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Request for information on federal old growth and mature forests (Executive Order 14072) #NP-3239.

Dear Deputy Chief French and Director Stone-Manning,

Georgia ForestWatch appreciates the opportunity to provide input for further recognizing and protecting our nation's forests. While we understand this request for information will not impact any current forest management practices or policies, we do urge a moratorium on timber projects within already-identified old-growth forests on US Federal lands during this information-collecting phase of Executive Order (EO) 14072.

What criteria are needed for a universal definition framework that motivates mature and old-growth forest conservation and can be used for planning and adaptive management?

The continuing uncertainty around how to define old growth after decades of debate reflects not only the complexity of the forests themselves, but also that forests exist along a continuum with varying degrees of old-growth characteristics. Some forests are recognized as old growth without any debate, such as stands with trees several hundred years old growing in valleys in Olympic National Park that were never logged. Conversely, no one would argue that a recently-clearcut stand is old growth.

In between those extremes there is uncertainty. If chestnut blight killed all the American chestnut trees in stand that was never logged, is the stand old growth? If a hurricane leveled the overstory of a never-logged stand, but the understory was left untouched, is that stand old growth? If the only anthropogenic disturbance in a stand were decades of grazing that lead to changes in both structure and composition, would that stand be old growth? The criteria for a definition framework must resolve those ambiguous intermediate cases.

We encourage the agencies to adopt inclusive criteria because only a portion of protected old growth and mature forests will remain in that condition in 10, 25, or 100 years later. As implied by the RFI, disturbances will occur in legally protected mature and old-growth and mature

forests that will change their character. For example, mountain pine beetle aided by climate change recently killed most of the bristlecone pines in Death Valley National Park. Due to the harsh environment where the bristlecones grew, other tree species are unlikely to replace them, and the woodland will convert to an ecosystem dominated by shrubs and herbaceous plants. Focusing the criteria on mature forests will help make the definition inclusive. Most old-growth forests are mature, but the opposite is not true. The exception to this general pattern is old-growth forests that have recently been disturbed by natural processes. Many old-growth definitions recognize continuity of ecological processes, such as nutrient cycling and succession, as a key aspect of old-growth forests and include more recently disturbed areas within old growth if they have not been directly anthropogenically altered. A definition based on mature forests that provides an exception for more recently disturbed areas that do not have a history of anthropogenic disturbance would inclusively capture what people mean by old-growth and mature forest.

Criteria related to disturbance should also focus on the condition of the majority of each stand and consider only direct impacts. Most people do not consider selective logging of a few exceptionally high value trees as disqualifying a stand from old growth. In that case, only a small percentage of the canopy was anthropogenically disturbed. Conversely, if a logging operation in a diverse stand left only one species with low value timber, most researchers would not consider that stand old growth. The majority of the overstory had been removed. When applying disturbance criteria at the stand scale, the criteria should be evaluated based on the condition of the majority of the stand.

Disturbance criteria should also be evaluated based on individual stands rather than on regional disturbance patterns. All forests on Earth have been subject to anthropogenic impacts due to carbon emissions, climate change, and other forms of pollution. Similarly, human ignitions have dominated fire regimes for thousands of years over most of the United States. If these impacts disqualified areas as old growth, there would be no old growth and the definition would be meaningless. Instead, stands should be evaluated on the basis of anthropogenic activity that occurred within that stand, such as tree cutting.

Criteria also need to reflect cultural and spiritual values, including local and indigenous knowledge. To advance the broader goals of the E.O., there should be mechanisms provided to integrate: local, place-based knowledge; communication and history-telling, such as stories, oral tradition, and oral histories; and for community participation in the planning and adaptive management of forests.

What are the overarching old-growth and mature forest characteristics that belong in a definition framework?

