frequent fires (probably annual in this case) also eliminated most other tree species and consumed most of the dead wood that formed. Restoration of (right) the mature second-growth longleaf stand from eastern Texas will require removal of most undesired overstory hardwoods and pines of other species, fire (and perhaps herbicides) to control the woody midstory vegetation, and the re-establishment of a diverse ground flora. (USDA Forest Service photos (left) by E. Block; (right) modern Texas longleaf pine stand by Don C. Bragg)

highly informative (fig. 4). After all, old-growth identification efforts that look for stands with high levels of arboreal richness, large trees, dense stocking, and high levels of dead wood will miss old woodlands and savannas without these characteristics. A few sources are directly related to silvicultural practices designed to restore or accentuate old-growth attributes, such as those related to managing stands for open conditions (for example, thinning overstocked stands, girdling undesired or nonnative trees to remove them, or the return of frequent prescribed fire to manipulate vegetation patterns).

This science review and update will also inform silviculture and other management options for old growth (known, likely, and planned), as work continues on the science, techniques, and technologies related to this stand condition. As an example, efforts to restore the ecosystem services of mature, open forests in the Southern Region have developed considerably since the 1990s to support the needs of declining species such as the red-cockaded woodpecker (*Leuconotopicus borealis*). Today, extensive areas receive restoration treatments that include over- and mid-story thinnings, increased use of prescribed fire, lengthened rotations, invasive species control, and other treatments designed to accentuate elements (such as a rich understory of native herbaceous species) deemed critical to healthy ecosystems. This restoration work has been supported and sustained by significant amounts of new and expanded research, some of which is specific to old-growth forests in the Southeastern United States (Bragg 2012, Gilliam and Platt 1999, Spetich and others 2022, Therrell and Stahle 1998, Varner and Kush 2004).

Eventually, the reference database on Southern Region old growth being developed by the Southern Research Station will be turned over to the Region for maintenance and content will be added as discovered. Supporting publications will also be produced from the database, including an annotated bibliography on regional old-growth

Figure 4—Further examples of important considerations regarding old growth in the Southeastern United States—not all "atypical" old forests in this region are the result of xeric sites or frequent fires. In these cases, (top) a historical photograph of an old pond pine (*Pinus serotina*) growing in an open stand in a pocosin on the Croatan National Forest near the coastline of North Carolina, and (bottom) a modern-day old-growth tupelo gum (*Nyssa aquatica*) and baldcypress (*Taxodium distichum*) swamp in eastern Arkansas. (USDA Forest Service photos (top) by Daniel O. Todd, July 1952; (bottom) modern swamp by Don C. Bragg)

resources and a peer-reviewed science synthesis/review research paper. Fundamental to these products, as well as the updated guidance document itself, will be how silvicultural options may be affected in the Southern Region.

Work Elsewhere…and How it May Affect This Guidance Update and Regional Silviculture

In addition to a growing body of work in the remaining old-growth forests of the Southern United States, new technologies have spurred efforts to assess forest age/structural conditions at a regional level, some of which readily translate themselves to finer-scale (even stand-level) mapping. One of the first such "big data" products to estimate age structure for North America was developed by Pan and others (2011), who combined forest inventory data, satellite data, and several types of disturbance datasets to predict forest age distributions for Canada and the United States. Pan and others (2011: figs. 1a and 4) estimated that about 80 percent of the forests in the Southeastern United States were <60 years old, only a few stands were >80 years old, and very few (<1 percent) >110 years old. Their estimate corresponds reasonably well with another estimate for old forests in the South from the 2020 Resource Planning Act (RPA) Assessment (Oswalt and others 2019). Using the Forest Service Forest Inventory and Analysis (FIA) data, Oswalt and others (2019: table 12) estimated that about 3.16 million acres (1.5 percent) of the forests in the Southeastern United States were >100 years old, with most of these older forests being hardwoods. According to their assessment (Oswalt and others 2019), only 0.02 percent of the forests of the South were older than 150 years, a common threshold for old-growth consideration.

