[redacted]

February 14, 2019

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Submitted via: comments-eastern-wayne-ironton@fs.fed.us

RE: "Sunny Oaks" – Supplemental Comments [redacted]

Dear Rachel,

The [redacted] submits the following comments on the Wayne National Forest's proposed Sunny Oaks project. These comments supplement our comments of January 14, 2019, and the January 11, 2019 comments of the [redacted] fully incorporated as its own. The literature cited herein will be submitted under separate cover.

The information discussed herein provides additional context for why appropriate oak ecosystem management in this region is vitally important. It is true that many species of wildlife benefit from having access to a diverse mix of oak species (e.g., northern red, white, chestnut, black, scarlet). However, the American white oak (*Quercus alba*) has long been regarded as the single most important oak species for wildlife. For example, sensitive wildlife species such as the American black bear and the cerulean warbler are especially reliant on interior habitat with large, mature white oaks for reproductive success and population growth. And, cerulean warbler favors white oaks on more mesic north- and east-facing slopes. This project proposes especially heavy management (clearcuts) on these slopes – an approach which will likely greatly reduce and/or permanently eliminate the oak and white oak components on these slopes.

And, American white oak is the most important ingredient in bourbon, a uniquely American beverage. The bourbon industry is booming, and as a consequence so are the white oak stave and cooperage industries. Appropriate oak management will be necessary to ensure a robust future for oak ecosystems in the region and for the future of bourbon and its associated industries.

Proposed harvests also fall within or very near parcels inventoried for roadless and wilderness characteristics in the Wayne's plan revision process. These harvests should be removed from the project.

Ecosystem resilience in the face of climate change is an important factor that should receive consideration in this project. Emerging science regarding carbon storage, mycorrhizal networks, and large, old trees shows that heavy-handed management (e.g., large clearcut prescriptions) negatively impacts the carbon balance, ecosystem resiliency, and even the regeneration success of young oak seedlings.

Absent appropriate management, the region's oak ecosystems are likely to decline in the future. This holds especially true for the American white oak, which once dominated southeast Ohio and which is now subject to unsustainable harvest and steep declines in the state of Ohio. Successful oak regeneration requires patience (often on the order of decades) and the investment of significant resources. The substantial demands of oak regeneration suggest that significant federal government involvement may be necessary for its success.

Unfortunately, this project is a painful illustration that the federal government is not appropriately equipping and funding the U.S. Forest Service to confront the vital task of oak ecosystem management. The SILVAH data associated with this project reveals that the vast majority of the Sunny Oaks stands are not ready for clearcut or shelterwood oak regeneration harvests. The requisite numbers and sizes of oak seedlings and saplings are simply not present in these stands. This project, if implemented according to either alternative, will significantly diminish the future oak components of the stands in question.

The (unusual, for the Wayne) size of this project – both in terms of the total acreage involved and the number and large sizes of individual harvest proposals – makes it unwieldy from a NEPA assessment perspective. And, this project is defined by the lack of adequate SILVAH plot data and the apparent total or near-total lack of stand preparatory treatments (e.g., of understory preparation, let alone the recommended 10-30 years of preparation). The picture painted is of an agency spread too thin. Rather than provide the Wayne National Forest with the resources and time to properly implement oak ecosystem management, it seems that the current administration is incentivizing and/or mandating a rapid and substantial increase in timber harvest on this national forest. The FY2018 timber targets for the Wayne, for example, were more than 400% of the forest's historical targets. This lack of investment coupled with aggressive timber targets is a recipe for oak ecosystem failure.

Both project alternatives, as proposed, require full NEPA analysis in an environmental impact statement (EIS). As does the rejected "optimum oak alternative" which the [redacted] earlier requested for consideration. USFS failed to meaningfully consider the optimum oak alternative on a stand-by-stand basis because it broadly (and incorrectly) assumed that all stands involved in this project are so heavily composed of oak that full or substantial oak retention would preclude the creation of early successional habitat.

Thank you for your consideration.

Sincerely,

[redacted]

I. Cerulean Warbler

Cerulean warbler is listed in the 2006 forest plan as a Management Indicator Species. The cerulean warbler holds the number one ranking in the Ohio State Wildlife Action Plan's conservation status rankings for avian species of greatest conservation need (SGCN). The species suffered range-wide decline of 3.04% per year from 1966-2000 (Link & Sauer 2002), and breeding bird survey (BBS) trends show that the species has continued to decline across its U.S. range, albeit at a slower rate of 1.31%, over the period of 2005-2015 (Sauer et al. 2017). Unfortunately, BBS data also indicate that declines across Ohio have been far steeper and are accelerating: the species declined by 4.22% per year over 1966-2015 and 4.91% per year from 2005-2015 (Sauer et al. 2017).

