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Comments: Dear Deputy Chief French and Director Stone-Manning:

Please accept the following comments on behalf of Chattooga Conservancy, Cherokee Forest Voices, The Clinch Coalition, MountainTrue, Virginia Wilderness Committee, and the Southern Environmental Law Center. We appreciate the opportunity to comment on the appropriate definitions for mature and old-growth forests to be used to complete an inventory of those forests by April 2023. As discussed below, these definitions and the ensuing inventory process are a critical piece of the federal government's plan to confront the climate and biodiversity crises. The Forest Service and Bureau of Land Management ("BLM") (collectively "the agencies") must fulfill their obligations consistent with this overall effort.

Here, this means developing definitions and conducting an inventory guided by the ultimate purpose of this exercise: "Conserving old-growth and mature forests on Federal lands" in order to "combat[] the global climate and biodiversity crises."1 This is an urgent matter. The agencies should not delay by attempting to develop a perfect scientific accounting of all mature and old-growth forests on federal lands. There is insufficient time[mdash]under both the directive of Executive Order 14,072 and the need for fast climate and biodiversity action[mdash]to complete an exact inventory. Instead, the inventory must use the best currently available information to meet the Executive Order's deadline and begin the dedicated conservation of these important resources. More refined and in-field identification of old-growth and mature forest will continue over a longer period of time. For now, the agencies need to quickly develop definitions that are easy to implement so that they can get a broad sense of the presence of mature and old-growth forests and develop policies to protect those ecosystems.

To that end, the agencies should begin by defining mature forest as forest over eighty years old. For purposes of the inventory, this is a reasonable, scientifically supported age for maturity that can be utilized to address some of the most pressing problems faced by older federal forests. Old growth should be defined by expanding upon and refining existing old[1]growth definitions applicable to specific forests and regions.

Candidly, while other federal agencies and Congress2 have taken action to address the climate crisis, the Forest Service has lagged behind. The Forest Service manages the largest single carbon stock in the United States[mdash]over eleven billion metric tons.3 Preventing the release of this stored carbon should be a centerpiece of any effort to address the climate crisis, but the Forest Service has been slow to act. Timber harvesting is the primary driver of carbon releases from Forest Service lands, 4 yet nationally the agency continues to focus on fulfillment of arbitrary timber volume targets[mdash]untethered from any objective to "restore" lands or mitigate wildfire risk[mdash]which it proposes to increase at least through 2026.5 In the carbon-dense, ecologically diverse Southern Appalachians, this often results in regenerating mature and old[1]growth forests to create early-successional habitat. This practice releases decades of sequestered carbon to create a successional class that can be created anywhere on the landscape simply by cutting trees down[mdash]including cutting younger and middle-aged trees that store far less carbon and provide fewer biodiversity benefits. From a carbon perspective, this tradeoff makes no sense. While the Forest Service likes to characterize forest carbon cycles as "closed loop," newly growing forests will not re-sequester carbon emitted from harvesting older forests for 40-100 years at best[mdash]a timeline irrelevant to avoiding the worst effects of climate change.6 Continuing to sacrifice carbon-dense forest for early successional habitat will jeopardize the United States' ability to meet its carbon-reduction objectives.

It is past time for the Forest Service and BLM to take bold action to mitigate the climate and biodiversity crises. That action should be informed by this comment period, but the agencies should not delay the ultimate purpose for developing those definitions: "Conserving old-growth and mature forests on Federal lands."

I. The inventory effort must be implemented consistent with the larger effort to address the climate and biodiversity crises.

Executive Order 14,072 and the instant comment period are part of a series of commitments the federal government has made to address the climate and biodiversity crises. The effort to define and inventory mature and old-growth forests must be implemented consistent with those prior commitments.

At the highest level, the Biden administration has committed to "deploy the full capacity of [federal agencies] to combat the climate crisis to implement a Government-wide approach that reduces climate pollution in every sector of the economy . . . [and] conserves our . . . biodiversity."7 This specifically includes "lead[ing] the Nation's effort to combat the climate crisis by example[mdash]specifically, by aligning the management of Federal . . . public lands . . . to support robust climate action."8

Following up on this commitment, the federal government set an "economy-wide target of reducing . . . net greenhouse gas emissions by 50-52 percent below 2005 levels in 2030" while working toward achieving net zero emissions by 2050.9 America's forests are key to achieving this target. In 2019, United States forests "offset approximately 12 percent of total United States greenhouse gas emissions . . . [which] was primarily the result of carbon uptake by standing United States forests" and other forest-related carbon sinks.10 As a result, to meet its 2030 and 2050 goals, the government identified the need to "reduce emissions from forests . . . and enhance carbon sinks."11 The government further explained that "America's vast lands provide opportunities to both reduce emissions, and sequester more carbon dioxide [CO2]."12 In other words, climate-smart management of federal lands can lead to fewer emissions and more sequestration. Both will be necessary to achieve the country's climate goals.

The cheapest, most straightforward opportunity for the federal government to contribute to those goals is to manage federal property to protect existing carbon stocks, which continue to sequester large amounts of carbon. Accordingly, the administration announced earlier this year that it would "manage forests on Federal lands, which include many mature and old-growth forests, to . . . retain and enhance carbon storage [and] conserve biodiversity" consistent with other objectives, including managing wildfire risk.13 The administration explained that "[c]onserving old-growth and mature forests on Federal lands . . . is critical to protecting . . . ecosystem services provided by those forests."14 Because mature and old-growth forests can only be conserved if we know where they are, the administration instructed the Forest Service and BLM to "define, identify, and complete an inventory of old-growth and mature forests on Federal lands" by April 2023.15 This comment period is a "first step" in that process.16

II. For purposes of this inventory, mature forests should be defined as starting at eighty years old.

Consistent with this broader context, the agencies have identified the task at hand as developing a definitional "framework that motivates mature and old-growth forest conservation."17 As the first step in this "framework," the agencies should adopt definitions that can be quickly and easily applied and that cast a wide net to estimate the potential mature forest on BLM and Forest Service lands and concomitant carbon and biodiversity assets. At this stage, it is appropriate to apply a definition identifying mature forests as starting at eighty years old. This definition may need further refinement as the "framework" is implemented over time, but eighty years is a reasonable, scientifically supported threshold for mature forests for several reasons.

