



7 February 2023

Mature and Old Growth Inventory Technical Team
c/o Mature and Old Growth Communications Team (Sm.fs.fsmogi_comm@usda.gov)
USDA Forest Service and USDI Bureau of Land Management

Dear Technical Team,

Thank you for all of your work to fulfill President Biden's Executive Order 14072 as it pertains to defining mature and old-growth forests on Forest Service and Bureau of Land Management lands. We also appreciate your holding two briefing sessions on February 3, 2023 and for inviting comments on the status of Phase 3 of the mature and old-growth forest inventory.

The undersigned organizations offer the following technical comments on the proposed definition of the mature and old-growth stand development stages.

Our understanding is that you are considering three proposed definitions of mature forests. One would be based on size requiring mature stands to exhibit sufficient density of large trees that also meet a minimum average height as weighted by basal area. It was unclear what would constitute a large tree in this definition as that can vary greatly by forest type and site class. You could correlate size (diameter) with age using a reasonable age cut off pegged to an ecologically grounded metric, such as peak rate of carbon sequestration (NPP). A second option you presented would be based solely on density of large trees that match an unspecified proportion of the diameter of old growth as defined by different site classes. Very little information was given about either of these options. The third option presented would be based on identifying stands that have two-thirds of the characteristics of old-growth forests. For any of these proposed definitions a lack of consideration for carbon benefits of mature forests leaves these definitions with too much room for error.

We urge the agency to use inclusive, expansive parameters to ensure coverage of all mature forests. Doing so will encompass the significant carbon, biodiversity, and watershed values of mature forests in order to fully serve the President's direction to conserve our Nation's older forests.

The information you did provide at the briefings about the third option indicates the agency is considering a very narrow definition tied to achieving roughly two-thirds of old growth characteristics. This proposal is scientifically unsupported and fails to encompass mature forests and their values effectively. Old growth definitions would be those developed three decades ago



from 1989 through the early 1990s. Your rationale for using the two-thirds of “old-growthiness”[1] is based on a 1996 book *Forest Stand Dynamics*[2] that describes four stages of forest development. Your logic for choosing two-thirds is that there are three forest development stages prior to old-growth and based on an assumption that these phases are the same length, therefore “mature” is one-third of the pre-old growth timespan.

We are extremely concerned about the methodology, logic and ratio proposed in the third approach to defining mature and old-growth forests. We detail our concerns below.

1. Current Forest Service old growth definitions significantly undercount the extent and kinds of old growth.

The current definitions of “old-growth forest” were directed 34 years ago by then Chief of the Forest Service by and within an agency that at the time had no higher bureaucratic goal than to limit losses to its commercial timber base. At the time, the Forest Service was liquidating old growth at a rapid pace. Given strong public opposition to old-growth logging, the Forest Service had to respond. As damage control, it did so by defining an old-growth forest using narrow, arbitrary criteria such that only those old-growth forests with the utmost “old-growthiness” met the definitions. These narrow definitions left out a lot of old-growth forest that will not be included in the inventory. The Northwest Forest Plan mature and old growth definitions are an exception.

Furthermore, 1989 definitions didn’t account for carbon as a climate value, which is a driving force of President Biden’s Executive Order.

It is more likely that identifying forests with two-thirds of the old growth characteristics based on the current definitions will result in more accurately defining old growth than in defining and inventorying mature forests.

2. Defining the mature forest stage as those stands that have achieved two-thirds of old-growth characteristics is arbitrary and counter to established definitions of mature forests and trees.

First, as a matter of accuracy, the stages of forest growth as you presented in the Oliver diagram[3] are not equal in length. A recent scientific paper that directly addresses the age of stand maturity in the context of President Biden’s executive order[4] demonstrates that the lengths of forest stages are not equal in timespan.



Whether calculating the mean or median length of forest development stages by forest type and site class, the fraction of the “mature” stage of the total pre-old growth stages is one-half—not two-thirds.[5] While there is more logic in using “one-half” as it is based on actual data, it is nonetheless still an illogical and arbitrary basis for defining mature forests.

