The Wilderness Society

Assessing the need for area-based conservation of old growth and mature forests on national forests

A SCIENCE AND POLICY BRIEF

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In April 2022, President Joe Biden issued Executive Order 14072, which, among other Instructions, directed federal agencies to define, inventory, assess threats to, and "develop policies…to institutionalize climate-smart management and conservation strategies that address threats to mature and old-growth forests on Federal land." The Order represented an inflection point in the decades-long effort to conserve older forests that first came to national attention in the Pacific Northwest, where the loss of older forests was first linked to species endangerment. Since 2022, the federal agencies have completed their inventory, as have two other groups, including The Wilderness Society, each using different methods. With the completion of these inventories (and a threat assessment ongoing), the process has turned to the formulation of national policy to deliver on the President's direction. The purpose of this Science and Policy Brief is to assess what inventory data can tell us about how to construct policy for the conservation of old growth and mature forests.

Specifically, we ask two questions:

- What is the distribution of old growth and mature forests on the national forests?
- Projecting into the near future, how much mature forest will develop into old growth across the national forests?

The TWS Inventory

We begin by analyzing the results of The Wilderness Society's inventory, which took a different approach from that of DellaSala et al.,[1] (2022), which used remotely sensed estimates of forest density to discern a single class of forest that they called "MOG" (short for mature and old-growth forest), and the federal agencies' approach,[2] which employed regional definitions based on structural attributes of old-growth forests. Our "functional approach," in contrast, took advantage of the widely reported observation that forests slow to near zero in their accumulation of biomass (live and dead wood, leaves, roots, etc.) as they reach the old-growth stage. We used the national Forest Inventory and Analysis (FIA) database to model forest carbon accumulation with time for different forest "type-groups" on sites of different productivity (under the assumption that stands on lower site quality develop at slower rates). We set the age at which a forest reaches 95% of its maximum modeled biomass as the age of onset of old growth and the age at which the forest stand reaches maximum average carbon productivity, analogous to "culmination of mean annual increment," which foresters have used for decades to demarcate forest maturity, as the age of onset of "mature." We then took those ages back into the forest inventory to estimate area of mature and old-growth forest for different forest type-groups and ownerships using the well-established population estimators of the FIA program.

The Wilderness Society's inventory[3] was published in January of 2023 (see Barnett et al. 2023) and found 6.3% of forestland in the contiguous U.S. to be old growth and almost a third to be mature. Just three forest type groups, Loblolly/shortleaf pine, Longleaf/slash pine, and Pinyon/Juniper make up 77% of the old growth estate, while Oak/hickory is the most common mature forest type, contributing almost one-third of the mature forest in the U.S. We found 45% of the nation's old growth to occur on private land, despite being only 4.4% old growth, and we found another 27.7% to occur on the national forests, which are 7.5% old growth. Only 11% of the nation's old growth occurs in congressionally designated reserves, 40% of which is Pinyon-Juniper.

The 38.7% of the forest estate that we estimated to be in mature and old-growth forests, combined (MOG), was surprisingly close to 35.9% estimated by DellaSala et al. (2022), despite the use of very different methods. Not surprisingly, DellaSala's inventory, which favored more massive forests, found more MOG in Douglas-fir and Fir/spruce/mountain hemlock, while we found more in smaller-statured forest types (e.g. Pinyon-Juniper) or forest types that gained biomass early (e.g. Loblolly/shortleaf pine, Longleaf/slash pine, Oak/hickory). In contrast, the federal inventory, which looked only at national forest and BLM lands, found more than twice as much old growth on those lands and almost twice as much mature as we did. Some of the difference can be explained by the fact that they included Alaska, which added 7% to the total amount of forest land considered, but the bulk of the difference had to do with methods. The federal inventory applied minimum threshold definitions that were inclusive of younger and smaller forests for the forest types most common on the national forests. While our inventory found far more Loblolly/slash pine old growth than theirs did, this forest type is rare on the national forests compared to Fir/spruce/mountain hemlock and Douglas-fir, which make up more than one third of the system. Our approach found far fewer inventory plots in these often cold, dry, unproductive forest types to have reached old growth (i.e., their carbon maximum). The differences among these three inventories suggest there is much yet to be learned about the definition and classification of old growth and mature forests. Nevertheless, these inventories can yield insights into the abundance and distribution of these forests.