First, using an eighty-year threshold would ensure that stands have surpassed their maximum net primary productivity before being considered "mature." Net primary productivity measures the average rate of biomass or carbon accumulation. According to Forest Service data, all dominant species on every national forest in the Southeast have reached their maximum net primary productivity by eighty years of age.18 Other Forest Service data indicate this same pattern holds across the country.19 Many species surpass their maximum net primary productivity at a much younger age, making the eighty-year threshold conservative. Biologically, stands should be considered mature after surpassing their maximum net primary productivity.

Second, the Forest Service generally considers "late seral" age-class stands to be "mature" and most species types reach this threshold at eighty to one hundred years of age.20 For example, on the Pisgah-Nantahala National Forest in North Carolina, "late seral" begins at around eighty years for shortleaf pine, shortleaf pine/hardwood, dry oak, pitch pine, pitch/Virginia pine, and spruce fir forest types.21 Nearly every forest type is considered to be "late seral" by one hundred years.22 Using an eighty-year threshold will ensure that quickly maturing forest types are appropriately captured by the "mature" definition at this stage in the framework.

Third, using an eighty-year threshold roughly approximates the period when most forest types achieve their culmination of mean annual increment ("CMAI"). CMAI is a silvicultural term used to define the peak growth of a stand in terms of timber volume. The fact that most forest types achieve CMAI around eighty years of age is further evidence that an eighty-year cutoff is reasonable. For example, on the Pisgah-Nantahala National Forest, forest types achieve CMAI between forty-eight and one hundred and four years with most forest types achieving CMAI before eighty years.23 Similarly, on the Chattahoochee National Forest in Georgia stands reach CMAI at forty to eighty years of age.24 And on the George Washington National Forest in Virginia, CMAI is defined as ranging from forty-five to sixty years.25 Inventorying stands over eighty years of age as "mature" would ensure that most of these stands have surpassed their CMAI.

Finally, we note that the eighty-year threshold is not only appropriate for the Southeast but appears to be generally applicable nationwide. For example, in the Pacific Northwest the Forest Service has used the "80-year threshold . . . [to] represent[] forests that had achieved structure commonly associated with mature . . . forests."26 As another example, the Green Mountain National Forest in Vermont also defines maturity as starting at less than eighty years of age.27 And Forest Service researchers have concluded that "central hardwood stands mature when they are 80 to 100 years old"[mdash]much of the East is located in the broader central hardwood region.28 Using this definition, stands over eighty years old can be preliminarily mapped using existing data sources including FIA and FS Veg and by incorporating ongoing mapping efforts such as those being completed by Dr. Dominick DellaSala and scientists at Griffith University.

III. Old-growth definitions and inventory should build on existing information.

Defining old growth is more complicated due to the structural and functional aspects of old-growth forests; old growth cannot be inventoried without ground truthing. For the most part, the outcome of the current inventory will be an estimate of the amount and potential locations of old growth across BLM and Forest Service units. But the agency is not starting from scratch[mdash]it should incorporate existing old-growth inventories into this inventory and build from and refine existing region-specific old-growth definitions to define old growth under Executive Order 14,072.

A. The agencies should incorporate existing old-growth inventories.

Existing, widely accepted old-growth inventories are already available to the agency and should be incorporated into the current inventory exercise. In the Southeast, this includes areas confirmed by the Forest Service as existing old growth[mdash]whether through plan- or project-level analysis[mdash]and inventories completed by Byrd, Carlson, Messick, and others.29 Old growth is incredibly rare in the Southeast, and areas confirmed as existing old growth should be immediately protected from logging and roadbuilding.

B. Old-growth definitions should be developed by refining existing region-specific definitions.

The process of developing old-growth definitions also need not start from scratch. As explained on the Forest

Service's website, it has already "define[d] old-growth forest based on the unique biophysical character of each of agency's nine regions."30 Thus, these definitions should already "reflect changes based on disturbance and variation in forest type/composition, climate, site productivity and geographic region" as noted in the RFI.31 To be sure, these definitions need refinement. But they also provide a solid foundation. Once refined, the agencies can use the improved definitions to identify currently uninventoried old growth in the field and apply appropriate protections. Moreover, the agencies can use various modeling exercises[mdash] including FIA-based models and models of canopy height or culmination of maximum biomass that take site characteristics into account[mdash]to prioritize areas for old-growth evaluation, starting with the highest priority areas and progressing into lower priority areas. This approach is consistent with applying the "framework" the agencies are developing over time.

In the Southeast, the agencies should start by reviewing the Forest Service Region 8 Old[1]growth Guidance. In our experience, the primary problem with this guidance is incorrect application in the field rather than the guidance itself. For years, we have pushed the Forest Service to apply this guidance but been met with resistance. If nothing else, in response to Executive Order 14,072 the Forest Service should finally apply its existing guidance. The definitions should also be improved.

Specifically, the definitions should be revised to:

[bull] Use variable area plots, since those are the standard format for stand examinations;

[bull] Focus on trees meeting minimum age thresholds rather than averaging the ages of trees in a particular stand;

[bull] Reduce requirements regarding the number of old trees per acre;

[bull] Focus on documenting other old-growth attributes including snags, the presence of multi-age stands with multi-layered canopies, and downed woody debris;

[bull] Use more accurate tree coring techniques; and

[bull] Add flexibility when considering the signs of human disturbance. This last change is particularly appropriate in the heavily managed forests of the East.