The fairly conservative estimates of Pan and others (2011) and Oswalt and others (2019) were dwarfed by those presented in two recent national-level assessments of old growth using big data. DellaSala and others (2022) and Barnett and others (2023) used different approaches to estimate forest maturity in the United States. While a full account of both approaches is beyond the scope of this paper, both DellaSala and others (2022) and Barnett and others (2023) claimed to have found significantly more old growth in the Southeastern United States, especially across the Atlantic and Gulf coastal plains.

Over the past year, other events have occurred that may affect the Southern Region old-growth guidance update and silvicultural practices, especially those related to ecosystem restoration. In April 2022, President Joseph Biden issued Executive Order 14072 entitled "Strengthening the Nation's Forests, Communities, and Local Economies." Section 2b of this Executive Order directed the Secretaries of Agriculture and Interior to have the Forest Service and Bureau of Land Management compile an estimate of how much mature and old-growth forest is found on these federal lands. To accomplish this,

the agencies used FIA, existing information, and available regional old-growth definitions to interpret older forests across their lands nationwide. The resulting report (USDA Forest Service 2023) provided estimates for old-growth area by FIA forest type group on these two federal ownerships.

As presented in USDA Forest Service (2023), it is not possible to decompose their forest type-based old-growth acreage estimates down too finely, as the FIA forest type groups listed for the Southern Region are also found in the Eastern Region. However, as can be seen in figure 5, older forests in the Southern Region tend to be concentrated in the more mountainous areas, such as the Appalachians in the east and the Ouachita and Ozarks in the west. Such elevated and remote forests were less likely to have been logged in the past for various reasons, including accessibility. These rocky, xeric, sometimes nutrient poor mountainous sites also often produced trees of smaller dimensions and poorer form that were ignored by loggers and farmers. Given that most of the national forests in this region were assembled from abused, abandoned, cleared, and cutover lands using the legislative authorities granted after the 1911 Weeks Act—and especially in the late 1920s and 1930s after additional laws strengthened the acquisition capacity of the Forest Service (Bramwell 2012)—the low levels of old growth are not surprising.

Finally, "mature" forests—defined in USDA Forest Service (2023) as the stage of forest development immediately prior to old growth—are more widely distributed (fig. 5) and found in greater quantity on most national forests in the Southern Region. Silvicultural practices including ecosystem restoration will likely remain a priority on these mature federal forests, so long as the language conflating mature and old-growth forests found in Executive Order 14072 and suggested by others (DellaSala and others 2022) does not lead to administrative withdrawals from harvesting. These mature forests offer the best opportunities to use silviculture to accelerate the development of old-growth characteristics and restore needed ecosystem goods and services, but only if the desire to sequester carbon is tempered by the recognition of how open forest ecosystems support other now-rare attributes.

CONCLUSIONS

This effort to develop new Southern Region old-growth guidance still has a long way to go, but steady progress has been made. Silviculturists in Southern Region national forests will need to balance many competing interests and a constantly evolving scientific and social environment to navigate the challenges presented by older forests. For instance, the updated Southern Region guidance on old growth will also need to address the significant ecological differences between mature and old-growth forests to assist forest managers and planners in determining what types of silvicultural systems and treatment options are available. In addition to management options, the updated guidance will provide information on important attributes related to old trees and forests for field staff to look for when entering stands that have little to no recent harvesting. This would include how extensive of an area may need to be considered if old trees are found before a silvicultural prescription is developed. Hopefully, a robust update to the existing Southern Region old-growth guidance will serve these silvicultural purposes, as well as address many other challenges and concerns of forest managers and planners.

