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Submitted by email to eastern-divide@fs.fed.us:

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Re: Scoping comments on Eastern Divide Insect and Disease Project Phase II

Dear Mr. McKeague,

On behalf of the Virginia Wilderness Committee and the Southern Environmental Law Center, I submit these comments responding to the May 8, 2019 scoping letter for the proposed Eastern Divide Insect and Disease Project Phase II.

These comments summarize the many concerns we have discussed since you first described plans for a gypsy moth project in 2017. We continue to have significant concerns that this proposal does not comply with the requirements of the National Environmental Policy Act, National Forest Management Act, the Jefferson National Forest Plan, the Farm Bill Insect and Disease Infestation Categorical Exclusion, and various regulations.

We understand the Forest Service's desire to use Categorical Exclusions (CEs) and do not oppose proper use of CEs. Proper use of CEs requires that projects: (1) fit squarely within the language and intent of the CE; (2) otherwise comply with the Forest Plan, regulations, and other laws; and (3) provide enough information to demonstrate that compliance.

We also understand the benefit of the Farm Bill' Insect and Disease CE, which helps the Forest Service develop and approve priority projects that address an insect and disease problem more swiftly than normal. Using the Insect and Disease CE requires that the Forest Service to strictly adhere to the explicit requirements and clear intent of the CE. That has not happened.

In many ways, this project has been playing out in reverse. In 2017, the District informed the public that it would be proposing a project in two phases that would use regeneration harvest to ostensibly address gypsy moth threats. The theory behind Phase I and Phase II was that gypsy moth threatened the proposed harvest areas and regeneration harvest would somehow restore ecological integrity to the damaged and/or imperiled stands. Shockingly, in the nearly two years since we began discussing this project, the District did not complete stand exams or other field surveys to confirm whether the units were in fact damaged or threatened by gypsy moth. Then, without field data to inform the purpose and need of the alleged restoration project, the District decided that clearcut harvests of 2,500+ acres were needed. And that all of this would be done under the Insect and Disease CE to avoid the need for full environmental review and public participation.

Because the District decided on a course of action without the basic information needed to make these decisions, the District is now in the position of trying to make the project fit into the Farm Bill CE. As would be expected, the theories for Phase II have shifted over time. At various points, we were told that while these stands did not face the same threat of gypsy moth defoliation and damage as those stands in Phase I, this project was nonetheless equally as urgent. Later we were told that Phase II was in fact about increasing the resiliency of these stands to a future gypsy moth infestation. More recently, it was explained that Phase II is actually about reducing the risk of gypsy moth defoliation in these stands.

The big problem, however, is that neither the on-the-ground conditions nor the best available science support those theories. To support this project, the District embraced Kurt Gottschalk's <u>Silvicultural Guidelines for Forest Stands Threatened by the Gypsy Moth</u> and offered it as the "best available scientific information" to support this proposal. Gottschalk's guidelines, however, are not the best available science. They had not been tested at publication in 1993 and in the 26 years since then, studies have largely shown the guidelines to be ineffective. Gottschalk himself has published a good deal of research and literature that belies the 1993 guidelines.

To better understand the 1993 guidelines and the best available science on gypsy moth, we hired Rose-Marie Muzika, Ph. D., to analyze this project and provide her professional opinion regarding whether the best available scientific information informs and supports the proposal. Dr. Muzika is a peer of Gottschalk and an expert in the field of forest health and forest disturbance ecology. For decades, she has, conducted research and published manuscripts—often with Gottschalk—describing gypsy moth population dynamics, the ecological effects of gypsy moth, mortality agents of oak, and secondary pests of oaks.

After reviewing all of the project documents, Dr. Muzika helped us gather the necessary field data that the Forest Service had not. As you will read in her attached Declaration and in these comments, she has concluded that this proposal contradicts the best available scientific information regarding ecological integrity in an area generally infested by gypsy moth. In her professional opinion, the proposed regeneration treatments using a clearcut with reserves method would not reduce the risk or extent of, or increase resilience to gypsy moth.

As a result, the District cannot rely on the Insect and Disease CE for this project, which is—at its core—an ordinary timber project to promote oak regeneration. If the District wishes to pursue this project, it must prepare an Environmental Assessment.

I. <u>Forest Service's proposal</u>

This is the second phase the Eastern Divide gypsy moth project. The District already approved and is implementing Phase 1, which includes over 1,250 acres of regeneration logging using the clearcut with reserves method. The District is also proposing approximately 91,000 acres of prescribed fire across the District.