One of the most important changes the agency could make however would be to underscore the importance of old-growth and mature tree surveys for line officers and staff and provide additional training and resource materials to make in-field identification easier.

Consistent with the Region 8 Old-growth Guidance, old growth in the Southeast should be identified in patches greater than one acre.32 Stated in the inverse, the agency may not disqualify an area for old-growth designation based on size as long as it is larger than one acre.

C. The agencies should not rely on forest plan-level designated old-growth networks.

We caution the agencies against attempting to rely on plan-level designated old-growth networks as a basis for the old growth inventory they are currently developing. These networks are unfortunately both over- and under-inclusive of existing old growth[mdash]in part because they are not intended as an "inventory"[mdash]and are generally a poor tool for accurately documenting old growth across a forest.

Plan-level old-growth networks identify existing old growth to some extent, but their primary purpose is to connect habitat where old growth conditions are desirable (or where timber harvesting is undesirable) and will be allowed to develop in the future.33 On the ground, confirmed old growth may be excluded from the designated network if certain distributional criteria are already met within a given compartment.34 In other words, only a portion of a designated old-growth network would qualify as old growth for the purposes of a moment-in[1]time inventory of the resource, while forest patches that would qualify may not have been designated.

Moreover, plan-level network decisions are made only as often as plans are revised, which in practice may mean an interval of several decades. And even when plans are updated, recent experience in the Southeast shows that patches of old growth previously identified and added to these networks during project-level analyses35 are not necessarily carried forward into revised networks.36 In fact, the revised Pisgah-Nantahala Forest Plan expressly commits to not adjusting the designated old growth network throughout the life of the plan.37 Thus, although designated old-growth networks are useful for helping national forest units account for connectivity among old growth and future old growth habitats, they do not locate or quantify all existing old growth.

D. The agencies' existing data sources can be helpful but are ultimately incomplete.

While the agencies should use their existing data[mdash]including the Forest Service's FS Veg database[mdash]to identify areas where old growth is likely to occur and prioritize those areas for review, those data cannot be used to definitively identify old growth. The FS Veg database has several shortcomings which make it insufficiently accurate as a predictive tool on its own. Most of our experience with FS Veg comes from the Southern Appalachians, so the examples that follow come from this region.

Perhaps the root of FS Veg's shortcomings is that it relies on historical stand examinations. Many forest stands have never had a proper examination, and the quality of stand examination varies greatly between practitioners. As a result, stands often contain both mid-seral and older trees, but the FS Veg database characterizes the stand as only one or the other. Thus, the database cannot ensure that a stand designated as mid-seral does not actually include significant amounts of old forest.

In some cases, the database can be especially inaccurate and list well-known old-growth forests as being of average age. For example, Joyce Kilmer Memorial Forest is the most famous old-growth forest in the Southern Appalachians. It harbors a forest with a multi-aged canopy, trees up to seven feet in diameter, and trees documented over 300 years of age. However, the FS Veg stand ages listed for the Poplar Cove Loop Trail date from 1890 and 1910. Neither age accurately reflects the character of the forest, and in another location, the 1910 age would cause the forest to be passed over as old growth in a desktop exercise.

FS Veg also erroneously lists stands as older than they actually are in some cases. This can occur for several reasons, the first of which is the infrequency with which the database is updated. Good examples of this phenomenon occur in Linville Gorge Wilderness, where several severe wildfires (2001, 2007, 2014, 2017) resulted in stand replacement fires in primary forests that had never been logged. The majority of Linville Gorge Wilderness is contained in just two stands that total approximately 7,453 acres, and just two forest types[mdash]both listed as originating in 1892. The database does not account for the fact that approximately 2,000 acres of stand replacement fire have occurred in Linville Gorge since 2001. This provided an excellent opportunity to split the existing stands into more manageable units and update the stand age for those that originated in 2001 or later. But that has never occurred, and Pisgah National Forest still counts it towards meeting forest plan goals for old-growth forest.

Another example of this occurs in the Balsam Mountains, where a well-known wildfire in 1925 destroyed the Spruce-Fir Forest at Graveyard Fields, leaving the burnt stumps of spruce trees looking like tombstones. And indeed, the stand origin date for Graveyard Fields and the surrounding area is listed as 1925. The problem is that the area has never reforested. Instead, it is a large complex of open areas and shrub thickets that is locally famous as a recreation destination and blueberry patch. Using FS Veg alone to define the age of the Forest would overestimate the actual cover of forest, let alone forest age, in this and similar cases.

The FS Veg data also often overstates the age of forests recently acquired by the Forest Service. The Cherokee National Forest has made several thousand acres of new acquisitions in the last twenty years, but without the funding to complete stand examinations, nearly all of these tracts have been listed as originating from 1800 in FS Veg. The reality is that many of these forests have been recently logged and are among the younger stands on the Cherokee National Forest.

We offer these examples as cautionary tales and to explain why reliance solely on the agencies' existing databases will be insufficient[mdash]particularly regarding old-growth identification. Certainly, the existing data can be improved by cross referencing it with aerial imagery, LiDAR canopy models, LiDAR hillshade models, NDVI data, field inventories, and other relevant data. Ultimately, the best use of the databases is to identify areas where old growth is likely to exist and to prioritize those areas for review in the field. Regarding mature forests, the databases can be used to identify forests likely to be over eighty years old, but these identifications may also change after in-field review.