Focusing on the old growth in the Southern Appalachians, White, Tuttle, and Collins (2018) importantly discuss not only forest canopy age, but also the concepts of forest continuity and human disturbance. Forest continuity goes beyond the age of individual trees and considers the age of the entire ecosystem. This concept is useful for developing effective definitions of old-growth because ecosystems are composed of not only physical states but also processes, such as nutrient cycling. Considering ecosystem age also helps to avoid focusing too much on one part of the ecosystem. For instance, even if trees are disturbed, soil and belowground processes may not be.

Hence, tree age may be culturally important and useful in defining some forms of old growth, but it is not crux of old growth. Considering the continuum from forests that are obviously old growth to obviously not old growth, the degree of human disturbance forms a close parallel. Forests in the middle of the continuum whose status as old growth is subject to debate vary in both the type and intensity of human disturbance. The heart of the definition framework should be what kinds of human disturbance are allowed and what kinds are not.
Questions that may be useful when developing criteria around human disturbance include:

- How much of the stand is disturbed?
- Does the disturbance affect overstory trees?
- Does the disturbance cause impact that persist beyond the life of individual trees, such as soil erosion?
- If the disturbance is discontinued, how long will it take the ecosystem to recover?

Note that these questions focus not on the disturbances themselves, but on how stands are impacted.

Considering mature forests, it is useful to consider the biological concept of maturation, an organism reaching its reproductive potential. At a minimum, mature forests should be those dominated by seed-producing trees. While seed production need not be at its peak for each species, seed production should not be marginal or only a fraction of what a tree would be expected to produce later in life.

Canopy height may be a useful proxy for defining and mapping mature forests and provides advantages over obvious alternatives. Tree diameter is highly sensitive to the idiosyncrasies of an individual tree's immediate surroundings, so even in a single stand, trees of similar age and height may vary widely in diameter. This phenomenon makes diameter inconsistent and more weakly correlated with other stand attributes. Tree age may be closely linked to concepts of maturity, but data on stand ages is expensive to acquire and, in uneven-aged forests, highly sensitive to which trees are selected for coring. Staff that collect age data are typically not trained in the signs of advanced tree age and frequently miss the oldest age class. Consequently, many large data sets of tree age are unreliable. We have repeatedly encountered stands that

were recorded as having an age of around 100 to 120 years but actually contained a large cohort of trees over 200 years old.

On a national scale, expected canopy height of mature forests can be effectively modeled with moisture availability (precipitation minus potential evapotranspiration) and growing-season length (Klein *et al.* 2015; Tao *et al.* 2016; Zhang *et al.* 2015). Locally, physical site characteristics such as topography and soils must be considered, or else the model will simply map low productivity sites as immature and high productivity sites as mature (Mao *et al.* 2017; Rahman *et al. 2022*). Forest Inventory and Analysis (FIA) would be critical for identifying height thresholds when forests are mature and how those thresholds vary with local conditions. Canopy height has the additional advantage of being strongly correlated with aboveground biomass.

How can a definition reflect changes based on disturbance and variation in forest type/composition, climate, site productivity and geographic region?

If definitions are based on structural characteristics of forests and tree age, then developing them will require using a set of forest types and empirically gathering data on those characteristics. This may be challenging since some national forest type systems are not ecologically based. For instance, Society of American Foresters forest types do not reflect common forest patterns in the Southern Appalachians. Using them in this region would result in great variability of old growth characteristics within an individual forest type.

Basing definitions on mature forests with exceptions for old growth with recent disturbance would largely avoid these issues. As described above, mature forest criteria could be calibrated with FIA plot data. The types of human disturbance that would disqualify an old growth area recently affected by natural disturbance should be consistent across the country, forest types, and site conditions.

How can a definition be durable but also accommodate and reflect changes in climate and forest composition?