1 DellaSala, D., Mackey, B.G., Norman, P., Campbell, C., Comer, P., Kormos, C., and Keith, H. 2022. Mature and old-growth forests contribute to large scale conservation targets in the conterminous USA. Front. For. Glob. Change https://doi.org/10.3389/ffgc.2022.979528

2 Mature and Old Growth Inventory Technical Team (MOGITT). 2023. Mature and Old Growth Forests: Definition, Identification, and Initial Inventory on Lands Managed by the Forest Service and Bureau of Land Management – Fulfillment of Executive Order 14072, Section 2(b). FS 1215a. https://www.fs.usda.gov/sites/default/files/mature-and-old-growth-forests-tech.pdf

3 Barnett, K.; Aplet, G.H.; Belote, R.T. 2023. Classifying, inventorying, and mapping mature and old growth forests in the United States. Front. For. Glob. Change. https://doi.org/10.3389/ffgc.2022.1070372

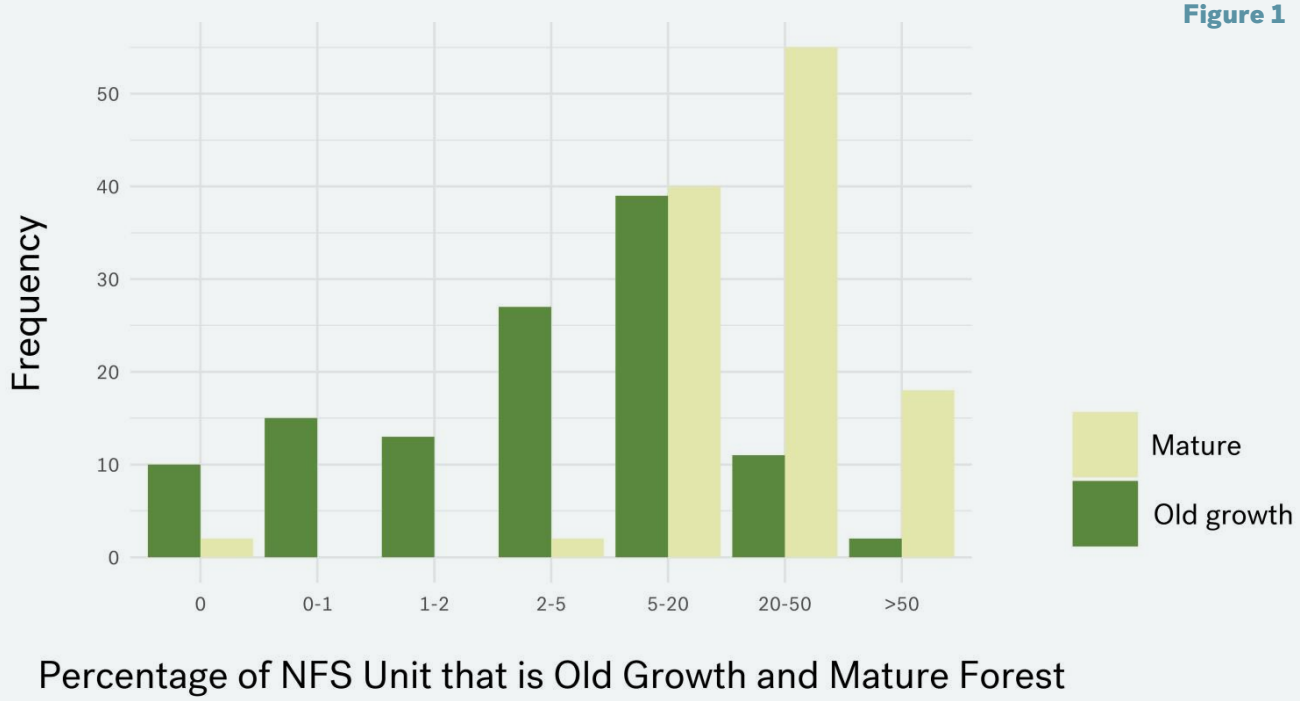
Distribution of Old Growth and Mature Forests