E. The agencies should not employ a "never cut" standard to define old growth or use density-based criteria.

Finally, the RFI asks for input on criteria that should not be used when defining old growth. First, the agency should not use a "never cut" standard to define old growth. That criterion is more appropriate for identifying primary forests; while some old growth is primary forest, the terms are not always interchangeable. In the East, most of our primary forests were liquidated over the past 150 years, which has now left us with both very little primary forest and old growth. Indeed, using a "never cut" standard to define old growth would conflict with one of the chief purposes of inventorying mature forests[mdash]so it can be protected and eventually become old growth.

Second, the agencies should not consider density-based criteria[mdash]such as canopy cover, basal area, and standing volume[mdash]when defining old growth. In the Southeast, significant amounts of remaining old growth are found on generally unproductive sites. In fact, the unproductive nature of these sites may have been what saved these forests from significant harvesting a hundred years ago. Despite their age and the fact that they provide many of the co[1]benefits discussed below, these forests generally cannot be described as dense. But they are old growth and should be appropriately protected.

IV. Mature and old-growth forests are essential in the fight against climate change.

As explained in the introduction, protection of carbon-dense forest is essential to ensuring public land management decisions are consistent with federal climate policy. The United States is counting on forests to sequester CO2, and continue to store currently sequestered CO2, to achieve net zero emissions by 2050. Old-growth forests are among the densest and most resilient form of carbon storage in the federal government's care.38 Mature forests also store high amounts of carbon and, critically, are transitioning into old growth, which is drastically underrepresented across United States forests. Protecting intact and healthy old-growth forests and managing mature forests to allow them to develop into old growth is the cheapest and most effective policy available to the federal government to sequester and remove carbon from the atmosphere. Indeed, the Forest Service itself has recognized that its "forests are climate change mitigation powerhouses."39

Forests are the largest form of terrestrial biomass globally, as well as the most significant terrestrial contributor to atmospheric carbon removal.40 Each year, forests remove about a third of the atmospheric carbon emitted through combustion of fossil fuels worldwide and 10-15 percent of the United States economy's total greenhouse gas emissions.41 "Mature, multi-aged forests" sequester far more carbon per unit of land area than young forest, with the largest one percent of trees storing half of the forest's living carbon.42 But old forests' remarkable carbon density is only achieved through decades of accumulation, which continues at significant rates even after peaking during the first few decades of a forest's maturation.43 The Forest Service's data for the Southeast shows that net primary productivity for most forest types peaks between forty and sixty years of age but then levels off at approximately seventy percent of the peak rate, which can be sustained for a century or more.44 Southeastern forests tend to be especially durable as carbon sinks because they experience less fire and storm disturbance than drier forests, such as those of the western United States. 45 And when disturbance does occur, intact old-growth ecosystems prove more resilient than younger, even-aged forests because secondary growth is available to quickly fill gaps in the canopy.46

Existing old growth's value as a climate change mitigator is even greater than its raw carbon value. The climate crisis has progressed to the point where it matters when and how soon a given amount of carbon can be kept from or removed from the atmosphere[mdash]not just that it eventually will be. The value of each unit of atmospheric carbon sequestered diminishes as time passes: Once further climatic "tipping points" are reached, feedback cycles of warming and volatility will occur that cannot be reversed by removing the same amount of atmospheric carbon that was responsible for their initiation.47 This dynamic makes it critical that forests currently storing the highest amounts of carbon[mdash]mature and old-growth forests[mdash]are managed to prevent release of that carbon.

It also underscores the importance of managing for future recruitment of old growth, primarily by allowing currently mature forests to develop into old growth. In the Southeast where very little old growth exists, "forest carbon densities are much lower than their potential."48 Undoubtedly, this is due at least in part to the region's long history of timber harvest. Allowing second-growth forests to mature into old growth will boost the carbon capturing potential of Southeastern forests, restore ecosystems, and benefit wildlife and biodiversity.

V. Mature and old-growth forests provide substantial co-benefits in addition to carbon storage.

In addition to the carbon storage and climate mitigation benefits provided by mature forests, the protection of late-aged forests has significant co-benefits for biodiversity, the health of connected watersheds, and social cohesion. Without proper management of older forests, the federal government cannot meet its stated goals of "combatting the . . . biodiversity crisis"49 or providing for the recovery of imperiled species. It also makes little policy sense to ignore a potent tool for maximizing access to clean water and social community benefits.

A. Mature and old-growth forests are central to stated biodiversity goals and will provide refugia to species vulnerable to climate change.

Older forests are biologically complex, dynamic ecosystems that provide crucial habitat to a wide range of species, including a host of federally listed flora and fauna. Mature and old[1]growth forests contain complex arrangement of trees, both dead and alive, which provide for multifaceted interactions between canopy and understory layers and contribute to unique arrangements of soil horizons.50 In short, they represent ecosystems that are difficult[mdash]if not impossible[mdash]to artificially recreate, and they take decades or centuries to fully recover from disturbance. Many species that have adapted to fill the niches offered by old forests cannot find those niches elsewhere. Moreover, moisture and shade retention from mature forests result in microclimatic effects that offer cooler, more temperate habitat to sensitive species during increasing temperatures and extreme weather events. That makes mature and old-growth forests even more important for species now, amidst the climate crisis.

1. Older forests are disproportionately biodiverse and provide important habitat for listed species.

Older forests are essential to EO 14,072's mandate to "conserve biodiversity." Mature and old-growth forests contain complex ecosystem dynamics important to the lifecycles of a broad range of terrestrial and aquatic taxa. Simply put, large old trees "are not simply enlarged versions of young trees and large young trees cannot duplicate all the functional roles that large old trees can play."51 Instead, older trees and mature forests are integral to complex ecosystem dynamics. For example, living older trees offer nesting habitat to interior forest species, whereas both standing snags and downed stumps of dead mature trees provide habitat for imperiled species that is not found elsewhere. Studies have found that nest boxes are insufficient to replace the nesting opportunities provided by large old trees when placed in the same ecosystem.52 Similarly, the retention of coarse woody debris and snags after logging, while important, is inadequate to compensate for the lost trees ecologically.53 For example, federally listed endangered and threatened forest bat species rely on exfoliating bark, roosting opportunities, and optimum foraging conditions and are, therefore, less present in intensively managed older forests.54 Similarly, management guidelines for the retention of coarse woody debris "may not provide adequate habitat" for amphibians and other forest-floor vertebrates that depend on decaying logs and log fragments.55 Mature and old-growth forest dynamics, in their entirety, are what make them so valuable to species.

