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Comments: Questions with answers following

Question: What criteria are need for universal definition framework that motivates mature and old growth forest conservation and can be used for planning and adaptive management?

We first need an agreed-upon definition of "forest" to be clear on what does/does not fall under the policy: the Federal Geographic Data Committee (FGDC) standard for "Forest & Woodland" would suffice:
"Summary:
Trees with broadly mesomorphic (including scleromorphic) growth forms (including broad-leaved, needle-leaved, sclerophyllous, palm, and bamboo trees, and tree ferns) characterize this type. Vegetation structure typically has irregular horizontal spacing. The mesomorphic tree canopy is typically >10% cover and often exceeds 5 m in height, and often has both a mature (overstory) and regeneration layer, except in tropical upland savanna regions, where trees typically have >40% cover, are >8 m tall, and the vegetation lacks a substantial graminoid layer. Climates range from humid tropical to boreal and subalpine, with fairly moderate moisture and temperature conditions. Substrate moisture conditions vary from dry to wet. Vegetation includes tropical, temperate, and boreal forests and woodlands.

Diagnostics Characteristics:
Mesomorphic tree growth forms (broad-leaved, needle-leaved, and sclerophyllous trees, palms, bamboo trees, and tree ferns) have >10% canopy cover, a spontaneous, irregular horizontal canopy spacing, and overtop other growth forms, except in tropical upland regions, where trees typically have >40% cover, are >8 m tall, and the vegetation lacks a substantial graminoid layer."

"Old Growth" definition can include commonly held concepts of "primary" forest that is a) ancient forest with no trees harvested by people with technology available since the industrial revolution, and b) all characteristic plant and animal species (including soil microflora and fauna) present.
vs.
"Mature Forest" a) late successional forest - including "old growth" forest - that may have had some or all tree species harvested at some point by people with technology available since the industrial revolution but have recovered or can recover, and b) all functionally important native plant and animal species (including soil microflora and fauna).

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

Biological Diversity:  representing known natural/seminatural (i.e., NOT purely cultural) variation in regional landscape, community, and species compositional diversity

Ecological Integrity (Forest Service definition): The ability of an ecological system to support and maintain a community of organisms that has species composition, diversity, and functional organization comparable to those of natural habitats within a region.

Mature stand development - for the type of forest and woodland identified, the later successional stage for structure and composition should define "mature." Tree, shrub, and ground cover species presence, abundance, and where documented, structural contribution (including snag or down woody debris) should define the variation in these successional stages. This is why it is important to establish a practical level of forest and woodland

classification so that these features can be adequately described and documented (see subsequent comments on classification)

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

1)Capture variation forest type/composition, climate, site productivity, and geographic region - Classification at mid-to-lower level equivalent to the USNVC hierarchy: LANDFIRE Biophysical Settings (BpS) are a federal product that approximate the USNVC group or alliance levels (mid to low levels of that national standard). BpS data have been maintained and advanced by LANDFIRE for over 15 years.

2)Over 200 forest and woodland BpS units occur on NFS and BLM lands, each has state and transition model (STM) describing natural disturbance regimes and up to 5 succession classes. Class E (the fifth succession class), and sometimes Class D (the fourth succession class where only 4 are described) provide a good approximation of "mature" for each type.

3)The LANDFIRE S-Class maps provide one indication of mature forest. A second continuous model of forest maturity (see Mackey et al. in review) uses Forest Inventory and Analysis (FIA) data analyzed within ecoregions to predict mature forest location. This and the LANDFIRE product could be used to provide two complementary perspectives predicting mature forest location. The LANDFIRE products are maintained federally and can be improved upon with advancing remotely sensed data. The mature forest model of Mackey et al. relies on FIA investments and could be further refined and maintained by the FIA program.

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

Scale of classification concept matters here for "durability" since thematically coarser forest and woodland concepts (e.g., SAF forest cover types) are inadequate to capture variation while finer concepts (e.g., USNVC associations) are too narrow and should be viewed as least stable given climate stress over upcoming decades. More "mid-scale" concepts like LANDFIRE BpS units match the need here.

Question: What, if any, forest characteristics should the definition exclude?

The definition could include age where dominant tree/stand age serves as a reliable surrogate for species composition and structure, but not a specific requirement.  For example, the LANDFIRE Succession class maps depict the various A-E Succession-Classes describing early, mid and late succession stages for a given Biophysical Setting (BpS). These A-E classes have associated age ranges, and can be used to indicate where classes D and E would best describe a mature forest (as opposed to just using class E). These can be provided by collaborative partners of LANDFIRE.

Additional recommendations on approach, data sets, and scientific process steps

We recommend taking a multi-level approach in concept, data, and process. Establish national standards and definition, then use national to local data, multiple lines of evidence, and approach that allows for local validation and continuous improvement.

Recommended Products in support of this policy:
Going beyond inventory of mature forest, a series of map products should be established to predict forest and woodland integrity, at-risk biodiversity status, and vulnerability to climate change. These products, collaboratively developed with US Forest Service and Bureau of Land Management staff, could then be combined with other products for forest carbon (and other ecosystem services) and used to establish management zones for climate-

informed forest restoration and management.

Some relevant products currently available at national or regional scales include:
Mapped measures of forest integrity (30m rasters) including fragmentation or intactness, fire regime departure, invasive species presence and abundance
Mapped measures of forest vulnerability to climate change (scaled to 1 mile2 hexagon grid) including climate change exposure (to mid-21st century), sensitivity, and adaptive capacity
Mapped zones (based on 1 mile2 hexagon grid) for climate-informed forest management and restoration/reforestation - built from relative vulnerability assessments and component drivers of vulnerability
Mapped zones (based on 1 mile2 hexagon grid) for forests attributed with presence, abundance, and proportion protected (defined by Gap 1&2 vs. 2.5 [roadless areas]) for biodiversity (at-risk forest ecosystems plus imperiled and ESA listed species), carbon, and other ecosystem service values

Cited:
Mackey, B., DellaSala, D.A., Norman, P., Campbell C., and Comer, P. in review. Mapping relative forest maturity and stand development for continental USA