Here, we rely on The Wilderness Society's inventory data to examine the distribution of old growth and mature forests across the national forest system.

We broke down mature and old-growth forests by national forest and reserved status and found the following:

- Our inventory classified plots from 117 units of the National Forest System with forested area.
- Of those, 10 have no FIA plots classified as old growth, 25 are less than 1%, and 65 (over half) are less than 5% old growth (Figure 1). Only 32 units are more than 10% old growth, including nine that are more than 25% old growth, but of those, seven are in Region 8 and likely majority Loblolly/shortleaf pine forest type group, and two, the Inyo NF and Desert Experimental Range are heavily Pinyon-Juniper.
- Eighty-seven percent of NFS units are more than 10% mature.
- Of the 65 units with less than 5% old growth, 22 are more than 25% mature, including 10 that are more than 50% mature.
- Of the top 25 NFS units in terms of % mature, all are in the East, except for the Sierra NF in California, the planted Nebraska NF, and the Pinyon-Juniper-heavy Tonto NF. Seven of these units are over two-thirds mature forest.
- Forty-two units with old growth have no plots classified as old growth in reserves, and 65 have less than 5% in reserves.
- Only nine units have more than 50% of their old growth in reserves, and four (the Daniel Boone NF, Wasatch-Cache NF, Sequoia NF, and Angeles NF) contain no plots classified as old growth outside of reserves. (This does not mean there is no old growth outside of reserves on these forests—only that no FIA plots classified as old growth occurred there.)
- Twenty NFS units account for over 60% of the old growth in the system, including eight in Region 8 and likely dominated by Loblolly/Shortleaf pine, six that are high in Pinyon-Juniper, and five that are protected by the Northwest Forest Plan.