Focusing definitions more on processes and less on structure and composition will minimize the influence of shifting composition and climate change on the definitions. If definitions are tied to forest types, they will be inherently unstable because species assemblages are expected to change as climate change proceeds. The species that occur together today may not occur together in the future, and novel forest types will develop as species migrate in response to changing climate. Conversely, if definitions are based on continuity of forest processes and what impact anthropogenic disturbance has had on the stands, those should be relatively stable. Using physical variables to model height thresholds for mature forests will also allow those

thresholds to change in sync with climate change. The relationship between tree growth and moisture availability should be generally stable as climate changes, even as the conditions individual trees experience change. Climate change will alter moisture availability and growing season length, but the expected height of mature forests in a given location will simply change in response. Other physical variables such as topography will remain unchanged. FIA plots will continue to provide validation of the models and provide opportunities for adjustment.

What, if any, forest characteristics should a definition exclude?

Stand size (acreage) should not be a limiting factor in any old-growth definition. Depending on their lack of disturbance and biological diversity, a two acre stand of old growth can be just as important as a 20+ acre stand of old growth.

Tree diameter should be used only with caution. In a naturally occurring even-aged stand, for example cottonwood along a meandering river, one tree may be twice the diameter of another of the same species. Entire old-growth stands may also include only small diameter trees if they occur on harsh sites. Old growth stands frequently occur on low productivity sites because those stands were of relatively low commercial value and thus provided less incentive for timber harvest. For some regions, basing definitions on expected diameter means systematically excluding the sites most likely to retain old growth.

Similarly, tree age should be used only with extreme care. We have observed that people, including professional foresters, often conflate size with age. While size and age are intuitively related, field staff generally receive no training in other characteristics of advanced age such as gnarled crowns, balding bark, and relatively large limbs for the size of the trunk (Pederson 2010).

Consequently, when age is assessed in the field, the oldest age class is often missed and growth rates are systematically overestimated, which leads to systematically underestimating the age of stems that were not cored. These issues are further exacerbated by counting rings on core samples in the field that have not been carefully surfaced to make the rings more visible. Under those conditions, very narrow rings, common in old trees, are very difficult to see, which leads to further underestimation of tree ages.

This issue arises because a characteristic of most types of old-growth forest is uneven age. This is particularly true in the Eastern United states where canopy gaps are the dominant forest disturbance (Barden 1989; Buchanan and Hart 2012). While many forest stand inventories assign a single age to each stand, old growth stands typically contain several to many cohorts that vary widely in age (Lorimer 1980; Seymour *et al.* 2002). Averaging ages from sampled trees, a common practice, obscures the oldest cohort and underestimates the overall stand age. Averaging ages has led to old-growth stands being misidentified and ignored (see Gaddy 1998

for examples and discussion). Ages from coring different cohorts should not be averaged to produce stand age, and any old-growth determination should be made based on the age of the oldest cohort.

Basing definitions of old growth on the specific density of trees meeting a size or age threshold introduces additional problems. As people have recognized the impacts of fire suppression, there is a growing appreciation of that many forests that are currently closed-canopied were once far more open, such as longleaf pine dominated areas in the Southeast and Ponderosa Pine ecosystems in much of the West. Unfortunately, just how open stands were historically varied considerably with site and is often difficult to estimate today. Hence, developing reliable estimates of how many large or old trees would be expected in an old-growth forest on a particular site is often not practical. Old or large tree thresholds also ignore the ideas of forest continuity and ecosystem age discussed above, and lead to narrow, exclusive definitions of old growth.

Finally, current management designations should not be considered in defining old growth. We have heard managers conflate "future old growth" with existing or current old growth. They have argued that existing old-growth forests are not needed because other areas have been reserved from logging and are expected to continue to age. This approach has many problems, including reducing the concept of old growth to tree age, ignoring the potential for future events to reduce the age of stands, and ignoring the cultural, scientific, and ecological values provided by existing old-growth forests.

How should an inventory of old-growth and mature forests on Federal lands be completed?