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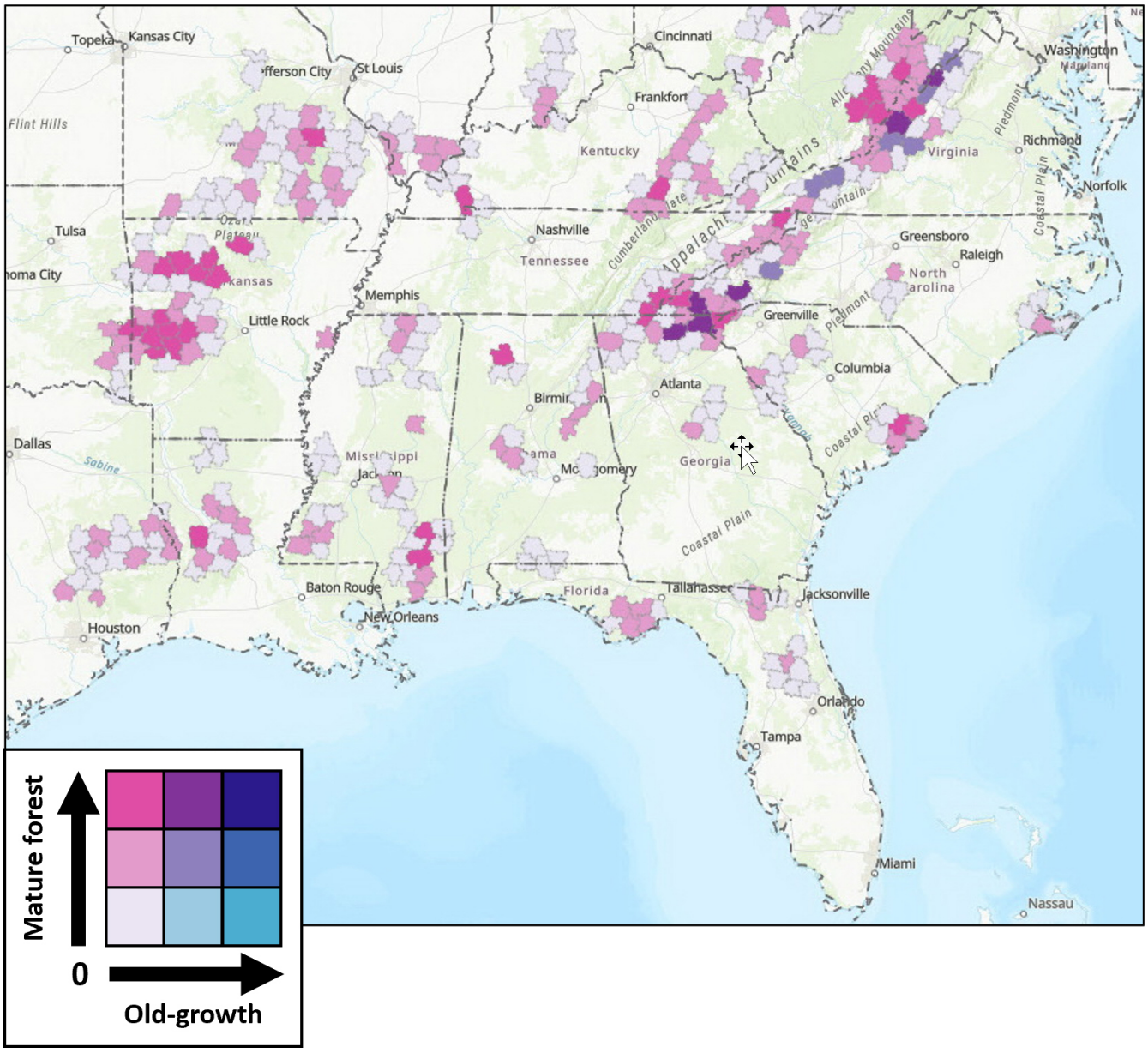

Figure 5—An adaptation of the map providing estimated levels of mature and old-growth forests for the Southern Region, taken from the Forest Service's Climate Risk Viewer (beta 0.1.1) story map (https://storymaps.arcgis.com/collections/87744e6b06c74e82916b9b11da218d28). The polygons used to develop this map are based on approximately 250,000-acre "firesheds" for which FIA data plots on Forest Service lands were assessed for their relative maturity using USDA Forest Service (2023) protocols.

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