Old-growth and mature forests are especially invaluable to imperiled species. In fact, mature forests studied in the western United States were found to have the "highest proportional area of terrestrial vertebrate habitat for species listed as threatened or endangered by the U.S. Fish and Wildlife Service," as well as the "highest proportion of habitat designated as critical for threatened or endangered species survival."56 This pattern is not limited to the West - older eastern forests are disproportionate reservoirs of amphibian, bird, and carnivore diversity, including imperiled species.57 Even globally, "most vulnerable bird species need large intact forests," although where necessary "relatively small fragments [of mature forest] can still have substantial biodiversity value if protected at the highest levels."58 The need for old-growth and mature forest conditions will only increase as the climate crisis accelerates.

2. The microclimates provided by old-growth and mature forests will be essential refugia for vulnerable species.

Structurally complex forests, especially old-growth forests, can be cooler than other forest types during the high heat of spring and summer months in the northern hemisphere.59 The vertical structure of mature and old-growth forests, denser canopy cover, and moisture retention in downed trees are among the factors that keep older forests slightly cooler and more humid than other forest types.60 Studies have found that maximum spring temperatures were reduced by as much as 2.5 degrees Celsius in the old-growth forests of the Pacific Northwest61 - a temperature disparity that could mean survival for heat-sensitive species. Studies focusing on climate-sensitive birds found that species associated with "significant negative effects of summer warming" had ill effects reduced and "even reversed" where the species had access to high proportions of old-growth forest.62

Old-growth and mature forests also contain a larger proportion of resources for some forest-associated species as compared to younger, less dense woodlands. This is especially true for food and nesting site availability.63 As species face increasing stress from a changing climate, and become less tolerant of other stressors, it is especially important to protect places where resources are more abundant.

B. Mature and old-growth forests provide substantial benefits to connected watersheds.

Mature and old-growth forests also provide substantial benefits to connected watersheds. The presence of older forests is associated with more regular water levels and flow, less waterbody sedimentation, and a decrease in contaminants associated with harms to human health. These positive impacts directly benefit aquatic species and human communities, and should not be overlooked when crafting policies that impact older forests.

In the United States, major rivers are declining in streamflow.64 This raises obvious concerns about impacts to drinking water supplies and human health as well as consequences for aquatic species. Yet a crucial component of streamflow protection[mdash]the protection of mature and old-growth forests[mdash]has not been broadly adopted as a policy response. The complex ecosystem dynamics of older forests directly affect streamflow by determining the trajectory and volume of runoff and soil permeability, which are improved by older forest conditions. For one, epiphytes associated with older forests stabilize water input into streams by containing, and then slowly releasing, rainfall back into the watershed.65 These lichen and bryophytes increase the maximum water storage capacity of the forest, storing water that would otherwise contribute to runoff, and help to maintain a more consistent, less variable streamflow than is associated with less forested areas. 66 Evapotranspiration from forest canopy is also crucial to the maintenance of a healthy hydrological cycle and adequate future rainfall. Indirect impacts of deforestation in Southeast Asia, for example, is expected to reduce future rainfall by as much as one millimeter per day.67 Epiphytes and microclimate impacts combined with the unique structure of older forests lead to substantial overall retention of water in older forest ecosystems. By one study's measure, the conversion of old-growth forests to Douglas-fir plantations led to a fifty percent total decrease in nearby streamflow.68 The total water deficit of the nearby waterway continued, even in stands that were fifty years old.69 Older forests allow for a greater uptake of rainfall and runoff into flowing waterways[mdash]water that is not adequately captured in other forest types.

The quality, as well as the quantity, of water is significantly improved in mature and old[1]growth forested watersheds. Intact forests are associated with erosion control and decreased landslide risk, and waterways connected to these forests are less subject to sedimentation.70 Sedimentation poses a direct threat to sensitive species71 and human drinking water.72 In the United States, national forests remain the largest source of drinking water in many areas, and federal land management actions on these Forests dictates both the quantity and quality of that resource.73 Disturbance to intact, older forests must be minimized to ensure the viability of forest-connected watersheds for both natural and human use.

C. Older forests are also associated with social and spiritual benefits that should not be overlooked.

Mature and old-growth forests are of social, cultural, and spiritual importance across the nation and the globe. While these benefits are difficult to quantify, the positive impact of older, intact forests on human community and identity are extensively documented.

First, older forests provide social benefits just by existing. When surveyed, eighty percent of Americans indicated that the protection of rare plant and animal species was "extremely important" to them.74 The same quantity of survey responders ranked maintaining wilderness for the benefit of future generations as "extremely important".75 Overall, the value difference in ranking between rural and city-based respondents was not significant, and these rankings do not appear to depend on a participant's likelihood of encountering wilderness or wildlife.76 Instead, Americans place great value on the existence of wild areas outside of their relationship to them. Both rare species and intact wilderness areas are associated with mature and old-growth forests. Policies that affect management of these forests should reflect their social importance to the public.

Older forests are also strongly related to cultural identity and understandings of generational heritage. Survey respondents who had longstanding ties with a particular area were more likely to list "generational sharing" as an important value of old-growth forests.77 There was an even stronger correlation with the importance of "generational sharing" and "cultural identity" practices among Native survey participants, who indicated the importance of teaching future generations specific practices related to older forests and old growth.78 These values were also associated with social cohesion and community bonding. Sharing knowledge of a particular place, and practices associated with that location, with future generations cannot be accomplished if active management of that forest substantially alters the look, feel, and ecological function of that area. When older forests are subject to intense active management, the social cohesion benefits associated with a cherished area are eliminated.