Figure 1

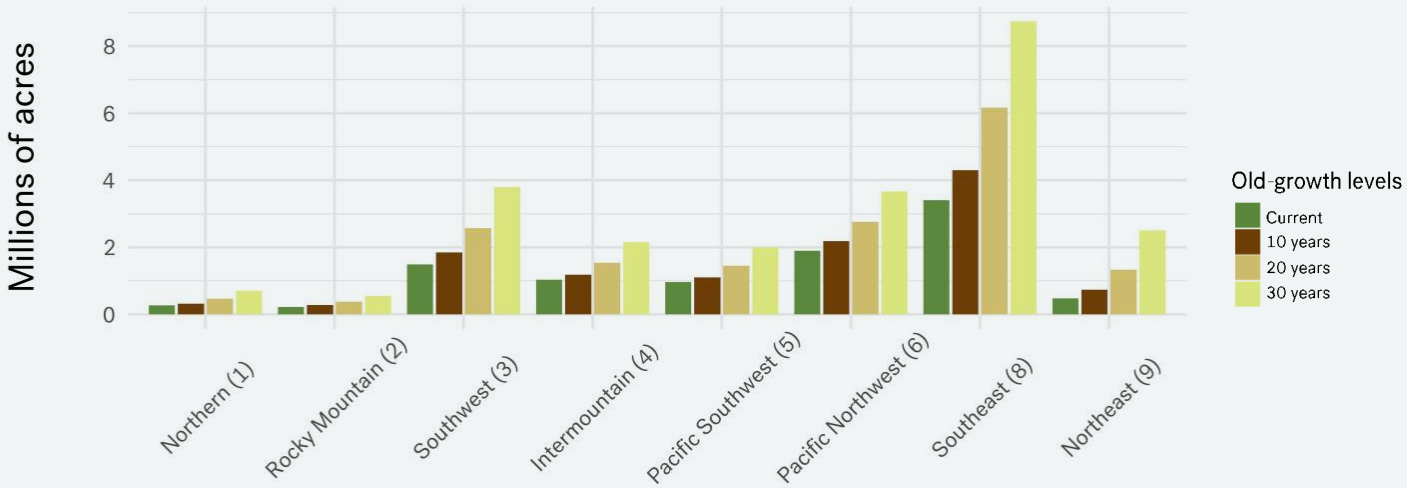


Future Old Growth

In addition to assessing the distribution of old growth and mature forests on the National Forest System, we queried our inventory to determine how much mature forest can be expected to develop into old growth in the near future. Our inventory is uniquely able to answer this question because old growth and mature transitions are demarcated by age, thereby allowing us to project stand age into the future to determine which FIA plots currently classified as mature will become old growth in ten, twenty, or thirty years. As is apparent in our summary Figure 2, the region with the most old growth – and the most old growth to gain – is the Southeast (Region 8), owing to the prevalence of fast-growing southern pines on the national forests. In the western regions, gains will be more modest, though both the Northern region (Region 1) and the Southwest (Region 3) will nearly double their old growth area if current mature forest is allowed to develop further over the next 30 years. The big winner, though, is clearly the Northeast (Region 9), where forest recovery from pre-20th century agricultural clearing has positioned the forest to recruit significant amounts of old growth over the next few decades. There, 30 years of continued forest development will more than triple the existing old growth area. Our numbers indicate that all these gains can be realized through the continued development of just 21% of existing mature forest on the national forests (assuming the accuracy of our methods and no future loss of older forest).

Figure 2

Current and projected levels of old growth by Forest Service Region



What can we learn from these findings?

The first and most obvious conclusion from the foregoing analysis is that old growth is exceedingly rare on the national forests, constituting less than 5% of the forest on over half of national forest units. Even if the amount of old growth is twice what we found, as suggested by the federal inventory, true old growth is still extremely rare on most of the national forest system. While old growth may be plentiful on a few forests, its uneven distribution ensures its shortage on the majority of units. These findings confirm what has been understood about the deficiency of old growth on the national forests for decades and underscores the urgency of President Biden's executive order.

A second conclusion is that not only is old growth rare, but it is likely found in small patches. Our analysis does not support patch-size analysis, but logic would dictate that where old growth is rare, it does not occur in large patches that can afford protection to the ecological function of the forest interior. The numbers further indicate that most forests have very little old growth (<5%) protected in reserves, thereby leaving remaining old growth patches vulnerable to further human-caused fragmentation.

A rich literature has developed in the past several decades describing the vulnerability of fragmented patches to degradation from external forces. This is especially true for old growth, where forest fragmentation is known to affect air and soil temperature, relative humidity, stocking levels, rates of growth and mortality, species composition of trees in old growth fragments, and susceptibility to invasive species. Fragmentation is also known to affect the animal community where exposed edges are more vulnerable to nest parasitism and predation from generalist predators. Where old growth fragments have been exposed by logging and other disturbances, the regrowth of secondary forest has been shown to "seal the edge" to the benefit of the interior old-growth forest ecosystem.