With Phase 2, the District proposes to log another 1,366 acres using the clearcut with reserves method to "address forest health concerns resulting from past gypsy moth defoliation and current gypsy moth presence."[1] The District contends this will "build resilience" because, while the proposed units "are not under imminent threat of defoliation," they are expected to be defoliated by gypsy moth in the next 1 to 3 years. According to the District, this mortality will cause widespread oak mortality in these stands.[2] And because there is reportedly little or no oak regeneration in the understory of these stands, the District further theorizes that the oak component will then be lost as composition shifts away from oak.

Accordingly, the District proposes to cut living oaks now while they can still stump sprout. This is "designed to regenerate most of the areas to maintain a significant oak component in the future stands."[3] The District wants the resulting oak stump sprouts to "succeed in dominating the regenerating stand."[4]

In conversation, the District reported it chose the proposed units by applying a "coarse filter" to identify: (1) mature/old trees, (2) in oak-dominated stands, (3) that are within 1/2 mile of an existing road. In scoping, the District states that proximity to defoliation in 2016 and 2017 and observed impacts from gypsy moth were also considered, as well as logging feasibility and slope considerations. [5]

While these stands are composed of 50-75% oak species, the District also plans to cut non-oak species "when required for stand management" to give the oak stump sprouts the best chance to succeed in dominating the regenerated stand.

II. Project Area conditions

On July 17, 2018, the District issued a pre-scoping letter stating that the counties containing the project area had experienced gypsy moth defoliation in 2016 and there were anecdotal reports of defoliation in 2017, although it was not documented through aerial surveys.[6]

In order to understand the basis for the District's predictions regarding gypsy moth and the proposed regeneration logging in response to gypsy moth threats, SELC filed a Freedom of

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[1] Scoping letter at 1.
[2] *Id.*
[3] *Id.* at 3.
[4] *Id.* at 4.
[5] *Id.* at 3.
[6] On June 24, 2019—the scoping comment deadline—the Forest Service finalized its response to SELC's FOIA request. This response include 572 pages of additional documents, including stand examinations for units in the Caseknife, Tunnel Hollow, Gatewood Reservoir, and Bromley Hollow working areas. The District is presumably still working on exams in the Dismal, Peak Creek, and Walker Mountain areas. This timeframe did not allow Dr. Muzika or SELC time to review the documents or include site-specific comments here. We look forward to reviewing these documents, as well as information related to stand exams not yet completed, and intend to provide additional site-specific comments.

Information Act (FOIA) request on October 29, 2018. SELC requested the entire project file, as well as any other project documents regarding gypsy moth, old growth, or other natural resources in the project area. On December 4, 2018, we received 4 documents, including 2 sets of comments received in August 2018, a November 6, 2018 email attaching a screen shot of trap counts in the general area, and several maps showing known old growth in the project area.[7]

On several occasions over the past year, the District confirmed that it had not done any stand exams in the proposed units. On May 13, 2019, SELC updated our FOIA request, asking for any additional documents in the project file. On May 18, 2019, SELC specifically requested the common stand exams for Phase 2. Finally, at an open house meeting with the District on May 30, 2019, we learned that the District had started conducting stand exams one day earlier. Obviously, this stand data being collected in 2019 was not used to develop the project in 2018.

While the counties containing the project area have experienced some gypsy moth defoliation in the past, the District has provided little to no information about the actual conditions of these units recently or currently.

This lack of information presented a real problem for members of the public who want to assess whether this large, intensive "gypsy moth" logging project makes sense and whether use of the Insect and Disease Infestation CE would be appropriate. Without field data, we had no way of knowing, for example: whether gypsy moth had defoliated these stands previously; if so, how many rounds of recent defoliation had occurred; the degree of damage and/or mortality that resulted from previous gypsy moth defoliation; the overall health of these stands and vigor of trees within them; or the species composition within the stands.

Since the District had not done this work before developing the project and proposing silvicultural prescriptions, SELC was compelled to hire a consultant, Jessica Bier, to perform field surveys. This fieldwork was guided by Dr. Rose-Marie Muzika, who advised on survey methods and reviewed data. From April through June 2019, Ms. Bier surveyed plots within all seven working units of this project.[8] Her primary objectives were to (1) assess impacts from defoliation that may have occurred in recent years (e.g., crown damage, mortality); and (2) determine the levels of current gypsy moth populations in the areas.[9]

Ms. Bier recorded tree species composition, crown condition (as a measure of vigor), and the presence of gypsy moth egg masses and/or defoliation in 131 plots throughout the project area. Her findings indicate that the units are in good health overall, gypsy moth presence is low, and there is no scientific basis for the District to predict outbreak, defoliation, or mortality in the next 1-3 years:

- In many units, there is no notable damage or mortality, or it is minimal. It is unlikely that defoliation previously occurred in these units. In units with damage, it is mostly low to moderate levels.