Mature and old-growth forests also serve as spiritual sanctuaries in ways that are not associated with young forests. In one study, ninety-five percent of participants noted the "untouched feeling" of older forests, especially old-growth forests.79 For eighty-eight percent of participants, this was associated with "peace" and "spiritual connection."80 Of particular importance to those who associate older forests with spiritual connection was the sense of solitude and associated tranquility, the feeling of being "away from human disturbance," and feeling "a lack of separation" between themselves and the ecosystem.81 These qualities were not associated with young forests, nor do they seem compatible with areas of high human management. The association between large trees and sacred importance is not unique to this country - at a global level, the idea of untouched, immense, and extremely old trees and forests is revered by many.82 Again, federal management decisions about older forests should take these values, and the positive impacts of spiritual sanctuary on the wellbeing of the public, into account.

VI. The primary threat to Southeastern forest carbon stocks is timber harvesting.

While the RFI requests specific feedback on questions related to defining and inventorying mature and old-growth forests, it generally invites comments on the appropriate response to Executive Order 14,072.83 The agencies cannot implement the Executive Order without recognizing that timber harvest is the primary threat to carbon stocks on Southeastern forests.

A. Old growth and mature forests are frequently targeted by Forest Service timber sales in the Southeast.

As noted elsewhere, old-growth forests are extremely rare in the East. Once the dominant forest successional class, recent scholarship estimates that approximately three percent of the Southern Blue Ridge Region is currently in old-growth condition.84 Nevertheless, the Forest Service continues to cut the few remaining acres of old growth left on public lands. For example, the ongoing Southside Project on the Nantahala National Forest in North Carolina involves the harvest of existing old growth. The Forest Service recently put out for bid the portion of the sale containing old growth, but it received no offers. In response, the Forest Service cut the bid price in half and reoffered the old growth for sale.85 During the second bid process, a local conservation group offered to pay the Forest Service to leave the old growth intact, but the agency refused.86 Astoundingly, in rejecting the conservation group's offer to pay the Forest Service to not cut the old growth, the agency insisted that old growth is not actually rare but "[w]hat is rare in the area is young forest," thereby justifying harvesting old growth to create early successional habitat.87 Even if that were true (it is not), it would not justify the tradeoff between harvesting existing old growth[mdash]which takes decades or centuries to develop[mdash]and creating early successional habitat. The agency is literally selling one of the most valuable resources it manages[mdash]from both a carbon and biodiversity perspective[mdash]at highly discounted prices. This makes no sense.

Other projects in the Southeast demonstrate that intense public pressure is often necessary to preserve old growth from Forest Service timber sales. For example, the Buck Project on the Nantahala National Forest proposed logging existing old growth, 88 which was dropped only after consistent pressure from local conservation groups.89 Old-growth logging initially proposed as part of the Upper Warwoman Project on the Chattahoochee National Forest in Georgia was also dropped after local groups raised the issue with the Forest Service.90

Southeastern forest plans also leave old growth vulnerable to logging. The recently revised Pisgah-Nantahala Forest Plan in North Carolina designates an old-growth network to "include[] areas where creation of young forest is unlikely to be prioritized" but leaves management of old growth outside of that network to the discretion of district rangers.91 Unfortunately, the old-growth network adopted under the revised plan excludes thousands of acres of old growth identified under the previous plan and places that old growth in management areas emphasizing timber harvest. 92 This is plainly inconsistent with protecting old-growth forests.

The revised Pisgah-Nantahala forest plan also proposes to increase the level of harvest[mdash] by three hundred and seventy-five percent93[mdash]and focus much of this increase in carbon-rich mature cove forests.94 Thus, the revised plan leaves old growth vulnerable to logging and plans to expand logging of mature forests.

Harvesting of mature forests is common in the Southeast. The Buck Project on the Nantahala National Forest in North Carolina calls for the harvest of 150 acres over 100 years old.95 Other recent examples of projects targeting mature forest include the South Redbird Project on the Daniel Boone National Forest in Kentucky and Upper Cheat River Project on the Monongahela National Forest in West Virginia. Indeed, according to Forest Service data, the most common disturbance affecting carbon stocks on Southeastern national forest is overwhelmingly timber harvest.96 As examples, timber harvest is responsible for ninety percent of the change in carbon stocks on the Daniel Boone National Forest, eighty-three percent of the change on the Chattahoochee National Forest, and seventy-one percent of the change on national forests in North Carolina.97 Nothing indicates that this harvest is focused in nonmature forests. To the contrary, in our experience the agency often rejects alternatives creating early successional habitat in younger stands as opposed to older ones. The practice of harvesting mature forest appears to be common nationwide. 98

B. Timber harvest releases substantial amounts of carbon to the atmosphere in the short term.

The science is clear that this harvesting of carbon-dense mature and old-growth forests releases substantial amounts of carbon to the atmosphere. The agencies must acknowledge this reality and disabuse themselves of the notion that logging is a solution to the climate crisis.

Far too often, the agencies cast aggressive logging as a carbon-positive management strategy by arguing that the young forests initiated by harvest sequester carbon at faster rates than older forests. The agencies further assume wood products "lock in" carbon gains rather than leaving older trees vulnerable to mortality events that ultimately allow them to release their stored carbon. But the math underlying these justifications for harvest does not hold up.