More importantly, there are established methods for defining mature forests quantitatively. Each defines mature as the **onset** of an inflection point in the rate of growth of a forest stand. For example, the onset of ecological maturity of a forest stand can be determined using the culmination of mean annual increment (CMAI) for a stand.

A leading contemporary forestry textbook, *Forest Management and Planning*,^[6] notes:

The point at which MAI [mean annual increment] peaks [culminates] commonly is referred to as biological maturity. [emphasis in original]

Similarly, in the 1993 scientific report that is the basis of the landmark Pacific Northwest Forest Plan, a mature forest is defined as follows:

*Mature seral stage—The period in the life of a forest stand from culmination of mean annual increment to an old-growth stage or to 200 years. **This is a time of gradually increasing stand diversity.** Hiding cover, thermal cover, and some forage may be present.[7] [emphasis added].*

The nation’s premier forestry textbook, *Ecological Forest Management*, notes:

*Although [culmination of mean annual increment] was considered to represent biological maturity, **forests reaching the [mature forest stage] are only just arriving at maturity from an ecological perspective.** In fact, high levels of primary productivity generally continue through the [mature forest stage] and result in significant additional accumulations of wood, an important consideration in carbon sequestration.[8] [emphasis and double-emphasis added]*

As these citations demonstrate, it is well-established that peak rate of annual growth can readily mark the **onset or beginning** of the mature forest stage. In stark contrast, your proposed definition will likely only capture mature stands that are near the **terminus or end** of the mature stage.



We are not insisting that you can only use CMAI in particular to demarcate the beginning of a mature forest stand, but rather to note that scientifically rigorous definitions of "mature" are available, and that you nonetheless created an arbitrary (and inaccurate) definition.

Choosing such an arbitrary definition of mature will result in the definition and inventory phase that ignores scientific analysis of forest maturity and will undermine the goals of the Executive Order. By limiting the definition of maturity in this way you appear to be making a de facto policy choice.

3. An arbitrary “two-thirds” definition of mature forest and using only the most “old-growthy” characteristics will likely result in significantly underreporting the amounts of mature forest.

As a practical matter, given the limiting nature of the existing old-growth definitions, anchoring the definition of mature forest as having two-thirds of those ultra-old growth characteristics will likely capture stands as “mature” that are actually old growth—but not “old-growthy” enough to meet the narrow criteria used in the Forest Service’s existing definitions of old growth. And, as noted above, it will exclude vast swaths of forest categorized as mature under current scientific understanding.

Another problem in defining mature forest based on three equal-timespan development stages is that your underlying assumption is that old-growth characteristics start to emerge at year zero, hence the math to divide by three and then require the application of “two-thirds” characteristics to determine the mature stage. However, old growth characteristics are absent in the first two (early seral and young) stages of the three pre-old growth stages and do not begin to slowly appear until after the onset of the mature forest stage.

Thus, it makes no sense to include two stages of forest development for which no old growth characteristics are present (and only appear later in the mature phase) as the basis for which to determine a ratio of “old-growthiness” as the definition of mature.

We believe that choosing the “two-thirds” schema violates the intent of President Biden’s Executive Order Section 2. The order establishes an immediately effective and ongoing policy to “conserve America’s mature and old-growth forests on federal lands” and to “manage forests on Federal lands, which include many mature and old-growth forests” for purposes including “retain[ing] and enhanc[ing] carbon storage” and “conserv[ing] biodiversity.” The goal of the directive to define, inventory, and develop strategies for mature and old-growth forests is expressly “[t]o **further** conserve mature and old-growth forests.” [emphasis added]



As such, the definition of mature forest should reflect the goal to conserve and restore mature and old growth and retain and enhance these carbon stores and on-going sequestration functions.

4. The assertion that not much is known about mature forests is not based in fact.

You stated “little information or consensus exists on mature forest, as it is a relatively new area of interest.”^[11] This is erroneous in multiple ways.