Cerulean warblers are dependent upon interior forests with complex old growth features, including heterogeneous canopies, small gaps, and large, tall trees with extensive grapevine cover. Large white oaks (*Quercus alba*) are the preferred and most important nesting sites for the species. During the breeding season, Cerulean Warblers are most closely associated with old, structurally complex forest stands (>80-100 years) that have features typical of old uneven-aged, steady-state forests (Bakermans and Rodewald 2009). Steady-state forests, which are typically >100 years old, are characterized by gap dynamics and natural disturbance processes that result in complex vertical strata and a heterogeneous canopy. One of the hallmarks of high-quality habitat for Cerulean Warblers is a relatively open and heterogeneous forest canopy that often includes canopy gaps of ~40-100 m^2 in size [1/100th to 1/40th an acre] and well-developed vertical strata (Roth and Islam 2007, Bakermans and Rodewald 2009, Hartman et al. 2009, Bakermans et al. 2012, Boves et al. 2013a, Kaminski and Kamal 2013). Canopy gaps of the size preferred by Ceruleans might be naturally expected to occur with natural disturbances including (but not limited to) treefalls in older forests with large trees and abundant grapevines, windstorms, icestorms, wildfire, or beaver activity.

The species requires specific old-forest features that are missing from many mature forests regenerated from stand-replacing disturbances, such as clearcutting (Rodewald Report). White oak (*Quercus alba*) stands out as the most consistently preferred tree species (Newell and Rodewald 2011, Boves et al. 2013a, Newell et al. 2014, Wagner and Islam 2014, Barnes et al. 2016, Nemes and Islam 2017). One especially striking pattern in southeast Ohio was that Ceruleans strongly avoided foraging or placing nests in Northern red oak (*Quercus rubra*) (Newell and Rodewald 2011, Boves et al. 2013a, Newell et al. 2014), which also was negatively associated with nest survival (Newell and Rodewald 2011).

For cerulean warbler management on the Wayne National Forest, the Rodewald Report recommends the following:

- "*Maintain or encourage heavily-forested landscapes*. […] Because most land in the WNF region is privately owned, public lands, including state and national forests, bear disproportionate responsibility for ensuring that landscapes remain heavily forested with significant cover in late-seral stages."
- "*Allow forests to mature and naturally develop old-forest features*. Given sufficient time to regenerate (usually >100 years, depending on site conditions), many forests will

develop the structural attributes required by Cerulean Warblers. Among the features that are expected to develop after forests reach steady-state, gap-dynamic phases are heterogeneous canopies, well-developed vertical strata, large diameter trees (>38 cm dbh), and grapevines – all of which promote high densities and successful reproduction of Cerluean Warblers."

- "*Retain white oaks whenever possible and promote oak-hickory forests*. […] Unless [white oak] recruitment problems are addressed, continued harvesting of mature white oak trees is likely to exacerbate regional declines of the species." Due to poor oak regeneration on mesic sites – which are most preferred by Cerulean Warblers, "managers may consider foregoing harvest in these locations. Within harvested stands, managers should make every effort to retain white oak trees and, as possible, avoid removing overstory oaks after shelterwood harvesting."
- "*When appropriate, use silviculture to create suitable structural conditions*. […] specific harvest prescriptions (e.g., single tree and group selection) and timber stand improvement practices (e.g., thinning and crop tree release) also may be able to create features typical of old, uneven-aged forests." […] "Overall, the extent to which Ceruleans will respond positively to harvesting depends on the number, size, and species of overstory trees that are retained. In cases where overstory trees are removed, as is typically done 5-10 years after initial harvest of shelterwoods for example, the sites would no longer be suitable for Cerulean Warblers." […] "In cases where there is wide latitude in choice of harvest location, managers should avoid harvesting older forests with canopy gaps and/or those on northeast-facing slopes, because these tend to be most heavily used by Cerulean Warbler." […] "Until sufficient regeneration of white oak is achieved, continued harvest of mature trees will likely exacerbate declines in the state."