In the long term, visiting potential old growth and mature forests in the field will be essential to determine whether they are indeed old growth or mature forest. Models are inherently imperfect, and models predicting the location of old growth and mature forests will not be an exception. In fact, they will be limited in ways that reduce their accuracy. Some key criteria are simply not available on a national scale. There is no inventory of the types or level of human disturbance in forest stands. Stand age data is unreliable for many forest types.

Unfortunately, ground-truthing stands is labor intensive and inventorying all stands nationwide within one year is not possible. Some reliance on predictive modeling is necessary. Fortunately, the weaknesses in models can be mitigated.

Any predictive model of old-growth and mature forests must be validated. At the risk of overexplaining, we feel it is imperative that the outputs of any model be compared against the real world to see if the model produces the results it was intended to. We raise this issue because we have seen the Forest Service repeatedly use models for critical tasks without

validation. For instance, the Nantahala-Pisgah Forest Plan used a model of the historical range of natural forest conditions as the foundation for many broad planning decisions, but never validated the model. You may be asking 'how could a model that predicts historic conditions be validated?' Planners could have checked the model by seeing if the model accurately predicted current Forest conditions based on the known history of the Nantahala-Pisgah National Forest. Many smart people worked hard on that model, but smart people working hard on difficult problems routinely fail on their first attempt. We implore the Agencies to approach the task at hand by making a model that predicts old growth but allows for visiting sites in the field to check the model's predictions and refine the model based on that feedback.

The agencies also need not base their inventories completely on models. Many regional inventories of old-growth forests already exist. One of the most comprehensive, if dated, inventories is *Old Growth in the East: A Survey (revised edition).* That work has recently been updated for the Southeast by Messick and Davis (2022). Relying on models for the same areas will produce larger errors. The inventories will always conceptually match the intent of the EO. Most stands identified in existing inventories will qualify under the Agencies framework, and if they differ from the agency definition, they differ only in the details. In contrast, some of the model results will simply be wrong. Existing inventories also provide additional opportunities for validating models.

We also encourage the Agencies to view this inventory not as a final product, but as an evolving data set. Like this inventory, all the regional inventories we are familiar with were constrained by resource limitations. They continued to improve though as other fieldwork and projects encountered old growth, and the inventories became much more complete long after the initial surveys. This ability to refine the inventory will become especially important as land management projects encounter areas in the inventory or areas that should have been included. A fixed survey would provide those who do not value old-growth and mature forest conservation with an excuse to dismiss stands they do not want to conserve and ignore their values. "That area can't be old-growth, it wasn't in the inventory."

Whether areas are ground-truthed as part of model validation or during subsequent management projects, we encourage the Agencies to provide training on visual identification of tree age and signs of human disturbance. Too often, we have seen that, in an effort to find the oldest age class, the largest trees are cored. That approach is a good way to find the fastest growing trees but leads to a systematic under estimation of tree ages and often misses the oldest age class. In the Upper Warwoman Project and the Cooper Creek Project, both on the Chattahoochee National Forest, old-growth stands were missed during surveys of project stands. In both cases, the Forest Service staff wanted to protect old growth, and did so once the nature of the stands were pointed out to them. However, the age of the modest-sized trees was not initially recognized in stand evaluations.

Conclusions

We encourage the Agencies to take an inclusive approach to defining old-growth and mature forests because old growth can never be completely protected. In practical terms, defining old growth largely comes down to what kinds of disturbance are acceptable within old-growth forests. We encourage the Agencies not to focus too much on tree age, and to include areas that have been subject to recent natural disturbances. We believe focusing definitions on mature forests and making the degree of anthropogenic disturbance a key criterion will help the definition framework remain useful as climate change alters forests.

We also encourage the Agencies to base the inventories on existing regional inventories and ground truthing as much as possible. Where modeling is necessary, correlating mature forests with canopy height estimated from climatic variables and physical site conditions should provide robust predictions.

Thank you for the opportunity to comment on one of our nation's most vital resources and if you have any questions, please do not hesitate to contact our organization.

J.D. McCrary
Executive Director

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