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[7] See attached.
[8] J. Bier Eastern Divide Insect and Disease Project Phase II, Jefferson National Forest, Summary of fieldwork at 1 ("Bier report").
[9] *Id.*

- 77% of the 870 overstory plot tree crowns evaluated were classified as Good vigor, with extensive lateral branching, absent or minimal dieback, no or minor wounds/canker, little or no epicormic branching, and healthy foliage. 16% were classified as Fair vigor, and only 1% were classified as Poor vigor. 6% were dead.

- Oaks dominate the overstory in most units, although white and yellow pine are dominant in the overstory and/or midstory in some portions of some units. Other hardwood species are present, including sourwood, red maple, blackgum, hickory, and tulip poplar.[10]

We also reviewed gypsy moth trap counts near the 7 working areas and aerial surveys of defoliation from 2016-2018.[11]

III. <u>This project is not eligible for the Farm Bill Insect and Disease CE.</u>

Not surprisingly, the Insect and Disease Infestation Categorical Exclusion (CE) applies only to an "insect and disease project."[12] Additionally, it must be a "priority project[]" that is "designed to reduce the risk or extent of, or increase the resilience to, insect or disease infestation in the area."[13, 14] Moreover, the insect and disease project must also be a "forest restoration treatment that … considers the best available scientific information to maintain or restore the ecological integrity[.]"[15] This includes maintaining or restoring structure, function, composition, and connectivity…."[16]

The project must also "maximize[] the retention of old growth and large trees, as appropriate for the forest type, to the extent that the trees promotes stands that are resilient to insects and disease[.]"[17] In addition, the project must also be developed and implemented collaboratively. Of course, the project must also comply with the forest plan.

A. <u>The best available scientific information does not support this proposal.</u>

In light of the District's intent to rely on the Insect and Disease CE provided in the 2014 Farm Bill, SELC asked Dr. Rose-Marie Muzika to analyze this project and provide her professional opinion regarding whether the best available scientific information informs and supports the project. Dr. Muzika is an expert in the field of forest health and forest disturbance ecology.[18] For over 25 years, she has conducted research in forest health, forest disturbance

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[10] *Id.* at 3.
[11] Declaration of Rose-Marie Muzika, Ph.D. at ¶¶ 17-22 ("Dr. Muzika declaration").
[12] FSH 1909.15 chapter 30, section 32.3(3).
[13] 16 U.S.C. 6591b(b)(1).
[14] FSH 1909.15 chapter 30, section 32.3(3).
[15] 16 U.S.C. 6591b(b)(1)(B); FSH 1909.15 chapter 30, section 32.3(3).
[16] *Id.*
[17] 16 U.S.C 6591b(1)(A).
[18] Dr. Muzika declaration at ¶¶ 3-10.

ecology and applied ecology.[19] In that time, she has published many manuscripts that describe gypsy moth population dynamics, the ecological effects of gypsy moth, and mortality agents of oak, and secondary pests of oaks. [20] Dr. Muzika worked with Kurt Gottschalk on several of these manuscripts.[21]

To evaluate the gypsy moth issues relevant to the best available science requirement of the Insect and Disease CE requirements, Dr. Muzika reviewed all publicly-available project documents for the project, as well as documents that SELC received in response to Freedom of Information Act requests by June 17, 2019 (one week before deadline for these comments).[22] She also reviewed the basic requirements of the Insect and Disease Categorical Exclusion provided for in the Farm Bill of 2014. [23]

Dr. Muzika also reviewed field data that Jessica Bier collected in the project area with guidance from Dr. Muzika. [24] In addition, she also reviewed trap count data provided by the Slow the Spread Foundation and aerial defoliation data provided by the Virginia Department of Forestry. [25]

Based on all of this information and her expertise in the field, it is Dr. Muzika's professional opinion that the proposal contradicts the best available scientific information regarding ecological integrity in an area generally infested by gypsy moth. [26] For the following reasons, Dr. Muzika does not believe the 1,366 acres of proposed regeneration treatments using the clearcut with reserves method would reduce the risk or extent of, or increase resilience to gypsy moth.[27]