II. American Black Bear

The American black bear is currently one of three Ohio state endangered mammal species (ODNR 2018a), and is listed in Ohio's State Wildlife Action Plan as a Mammal Species of Greatest Conservation Need (SGCN). Once common in Ohio, black bear were extirpated from the state during the mid- to later-1800s due to extensive deforestation and unregulated hunting (ODOW 2015; ODOW Pub. 378 (R905)). Black bear are slowly making a comeback in southeast Ohio, with 135 sightings involving an estimated 88 individual black bears reported to the Ohio Division of Wildlife (ODOW) in 2014 (ODOW 2015). These sightings are often of immature males seeking new territory, although there is thought to be a small reproducing population in the state (ODOW Pub. 378 (R905)).

White oak (*Quercus alba*) acorn availability is the single most important driver of black bear population growth in the southern Appalachian region[1] (Azad 2017; Vaughan 2002; Prange

[1] Southeastern Ohio and the southern Appalachians share many ecological similarities. The Wayne National Forest and much of the southern Appalachians fall within the same U.S. Forest Service Ecoregion Province, 221 "Eastern Broadleaf Forest." Southeastern Ohio and the southern Appalachians are also part of the same U.S. Environmental Protection Agency (EPA) Level II Ecoregion, 8.4 "Ozark, Ouachita-Appalachian Forests." For further context at a finer scale, the Wayne also falls within U.S. Forest Service Subregion, Section 221E "Southern Unglaciated Allegheny Plateau," and its acreage is divided among the still smaller Forest Service Subsections 221Eb "Teays Plateau," 221Ec "Ohio Valley Lowland," 221Ed "East Hocking Plateau," and 221Ef "Western Hocking Plateau." And, within the EPA Ecoregion framework, the Wayne National Forest further falls within EPA Level III Ecoregion

Report: "Simply put, mature, mast-bearing oaks – especially white oaks – are the driving force behind black bear population dynamics and movements."). Most importantly in this region, successfully reproducing black bear populations will need large expanses of mature interior forest (Rogers and Allen 1987; Smith et al. 2016; Prange Report) that contain high levels of white oak mast (Azad 2017; Prange Report), mature oak forest-dependent squawroot (*Conopholis americana*) (Vaughan 2002; Seibert and Pelton 1994; Prange Report), large (>33 in dbh) hollow oak trees for den sites (Ryan and Vaughan 2004; Vaughan 2002; Oli et al. 1997; Prange Report), and significant amounts of downed coarse woody debris that hosts food insects (Beeman and Pelton 1980; Bull et al. 2001; Prange Report). Older stands, which support high levels of hard mast and moderate levels of soft mast, should be maintained to sustain population growth of black bears in the Appalachians (Reynolds-Hogland et al. 2007; Prange Report). Simultaneously, the acreage of intermediate stands (10-25 years) – which result from clearcutting – support very low levels of both hard mast and soft mast, should be minimized (Reynolds-Hogland et al. 2007; Prange Report).

III. Old Growth, Carbon, and Mycorrhizal Networks

A. Above-Ground Carbon

Carbon sequestration and storage potential is highest when old growth forests are allowed to recover. This is because old growth forests in the eastern United States[2] are superior to all other forest age classes for both carbon sequestration and carbon storage (see McGarvey et al. 2015; Liebman et al. 2017; Stephenson et al. 2014; Burrascano et al. 2013; Lichstein et al. 2009). Old growth forests of the eastern United States sequester and store significantly more carbon than both young and mature forests (McGarvey et al. 2015; Burrascano et al. 2013) because they generally host significantly more large living trees, above ground biomass, and dead wood (McGarvey et al. 2015; Burrascano et al. 2013), because they have been shown to have lower soil respiration rates than younger forests (Liebman et al. 2017), and because the rate of tree carbon accumulation increases continuously as trees grow in size (Stephenson et al. 2014). The transition of young and mature secondary forests in the eastern United States to old growth status is an especially promising opportunity to increase carbon sequestration and storage (Lichstein et al. 2009).

The assessment report should discuss anticipated carbon sequestration and storage in old growth forests (or those evolving toward old growth status) and compare it to anticipated carbon sequestration and storage in forests undergoing intensive timber harvesting as anticipated on the Wayne in the next several years.[3] Note that an analysis of U.S. public timberlands found that a

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70 "Western Allegheny Plateau," and its acreage is divided among the still smaller EPA Level IV Ecoregions 70a "Permian Hills," 70b "Monongahela Transition Zone," and 70f "Ohio/Kentucky Carboniferous Plateau."