The Forest Service has long defined “mature” forests. Scores of national forest resource management plans and/or related environmental impact statements, ranging from the 1980s to present day, contain definitions of “mature.” Your presentation includes an imperative: “don’t reinvent definitions — start with what’s in current management plans.”^[12] But that imperative—which we do not support—is applied selectively to existing definitions of old growth stands, but not the existing definitions of mature stands.

The nation’s current premier forestry textbook, *Ecological Forest Management*, published in 2017, extensively discusses the stages of forest development for all the nation’s forest types (including mature). The book has an in-depth discussion of the mature forest stage—including photographs, drawings, and charts. It also discusses major forest stages (pre-forest, young, mature and old growth) in the context of three major forest archetypes based on disturbance regimes and dominant tree species.

Disregarding the role of carbon storage and sequestration in determining definitions of mature and old-growth forest is both scientifically unsound and not within the spirit and intent of Executive Order 14072.

RECOMMENDATIONS AND CONCLUSIONS

Today is a time of carbon science and a carbon emergency. A major purpose of President Biden’s Executive Order 14072 is to have more US carbon remain in and be reabsorbed into the biosphere from the atmosphere. A definition of mature or old-growth forest that doesn’t consider the relative carbon stored in such forests is not responsive to the executive order.

Defining “mature forests” in the way you are proposing will result in only capturing those forests that are closer to the initiation of the old-growth stage, which will leave out the overwhelming majority of scientifically defined mature stands.



A. We recommend that you use metrics for defining mature and old-growth fully reflective of current scientific understanding of those stages of forest development and not use arbitrary definitions of mature or old-growth forest.

Your structure-based definition of “mature”—even if based on objective data in FIA—ends up being subjective in that arbitrary choices are made as to the inflection points in the data of what will qualify as mature. Rather, the definition of “mature” should be based on ecologically objective data to determine the onset of a mature stand. These should correspond to ecological inflection points in forest development. Fortunately, peer-reviewed literature provides a path forward.

Two recent scientific papers offer quantitatively objective definitions of mature forests that are ecologically based (consistent with the EO). Birdsey et al. 2023 marks the inflection point to demarcate mature stands by reference to the culmination of net primary productivity (CNPP).[13] Barnett, et al. 2023 marks the inflection point of a mature stand as its peak annual carbon increment (PACI).[14] And, as noted, above, scientists have long understood the culmination of mean annual increment to correspond to biological maturity."

We offer these observations to demonstrate that the agencies arbitrarily created a definition of mature forest that ignores carbon storage and sequestration despite the existence of established definitions.

In the end, the subjective application of even objective data to determine a mature or old-growth forest stand will undermine the credibility of the inventory. As most foresters and various parts of the public often see a forest stand differently, the objective application of plot data (e.g. CMAI, CNPP or PACI) negates any “I know it when I see it” debate.

We also recommend that the inventory definition include identification of large older trees in both dry and moist forest types where, because of current and past logging, the stands in which they are located may not qualify as a mature or old-growth stand. These large old trees contribute to carbon storage, seed sources and wildlife values.

B. We request that you report the results of the pilot units and final inventory in several ways.

All results of the amounts of mature and old-growth forest should be reported out by FIA forest type, FIA age classes, and site class. This should be compared to published inventories including those that are spatially based using LiDAR measurements.[17]



You also should report the total amount of above-ground and soil carbon in each mature and old-growth forest, by forest types and age classes and by federal administrative units (national forest or its BLM analog).

Please also report in acres and by forest development stage and by federal administrative unit that which is:

- “reserved” or “unreserved” (FIA definitions);
- in the programmed timber base;
- in Forest Service Inventoried Roadless Areas; and
- USGS GAP 1, GAP 2, GAP 3 and GAP 4.

If you have any questions about these technical comments, please don’t hesitate to contact us.

Thank you for your consideration.

Climate Forests Campaign Coordinating Group:

Center for Biological Diversity, Earthjustice, Environment America, Natural Resources Defense Council, Sierra Club, Oregon Wild, Standing Trees, The Larch Company, Wild Heritage, WildEarth Guardians

[1] USDA Forest Service. Feb. 2023. “Defining Mature and Old Growth Forests” (slide) in “Mature and Old-Growth Forests: Define, Identify, Inventory” (slide deck).