1. The best available science regarding gypsy moth does not support Gottschalk's Silvicultural Guidelines.

The Forest Service contends that the proposed regeneration logging "are based on the findings in Silvicultural Guidelines for Forest Stands Threatened by Gypsy Moth by Kurt W. Gottschalk."[28] Gottschalk's recommendations, however, were largely untested when they were published in 1993 and "subject to modification using professional judgment to make them fit

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19 *Id.* at ¶ 6.
20 *Id.* at ¶ 7.
21 *Id.*
22 *Id.* at ¶¶ 11-12. The Forest Service finalized its response to a May 15, 2019 FOIA request on Monday, June 24, 2019. This occurred a few hours before the deadline for these comment. Consequently, neither Dr. Muzika nor SELC had time to review the 572 pages of additional documents, which include stand examinations for some of the working units. We look forward to reviewing these documents, as well as information related to stand exams not yet completed. We intend to provide additional site-specific comments when that information is available.
23 Dr. Muzika declaration at ¶ 13.
24 *Id.*at ¶ 20.
25 *Id.* at ¶ 17.
26 *Id.* at ¶ 55.
27 *Id.*
28 *Id.*at ¶ 31.

specific stands or management objectives." [29] Twenty-six years later, "[d]espite decades of research and extensive implementation," there is still "uncertainty about how successful these established [silvicultural] approaches are for limiting damage and mortality" from gypsy moth.[30] In short, Gottschalk's guidelines remain largely unsupported by science.[31]

The 1993 Silvicultural Guidelines highlighted stand susceptibility and stand vulnerability as determinants of potential impacts of gypsy moths on forests.[32] Gottschalk defined stand susceptibility as the probability of defoliation, given gypsy moth are present in a stand.[33] He defined stand vulnerability as the probability of tree mortality, given gypsy moths have defoliated a stand.[34] Decreasing stand susceptibility and vulnerability are objectives of silvicultural treatments directed at mitigating gypsy moth impacts.[35]

a. Silviculture does not reduce susceptibility of oak-dominated ecosystems to gypsy moths.

Theoretically, silviculture could reduce susceptibility of oak-dominated ecosystems to gypsy moths by (A) removing preferred host tree species; (B) improving conditions for gypsy moth predators and pathogens; and (C) increasing the health and vigor of oaks following treatment. In practice, however, Dr. Muzika reports that silviculture has not succeeded in reducing susceptibility to gypsy moths.

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[29] *Id.*at ¶ 32 (citing K.W. Gottschalk 1993 at 1 ("Most of the prescriptions have not been extensively tested. They are guides subject to modification using professional judgment to make them fit specific stands or management objectives."); 38 ("[T]hese results have not been extensively tested…")).
[30] *Id.* (citing Muzika 2017 at 3421, 3429 ("Despite the thoroughness of the development of [Gottschalk's 1993] guidelines, there have been few evaluations of them."); Muzika & Liebhold 2000 at 98).
[31] *Id.* (citing R.M. Muzika & A.M. Liebhold, A Critique of Silvicultural Approaches to Managing Defoliating Insects in North America, 2 Agricultural and Forest Entomology 97, 98 (2000) ("Examples demonstrating the use of silviculture to successfully mitigate the impacts of defoliating insects are…limited.") ("Muzika & Liebhold 2000"); R.M. Muzika Opportunities for Silviculture in Management and Restoration of Forests Affected by Invasive Species, 19 Biological Invasions 3419, 3429 (2017) ("Despite the thoroughness of the development of [Gottschalks' 1993] guidelines, there have been few evaluations of them.") ("Muzika 2017"); C. Schweitzer et al., Proactive Restoration: Planning, Implementation, and Early Results of Silvicultural Strategies for Increasing Resilience against Gypsy Moth Infestation in Upland Oak Forests on the Daniel Boone National Forest, Kentucky, 112 J. of Forestry 401, 402 (2014) ("A variety of both regeneration and intermediate stand treatments, …, need to be tested for their efficacy in mitigating for the susceptibility and vulnerability to gypsy moth and oak decline.") ("Schweitzer et al. 2000")).
[32] Dr. Muzika Declaration at ¶ 33 (citing Gottschalk 1993 at 7-8).
[33] *Id.* (citing Gottschalk 1993 at 7).
[34] *Id.* (citing Gottschalk 1993 at 8).
[35] *Id.* (citing Muzika & Liebhold 2000 at 98).