[2] Old growth forest habitat dominated the vast majority of the eastern United States prior to European settlement. Staeyert and Knox estimate that 70% of the original eastern old growth remained in 1850, only 7% in 1920, and an insufficient amount to include as a land-use category in 1992. Staeyert, L.T. and R.G. Knox, "Reconstructed historical land cover and biophysical parameters for studies of land-atmosphere interactions within the eastern United States," *Journal of Geophysical Research* 113, at p. 6 (2008).

[3] The WNF's current (FY 2018) timber target level is more than 422% the size of historical target levels (1997-2017) (See PSTAR [Periodic Timber Sale Accomplishment Reports] data for WNF, FYs 1997 – 2018, available at: https://www.fs.fed.us/forestmanagement/products/ptsar/index.shtml). Also, the Executive Order issued by President

"no timber harvest" scenario eliminating harvests on public lands would result in an annual increase of 17-29 million metric tonnes of carbon (MMTC) per year between 2010 and 2050—as much as a 43% increase over current sequestration levels on public timberlands and would offset up to 1.5% of total U.S. GHG emissions (Depro et al. 2008). In contrast, moving to a more intense harvesting policy similar to that which prevailed in the 1980s may result in annual carbon losses of 27-35 MMTC per year between 2010 and 2050. These losses would represent a significant decline (50-80%) in anticipated carbon sequestration associated with the existing timber harvest policies (Depro et al. 2008).

B. Soil Carbon; Old Forest Mycorrhizal Resiliency

It should be noted that the estimates of Depro et al. 2008 are likely overly conservative because the study did not take soil carbon fluxes into consideration. This is significant because soil carbon represents roughly 60% of forest carbon storage in temperate forests (James and Harrison 2016). And, harvesting substantially disrupts soil carbon storage, which results in significant carbon emissions. In particular, a recent meta-analysis of existing literature demonstrates that harvesting results in significant carbon losses in the organic horizons of forest Alfisols (-12%) and Ultisols (-66%), as well as in the mineral soils of Ultisols (-11.9%) (James and Harrison 2016).[4] And, these soil carbon findings are themselves likely overly conservative: they do not account for carbon losses in soils deeper than approximately 14 inches, which is a recognized major gap in the scientific literature (James and Harrison 2016). The recovery period of soil C following harvest depends upon soil type and takes at least 60 years in many production forests (James and Harrison 2016).

The FS should consider the value of old forests in relation to their intact soils with highly developed and well-established mycorrhizal structure. These intact and structured soils are important for carbon storage and sequestration purposes, and for forest health and resiliency in the face of climate change. The 2006 Forest Plan did not account for mycorrhizal relationships, and the 2006 EIS contained only passing reference to the subject (2006 FEIS, Appendix D-8 to D-9). Subsequent emerging science has demonstrated the foundational role of mycorrhizal networks – dubbed the "Wood Wide Web" – in forest ecology.[5]

Mycorrhizal networks (MNs) influence the survival, growth, physiology, competitive ability, and behavior of the plants and fungi linked in the network (Gorzelak et al. 2015). MNs enable networked trees to share nutrients, carbon, water, electrical signals, and biochemical information.

Trump on December 21, 2018 entitled "Promoting Active Management of America's Forests, Rangelands, and other Federal Lands to Improve Conditions and Reduce Wildfire Risk" (E.O.) directs the Forest Service to sell 3.8 billion board feet (BBF) of timber in 2019, which is 19 percent more than the 3.2 BBF it sold in 2018 and 31 percent more than the 2.9 BBF sold in 2017.

[4] The major soil types in the Wayne's region appear to be Alfisols (Udalfs) and Ultisols (Udults). See USDA, NRCS "Distribution Maps of Dominant Soil Orders," available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/maps/?cid=nrcs142p2_053589

[5] Mycorrhizal fungi are obligate symbionts with all forest tree species, where they scavenge soil nutrients and water from the soil in exchange for photosynthate from the tree. Mycorrhizal fungi are considered the primary vectors for plant carbon to soils and, conversely, the primary vectors of soil nutrients to plants (Simard 2010). Plants invest photosynthate carbon in mycorrhizas (instead of building their own roots) because the small and profuse hyphae have 60 times more absorptive area than fine roots (Simard 2010).