Although carbon sequestration rates peak during the early decades of a forest's development, this increase in speed comes at a high cost. Speed is no substitute for lost volume or the time it took that volume to accumulate. Harvested mature stands on a particular site sequestered similar amounts of carbon at a similar speed early in their own development[mdash]but over many decades, they continued to store much more carbon even as the overall rate of sequestration (as opposed to the amount) for the stand levelled off. This distinction is critical and is due to the presence of older trees[mdash]as trees get older and larger, they remove increasingly more carbon from the atmosphere. 99 Indeed, this is why carbon densities (stored carbon) in the Southeast are relatively low even if sequestration rates are relatively high (due to young trees).100 As explained below, when these trees are harvested, much of this sequestered carbon is emitted to the atmosphere, and it cannot be replaced quickly. The vast majority of forests' above-ground carbon is stored in the oldest and largest trees.101

Calculations suggesting this carbon debt can be repaid by "locking in" carbon in wood products overestimate how much carbon actually remains in wood products and underestimate the carbon cost of the harvest and production processes that create them. The amount of carbon stored in harvested wood is also highly dependent on the end use of the wood product. The Forest Service determined in its 2014 planning assessment of the Nantahala and Pisgah National Forests in North Carolina that just twelve percent of harvested carbon remained stored in wood products after fifty years.102 Another eighteen percent remained sequestered in landfills. In the short term, especially after accounting for production and harvest losses, wood products appear to store carbon less effectively than dead trees, which release carbon slowly while providing habitat and other ecosystem services for decades after death.103

Adding the carbon sequestered in wood products (which diminishes over time) to the carbon sequestered by young forests (which, like the forest it replaced, slows over time) shows that timber harvest, far from increasing carbon storage potential, both emits carbon and precludes the achievement of "replacement" benefits on any timescale relevant to the exigencies of the climate crisis. The regenerated forest may simply never catch up as explained in the figure below from Law et al. (2019).

IMAGE: page 19 of 22 - The regenerated forest may simply never catch up as explained in the figure below from Law et al. (2019).

Finally, even assuming carbon stored in regenerated forests combined with carbon stored in wood products from the previous harvest does at some point 1) replace the carbon lost to the initial harvest and 2) make up the opportunity cost of the harvested forest's carbon sequestration potential over the same period, the climate value of storing carbon in the future is far lower than the climate value of carbon stored in the present. Again, the value of avoided or sequestered carbon emissions decreases as time passes because it costs more time and money to reverse climate impacts than to have never caused them at all.

These conclusions point to a single policy solution to meaningfully address climate change: The immediate protection of the carbon stored in our most carbon-dense forests by forgoing unnecessary timber harvest in those areas. In the Southeast, wood products and early successional habitat can still be created by focusing harvests in middle-aged and younger stands, which provide fewer climate and biodiversity benefits. While the amount of carbon lost from timber harvesting "may seem relatively small" when compared to economy-wide emissions, the Forest Service has already confirmed that "they often represent very large amounts of climate mitigation benefit."104

VII. Other threats to Southeastern forests are less significant from a carbon storage perspective and harder to manage.

Thinning harvests can serve important purposes in some Southeastern forests, such as creating red-cockaded woodpecker habitat in long leaf pine forests, but it is too often justified as averting greater carbon losses due to wildfire. In the Southeast[mdash]which does not face the same wildfire threats as western forests[mdash]the marginal reduction in fire risk and intensity associated with "thinning" an area is generally too small to justify the carbon losses of those treatments. The treatments themselves seem to be minimally effective at reducing wildfire risk, and only for 10-20 years at most.105 Forest type, temperature, drought level, and winds are greater determinants of ignition rate and fire severity than whether a forest has undergone "thinning" treatments, which can alter forest structure by removing large-diameter trees.106 Although brush[1]clearing and prescribed burns can increase old growth's resiliency and carbon uptake potential,107 more aggressive thinning does precisely the opposite.

Studies in western forests have shown that even in those fire-prone landscapes, carbon losses due to wildfire[mdash]even severe wildfire[mdash]are typically less per unit area than from thinning treatments.108 Even assuming every acre thinned would have otherwise burned in a wildfire, the treatment would be worse than the disease in almost every case. The figure below (from Bartowitz et al. (2022)) shows that carbon losses from even a thirty percent harvest are typically greater than those from a fire burning the same area.

IMAGE: page 21 of 22 - Figure 4 | Comparison of per area (Mg C ha~1) hypothetical harvest scenario carbon losses to actual fire emissions.

This disparity grows when it is further discounted by the rate at which treated acres do actually burn in wildfires[mdash]about one percent of Forest Service treatments in a given year. 109 These treatments are therefore particularly unjustifiable in the forests of the Southeast, where the rate of carbon loss to wildfire is naturally much lower[mdash]ninety-two percent of carbon losses are attributable to timber harvest (as opposed to natural disturbances such as fire, storms, and pests) in the Southeast, compared to sixty-six percent in western forests.110 Fortunately, this also means that carbon losses in Southeastern forests are especially easy to mitigate simply by reducing harvest.

Further, thinning does not appear to prevent tree mortality caused by insects. In fact, thinning operations may compact soils and harm root systems, making trees more vulnerable to infestation and illness.111 Nor do insect outbreaks appear to independently increase fire risk[mdash] that risk, as discussed above, is most substantially linked to climate change.112 Indeed, even as an indispensable natural buffer against climate change, old-growth and mature forests are no less vulnerable to climate change's consequences than other parts of the global ecosystem: The further climate change advances, the less effective and resilient our old-growth forests become, both as valuable habitat and as buffers against further climate catastrophe.

While we agree that wildfire, pests, and climate change pose threats to our old-growth and mature forests, timber harvest is by far the more serious threat from a carbon perspective; but it is also, conveniently, the easiest to manage.