Concerns about fragmentation have been at the heart of strategies to conserve older forests in specific locations for decades. The "Late Successional Reserves" of the Northwest Forest Plan are based on a strategy to incorporate sufficient area to meet species-specific habitat needs in a "shape [that] minimizes edge and maximizes interior forest conditions."[4] These areas covered almost 30% of the federal land in the plan area. Similarly, the 2001 Sierra Nevada Forest Plan Amendment designated a system of "Old Forest Emphasis Areas," comprising approximately 40 percent of the national forest lands in the Sierra Nevada and Modoc Plateau, to "provide a network of large, relatively contiguous landscapes distributed throughout the Sierra Nevada where old forest conditions and associated ecological processes predominate."[5] Likewise, for 25 years, the U.S. Forest Service Southern Region (Region 8) has sought to establish a "network of old-growth areas…to provide for the distribution, linkages, and representation of all old-growth forest community types on national forest lands."[6] Questions will remain about the adequacy of the size of any given designated network and its ability to adapt to new information, but the approach demonstrates a well-established precedent for using "theories relate[d] to the effective patch size, the distribution of patches across the landscape, the relationship of the patches to the adjacent forest matrix, and the relationship or connectivity of the patches" to establish an area-based conservation network.

4 Forest Ecosystem Management Assessment Team [FEMAT] (1993). Forest ecosystem management: An ecological, economic, and social assessment. Washington, DC: US Government Printing Office.

5 USDA Forest Service. 2001. Record of Decision – Sierra Nevada Forest Plan Amendment Environmental Impact Statement.

6 Gaines, G., Arndt, P., Croy, S., Devall, M., Greenberg, C., Hooks, S., et al. (1997). Guidance for conserving and restoring old-growth forest communities on national forests in the Southern Region. (Atlanta, GA: U.S. Department of Agriculture, Forest Service), 121.

A third conclusion that can be derived from the analysis above is that even where old growth is rare, large blocks of older forest can be formed from abundant mature forest, augmented with younger forest where necessary. Conserving mature forest in a delineated area can provide a source of future old growth to augment existing supplies. Surrounding old growth with mature forest can also help to keep old growth edges "sealed" and increase forest function and resilience. As is recognized in both the Northwest Forest Plan and the Region 8 Guidance, protecting mature forest within old forest emphasis areas can provide for landscape connectivity. Further, where delineated areas are large enough, they can accommodate inevitable disturbances and help sustain a dynamic landscape with all its components, including older forest.

Policy Implications

Our analysis shows that old growth forests on the national forests are currently rare, but there are mature forests across many forest-types that are approaching old-growth condition in the near-term. It is important to adopt a policy that affirmatively helps this older cohort of mature forests reach the old-growth phase. An **area-based strategy akin to the Late-Successional Reserves, Old Forest Emphasis Areas, and Region 8 network of old-growth areas, implemented across the National Forest System, would assure the provision of future old growth, protect old growth interior habitat from human-caused disturbance, and sustain ecological connectivity if managed to sustain the landscape dynamics that shaped these forests historically.** Such a network should include all known old growth and allow for the future inclusion of unknown old growth as it is discovered. Areas should also be big enough to accommodate natural disturbances without catastrophic loss to the future old-growth resource. The idea is not to "freeze" the forest in a permanent condition but, rather, to identify where the intent is to emphasize a critical element of a dynamic landscape for a committed period of time, subject to reevaluation based on new information acquired through monitoring. In many cases, especially dry forests and ecosystems that have been deprived of cultural burning, management will be necessary to reverse the effects of fire exclusion, restore old forest structure and composition, and create conditions for the use of prescribed and wildland fire. Old Forest Emphasis Areas, identified through "lines on a map," can help provide assurance to a skeptical public that the land is indeed being managed for old forest conditions and provide managers with clarity as to the management options available to them.

Of course, the reality is that we now live in a world influenced by climate change, with an uncertain future, and we cannot assume that a single strategy will suffice to sustain the conditions we desire. This is the idea behind the Resist-Accept-Direct ("RAD") approach that has gained popularity recently among many resource managers.[7] Because we cannot say with certainty that any given strategy will conserve management targets in the face of climate change, we are going to need to apply a portfolio of strategies, including **resisting change** through restoration activities intended to conserve whole ecosystems as we have known them historically, **directing change** by anticipating future conditions as best we can and managing for ecosystems adapted to those new conditions, and **accepting change**, acknowledging the limits of our knowledge and maintaining a "control" against which to judge our success elsewhere.

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