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First name: Virginia

Last name: Dale

Organization: University of Tennessee and Oak Ridge National Laboratory

Title: Research Professor

Comments: GENERAL COMMENTS

It was not clear if the comments are regarding old growth forest and mature forest or to forests that are both old growth and mature. An example of a forest that is old growth but not mature is the Joyce Kilmer Memorial Forest, where the large, old tulip poplar trees died recently, and the rhododendron understory are inhibiting growth and establishment of trees. I would still call this old growth because of its characteristics including large, dispersed trees in various stages of decay, lack of human disturbance, and being in a forested area.

Both old growth and mature definitions are highly dependent upon regional differences in soil, climate, past land use and disturbance as well as the potential for future disturbances and climate change. It should be recognized that future disturbances due to hurricanes, tornadoes, fires, floods, drought, insect outbreaks, disease, and invasive species are likely to be different than the past with frequency, severity, and extent of these disturbances being altered.

QUESTIONS FROM USDA AND US DI:

1. 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?

I think the criteria for old growth should use those presented on page 5 in the 1996 book edited by Mary Byrd Davis on "Eastern Old Growth Forest: Prospects for Re-discovery and Recovery" (Island Press, Washington, DC). The key criteria from that book are listed below:

- * Age of trees relative to maximum age for the species present
 - oA high percentage of the canopy trees over half the maximum life spans for the represented species
 - oAt least a few trees near the maximum life spans for the species
- * Lack of human disturbance
 - oNo recorded history or discernable signs of human activity such a planting, cutting, roadbeds, or thinning
- * Forest floor conditions
- * Successional stage of the forest
 - oComposition of late-successional species
 - oStructure and set of characteristics (listed below) associated with late successional forests
- * Minimum stand size of 5 acres

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

Defining Old-growth Forest

I think the definition of old growth should use the use the accepted definition presented on pages 5-7 in the 1996 book edited by Mary Byrd Davis on "Eastern Old Growth Forest: Prospects for Re-discovery and Recovery" (Island Press, Washington, DC). The key characteristics from that book are listed below:

- * "An abundance of old trees as recognized by their asymmetrical shapes, relatively long trunks free of low branches, deep furrows or plated bark, signs of heartwood decay, large prominent root structures, flattened crown with protruding dead limbs, large thick limbs, and trucks often showing a twist that develops with age.
- * Fallen logs in all stages of decomposition, crisscrossing the forest floor and lying in and across stream beds, covered by moss and lichens
- * Plentiful snags (standing dead trees)
- * Canopy gaps large and small, formed from trees that have fallen
- * Undulating forest floor expressed in randomly scattered pits and mounds where trees have fallen over and decomposed

- * Multiple growth layers: overstory, understory, and shrub, herbaceous and ground layers visible to one degree or another, all reflecting a broad spectrum of ages.
 - * Understory soils with a relatively thick hummus layer in some forest types
 - * Large trees for the growing conditions
 - * Well-developed herbaceous layer with a diverse composition, especially in neutral soils
 - * Abundance of lichen and fungi, particularly an acid base soils
 - * Majority of tree species that fall into the late successional class and a conspicuous absence of multi-stem trees
 - * Absence of signs of human disturbance
 - * A mosaic of age groupings left as imprints from many natural disturbances of varying sizes."
- Some of these characteristics are part of the FIA data collection, but others need to be added.

Defining Mature Forest

Davis (1996) defines mature forests as those secondary forests that have existed longer than the normal harvesting rotation practiced by foresters on that particular forest type (page 50). However, I do not support that definition, for it can change depending on supply and demand of wood products.

Biologically a forest is mature if most of the trees are reproducing.

The definition of mature forest depends upon the intent of resource management for the particular forest. For example, if the goal is timber harvest to support economic development, then the definition of mature depends on the relationship between growth rate and market value. If the intent is carbon sequestration or biodiversity, then mature forests would have other attributes. As another example, a mature urban forest would have quite distinctive characteristics than other mature forests. You would not want limbs to be falling, dead wood to accrue, or decay to be occurring in an urban setting.

An example of the challenge in defining mature forests comes from the 42-year recovery of vegetation reestablishment in the Mount Saint Helens National Volcanic Monument as well as in the adjacent Gifford Pinchot National Forest. In the summer of 2022, mature stands of red alder dominate some of the area, and those alder are expected to die soon because older have such a short lifespan. This is certainly not a mature forest ecosystem. Similarly, nearby on Weyerhaeuser land, there are stands of noble fir they were planted in 1981 and 82 and are now being harvested; however, I would certainly not call those ecologically mature stands although they are certainly large enough for harvesting purposes. However, they are economically mature because it is profitable to cut them at this stage.

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

- * It would be useful to have the inventory collect information on the evidence of past disturbances (such as fire scars).
- * Ecologists refer to forests being in a dynamic equilibrium when disturbances typical of that forest type occur on a regular basis and the trees have some of the characteristics under topic 2 above. For example, mature longleaf pine forests that experience regular low-level fires have few deciduous trees in the understory and the longleaf pine are large, tall, and reproducing.

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

- * The definition should not refer to particular species, forest types, soils, or climate but rather to general characteristics. However, examples of the definition being applied can refer to particular species, forest types, soils, or climate.
- * The definition should not refer to the particular age of trees or forests but rather age relative to maximum age of trees of a dominant species under certain soil and climate conditions.
- * The definition of maturity should be relative to the goal for the forest under consideration.

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

* The absence of early succession species is not a factor, for early successional species can occur in gaps within a mature or old-growth forests.

* The presence of natural disturbance is not a factor. Many forest types depend on regular disturbances.

6. Other comments: Books to investigate

Eastern old Growth Forests: Prospects for Rediscovery and Recovery edited by Mary Byrd Davis (1996) Island Press, Washington DC - I like the discussion and definitions on page 5 to 7.

Ecology and Recovery of Eastern Old-Growth Forests edited by Andrew M Barton and William S Keaton (2018) Island press, Washington DC.

Ecological Forest Management by Jerry F. Franklin, K Norman Johnson, Deborah AI Johnson (2018) Waveland Press, I NC. Long Grove, Illinois.