VIII. Conclusion

Using Southeastern federal forests as "climate change mitigation powerhouses" requires ensuring that carbon stored in older forests is not needlessly emitted to the atmosphere through unnecessary timber harvests. The tradeoffs between emitting carbon accumulated over decades for ephemeral gains in early successional habitat in particular are often not worth it. We appreciate the opportunity to comment on the appropriate definitions for mature and old-growth forests and urge the agencies to act swiftly to protect these important climate and biodiversity assets.

Sincerely,

FOOTNOTES:

1 Exec. Order 14,072 [sect] 1, 87 Fed. Reg. 24,851, 24,851 (Apr. 22, 2022) ("EO 14,072"). I. The inventory effort must be implemented consistent with the larger effort to address the climate and biodiversity crises. Executive Order 14,072 and the instant comment period are part of a series of commitments the federal government has made to address the climate and biodiversity crises. The effort to define and inventory mature and old-growth forests must be implemented consistent with those prior commitments.

2 See Inflation Reduction Act, P.L. 117-169 (2022).

3 See Forest Service, Fiscal Year 2023 Budget Justification, 175, https://www.usda.gov/sites/default/files/documents/30a-2023-FS.pdf.

4 See generally Birdsey, Richard A., et al.. 2019. Assessment of the influence of disturbance, management activities, and environmental factors on carbon stocks of U.S. national forests. Gen. Tech. Rep. RMRS-GTR-402. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

5 Budget Justification, supra note 3 at 168.

6 See John D. Sterman et al., Does Replacing Coal with Wood Lower CO2 Emissions? Dynamic Lifecycle Analysis of Wood Bioenergy, 13 Envtl. Res. Letters (2018), http://iopscience.iop.org/article/10.1088/1748-9326/aaa512/meta.

7 Exec. Order 14,008 [sect] 201, 86 Fed. Reg. 7,619 (Feb. 1, 2021) ("EO 14,008").

8 Id. [sect] 204.

9 United States, Nationally Determined Contribution, 1 (April 1, 2021), https://unfccc.int/sites/default/files/NDC/2022-06/United%20States%20NDC%20April%2021%202021%20Final.pdf.

10 Id. at 14.

11 Id. at 5.

12 Id.

13 EO 14,072 [sect] 2.

14 Id. [sect] 1.

15 Id. [sect] 2.

16 See Request for Information, 87 Fed. Reg. 42,493 (July 15, 2022) ("RFI").

17 Id. at 42,494 (emphasis added).

18 See supra note 4.

19 See Liming He, et al., Relationships between net primary productivity and forest stand age in U.S. forests, 26 Global Biogeochemical Cycles (2012), https://www.nrs.fs.usda.gov/pubs/jrnl/2012/nrs_2012_he-l_001.pdf.

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21 Pisgah-Nantahala Forest Plan FEIS at 3-119.

22 Id.

23 Revised Pisgah-Nantahala Forest Plan, 314 (2022).

24 Chattahoochee-Oconee Forest Plan, Final Environmental Impact Statement, 3-543 (2004).

25 George Washington National Forest Land and Resource Management Plan, 4-13 (2014).

26 See Davis, Raymond J., et al., 2015. Northwest Forest Plan-the first 20 years (1994-2013): status and trends of late-successional and old-growth forests. Gen. Tech. Rep. PNW-GTR-911. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, https://www.fs.usda.gov/pnw/pubs/pnw_gtr911.pdf.

27 Green Mountain National Forest Land and Resource Management Plan, 11 (2006).

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29 See Davis, M.D., 1993, Old Growth in the East: A Survey, Cenozoic Society, University of Wisconsin-Madison; Carlson, Paul J., 1995: An assessment of the old-growth forest resource on national forest system lands in the Chattooga River watershed. Chattooga Ecosystem Demonstration Management Project, USDA Forest Service Region 8; see, e.g., Messick, R. 2000. Old-growth forest communities in the Nantahala-Pisgah National Forest. Western North Carolina Alliance, Asheville.

30 See U.S. Forest Service, Old-Growth Forests webpage, https://www.fs.usda.gov/managing-land/old-growth[1]forests#:~:text=The%20Forest%20Service%20defines%20old,development%20of%20old%2Dgrowth%

20forest.

31 87 Fed. Reg. at 42,494.

32 U.S. Forest Service Region 8 Old-growth Team, Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region, 18 (1997) ("Region 8 Old-growth Guidance").

33 See Pisgah-Nantahala Forest Plan FEIS at 2-13 ("[The old growth network] does not account for all the pockets of old forest that may exist on the Nantahala and Pisgah NFs."); 3-383 (explaining that the "designated network will contain both current old growth and forest that has the potential to acquire old growth characteristics in the future"); 3-389 ("[A]nalysis estimates sixteen percent of the existing designated old growth network meets the minimum [old growth] age" for each of the landscape's forest types.).

34 Id. at 3-385.

35 See Region 8 Old-growth Guidance; Amendment 5 to the 1994 Pisgah-Nantahala Forest Plan.

36 S. Env't L. Ctr., Notice of Objection to the Revised Land Management Plan for the Nantahala and Pisgah National Forests (March 22, 2022), at 112-13.

37 Pisgah-Nantahala Forest Plan FEIS at 3-392 ("[I]n [the selected alternative], the size and configuration of the network is set at the plan level, and projects will not be able to add, subtract, or adjust the footprint of the designated OG network.").

38 See, e.g., Pisgah-Nantahala Forest Plan FEIS, at 3-28 ("[o]lder forest stands . . . stor[e] more carbon than do younger stands.").

39 U.S. Dept. of Agriculture, Secretarial Memorandum 1077-04 (June 23, 2022), https://www.usda.gov/directives/sm-1077-004.

40 U.S. Global Change Research Program, Second State of the Carbon Cycle Report: A Sustained Assessment Report, Chapter 9, 1 (2018), https://carbon2018.globalchange.gov/chapter/9/.

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