[2] Oliver, C.D. and B. C. Larson. 1996. [Forest Stand Dynamics \(Update Edition\)](#). Formerly published by John Wiley and Sons, New York and now freely available.

[3] USDA Forest Service. Feb. 2023. “Potential Frame” (slide) in “Mature and Old-Growth Forests: Define, Identify, Inventory” (slide deck).

[4] Barnett K., Aplet G.H. and Belote R.T. (2023) [Classifying, inventorying, and mapping mature and old-growth forests in the United States](#). *Front. For. Glob. Change* 5:1070372. doi: 10.3389/ffgc.2022.1070372

[5] In Barnett et al. 2023, mean and median lengths in years are for (a) “early seral” (Oliver’s and Larson’s “stand initiation phase,” pre-forest, etc.): 52 and 41; (b) “young” (Oliver’s and



- Larson’s “stem-exclusion phase”): 40 and 31.5; and (c) “mature” (Oliver’s and Larson’s “understory reinitiation phase”): 88 and 73.5; respectively. (*Note: Mean and median numbers were derived from data in the paper, but produced by Andy Kerr, The Larch Company.*)
- [6] Bettinger, P., K. Boston and J.P. Siry, and D.L. Grebner. 2017. *Forest Management and Planning: (2nd ed)*. Academic Press.
- [7] Thomas, Jack Ward, et al. [*Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*](#) (Report of the Forest Ecosystem Management Assessment Team). July 1993. Forest Service, Fish and Wildlife Service, National Marine Fisheries Service, National Park Service, Bureau of Land Management, and Environmental Protection Agency.
- [8] Franklin, Jerry F., K. Norman Johnson, and Debora Johnson. 2018. *Ecological Forest Management*, page 61. Long Grove, IL: Waveland Press.
- [9] [16 U.S.C. 1604](#).
- [10] USDA Forest Service. 2013. Forest Service Manual [Chapter 1920—Land Management Planning](#).
- [11] USDA Forest Service. Feb. 2023. “Defining Mature and Old Growth Forests” (slide) in “Mature and Old-Growth Forests: Define, Identify, Inventory” (slide deck).
- [12] USDA Forest Service. 3 Feb. 2023. “Public comment — what we heard” (slide) in “Mature and Old-Growth Forests: Define, Identify, Inventory” (slide deck).
- [13] Birdsey R.A., DellaSala D.A., Walker W.S., Gorelik S.R., Rose G. and Ramírez C.E. (2023) [Assessing carbon stocks and accumulation potential of mature forests and larger trees in U.S. federal lands](#). *Front. For. Glob. Change* 5:1074508. doi: 10.3389/ffgc.2022.1074508
- [14] Barnett, K., G. H. Aplet, and R. T. Belote. 2023. [Classifying, inventorying, and mapping mature and old-growth forests in the United States](#). *Front. For. Glob. Change* 5:1070372. doi: 10.3389/ffgc.2022.1070372
- [15] Barnett K., Aplet G.H. and Belote R.T. (2023) [Classifying, inventorying, and mapping mature and old-growth forests in the United States](#). *Front. For. Glob. Change* 5:1070372. doi: 10.3389/ffgc.2022.1070372
- [16] Birdsey R.A., DellaSala D.A., Walker W.S., Gorelik S.R., Rose G. and Ramírez C.E. (2023) [Assessing carbon stocks and accumulation potential of mature forests and larger trees in U.S. federal lands](#). *Front. For. Glob. Change* 5:1074508. doi: 10.3389/ffgc.2022.1074508
- [17] DellaSala, D. A., B. Mackey, P. Norman, C. Campbell, P. J. Comer, C. F. Kormos, H. Keith, and B. Rogers. 2022. [Mature and old-growth forests contribute to large-scale conservation targets in the conterminous United States](#). *Front. For. Glob. Change* 5:979528. doi: 10.3389/ffgc.2022.979528