Plant behavioral responses that have been measured thus far include rapid changes in mycorrhizal colonization, root growth, shoot growth, photosynthetic rate, foliar nutrition, foliar defense chemistry and defense response to pest pressures (Gorzelak et al. 2015). And, large old trees tend to serve as especially important network "hubs" in MNs, as they have been found to have more numerous and robust mycorrhizal connections than younger, smaller trees (Beiler et al. 2015). The presence of large trees can influence the ambient temperature and moisture of local environments, modify local edaphic conditions (soil pH, nutrient status, etc.) and sustain rich assemblages of EMF species that provide a diverse inoculum source to regenerating seedlings (Beiler et al. 2015). The diverse capacities amongst mycorrhizal species for mobilizing nutrients from soil mineral and organic matter insure a host tree against environmental stresses (Spake et al. 2016). At the ecosystem level, mycorrhizal fungi are not only important for nutrient cycling, but high mycorrhizal fungal species diversity can facilitate resistance to disease and drought, and contribute to net primary productivity, mineral weathering and soil carbon storage (Spake et al. 2016). And, the presence of robust MNs is important for seedling establishment and growth. When seedlings become linked into a MN with veteran trees, they gain access to hydraulically lifted water and patchily distributed nutrients that might otherwise be limiting resources (Beiler et al. 2015; Gorzelak et al. 2015).

The FS should also note that MNs generally fall under two separate categories: Ectomycorrhizal (ECM) fungi and Arbuscular (AM) fungi. These two classes of MN have some fundamental differences and appear to compete with one another (Johnson et al. 2018).[6] Interestingly, species such as oak, hickory, and beech are served by ECM networks, whereas maples and tulip poplars are served by AM networks. Red oak (*Quercus rubra*) seedlings have been found to benefit from the mycorrhizal networks of nearby chestnut oaks, but did not benefit when placed near the arbuscular MNs of maples (Dickie et al. 2002). An examination of an old growth oak-hickory forest in southern Indiana found that opposing mycorrhizal associations (AM saplings near ECM trees and ECM saplings near AM trees) had significant inhibition at distances up to 13 m, whereas sapling inhibition only extended to ~1 m for in-network species (i.e., ECM saplings near ECM trees) (Johnson et al. 2018). ECM trees typically produce slow-decaying leaf litters with lower nutrient content relative to co-occurring AM trees, resulting in distinct biogeochemical syndromes or nutrient economies. Because ECM fungi possess the ability to mine nutrients from detritus, whereas AM fungi do not, ECM trees may be most competitive in their own soils (Johnson et al. 2018). By implication, the removal of mature ECM trees and the corresponding disruption of ECM networks may facilitate AM invasion and succession from oak-hickory to maple-tulip ecosystems.

ECM networks are especially sensitive to intensive harvesting regimes. Research has shown that ECM fungi decline overall, regardless of ecozone, due to harvesting (Wilhelm et al. 2017). In contrast, arbuscular mycorrhiza populations increased in harvested plots likely due to their common symbioses with successional plant cover (Wilhelm et al. 2017). Soil compaction from

[6] And, the distinction between ECM and AM networks has significant carbon sequestration and storage implications. AM systems have lower soil C:N ratios than those dominated by ECM, indicating fundamentally different nutrient cycling regimes, resulting in more carbon sequestered in EMF forests (Averill 2014). Global data sets have shown that soil in ecosystems dominated by ECM plants contains 70% more carbon per unit nitrogen than soil in ecosystems dominated by AM-associated plants (Averill 2014). The effect of mycorrhizal type on soil carbon is independent of, and of far larger consequence than, the effects of net primary production, temperature, precipitation and soil clay content (Averill 2014).

harvesting profoundly affects ECM fungi abundance, structure, and function; it therefore raises concerns regarding forest productivity, juvenile tree regeneration and long-term ecosystem functioning (Hartmann et al. 2014). The disruption and diminishment of ECM networks due to harvest-induced soil compaction has been shown to be substantial and long-lasting, and recovery of a soil from severe compaction may take centuries rather than decades (Hartmann et al. 2014; Hartman et al. 2012). Data shows that clearcut harvesting is especially destructive of ECM fungal networks (Hartman et al. 2012). A meta-analysis of harvesting impacts on ectomycorrhizal fungi found that it generally takes 90 years for ectomycorrhizal species richness to approach that found in undisturbed old growth forests (Spake et al. 2015).[7] The slow recovery of species richness for some functional groups essential to ecosystem functioning makes old-growth forest an effectively irreplaceable biodiversity resource (Spake et al. 2015).

[7] The same meta-analysis found that the best estimate for lichen species richness was 180 years to reach 90% of undisturbed forest values (between 140 years and never for full recovery), and that saproxylic beetles had a best estimate of about 60 years to reach 90% of old-growth values (between 10 years and never for full recovery).