Forest stands that are most susceptible to defoliating insects are those in which preferred host tree species are abundant.[36] The proportion of a stand comprised of preferred host tree species is a powerful predictor of defoliation potential.[37] Oaks, in general, are highly preferred by gypsy moths.[38] Throughout their range in North America, gypsy moths are most commonly defoliating red oaks and white oaks.[39] Reducing susceptibility thus tends to focus on reducing the prevalence of preferred host trees within a stand.[40] The most common silvicultural method for doing so is selectively thinning oak and other preferred host species.[41]

While the precise interrelationship of gypsy moths and oaks at large spatial scales remains undefined, there is scant evidence that changing stand composition through silviculture has any effect on gypsy moths.[42] Changing stand composition to one with a reduced density of preferred species and a higher density of non-preferred species renders a treated stand less appetizing to gypsy moths. [43] However, "it is not possible to reduce the actual spread of defoliating insect populations [through silviculture]."[44] In other words, even if gypsy moth density in a treated stand is decreased by reducing the density of highly preferred oak trees, gypsy moth spread into other areas is not reduced. There is not a "net loss" of gypsy moth density across the landscape.

There are several possible explanations for this: (A) the scale at which silviculture is practiced – forest stands – is too small to affect processes that control gypsy moth spread across

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[36] *Id.* (citing Gottschalk 1993 at 7; Guo et al., Tree Diversity Regulates Forest Pest Invasion, 116(15) Proceedings of the National Academy of Sciences 7382, 7385 (2019) (finding greater tree species diversity diminished insect invasion success by reducing the availability of susceptible species)).
[37] *Id.* at ¶ 35 (citing C.B. Davidson et al., Tree Mortality Following Defoliation by the European Gypsy Moth (*Lymantra dispar* L.) in the United States: a Review, 45(1) Forest Science 74, 75 (1999) ("Davidson et al. 1999"); C. Hartl-Meier et al., Effects of Host Abundance on Larch Budmoth Outbreaks in the European Alps, 19 Agricultural and Forest Entomology 376, 376 (2017) (documenting the correlation between outbreaks of larch budworm and availability of their preferred host tree species, the European larch.)).
[38] *Id.* (citing C.B. Davidson et al., (Tree Mortality Following Defoliation by the European Gypsy Moth (Lymantra dispar L.) in the United States: a Review, 45(1) Forest Science 74, 75 tbl. 1 (1999) ("Davidson et al. 1999")).
[39] *Id.* (citing Haynes et al., Geographic Variation in Forest Composition and Precipitation Predict the Synchrony of Forest Insect Outbreaks, 127(4) Oikos 634, 635 (2018) (citation omitted) ("Haynes et al. 2018")).
[40] Dr. Muzika Declaration at ¶ 35 (citing Muzika & Liebhold 2000 at 99).
[41] *Id.* (citing Muzika & Liebhold 2000 at 99; Muzika 2017 at 3424; Davidson et al. 1999 at 75).
[42] Dr. Muzika Declaration at ¶ 36 (citing Muzika & Liebhold 2000 at 101 ("Actual empirical evidence to suggest that management aimed at changing species composition could be used to successfully control defoliators is scant.")).
[43] *Id.* (citing Muzika & Liebhold 2000 at 103 ("There is little or no evidence that silviculture can be used for altering susceptibility other than by eliminating host species.")).
[44] *Id.* (citing Muzika & Liebhold 2000 at 101).

a landscape;[45] (B) gypsy moth dynamics are controlled by a complex web of biological, chemical, and physical processes[46]; and (C) irrespective of the gypsy moth, landscape-scale oak dynamics in eastern North America are controlled by numerous factors including disturbance, climate, herbivory and land use.[47]

Accordingly, there is no compelling evidence that the ecological integrity of the area surrounding the treated stands (i.e., the surrounding landscape) is improved with silvicultural treatment.

Additionally, there is no evidence that silviculture reduces susceptibility to gypsy moths by improving conditions for gypsy moth predators and pathogens. In 1998, Dr. Muzika, Kurt Gottschalk, and Andrew Liebhold (Research Entomologist for the Forest Service's North Research Station) published results from a long-term study of the effects of presalvage and sanitation thinning on gypsy moth dynamics. They tested how thinning affected changes in gypsy moth egg mass density, patterns of within-generation gypsy moth survivorship, gypsy moth mortality caused by various parasitoids and pathogens, forest vegetation following thinning, and the long-term impact of gypsy moth populations.[48]

In stands where oak accounted for less than 50% of the basal area, they applied a sanitation thinning. [49] Objectives were to reduce total stand basal area and preferentially remove species preferred by the gypsy moth (e.g. oak). [50] In stands where oak accounted for more than 50% of the basal area, they applied a presalvage thinning, with the objective of removing trees in poor condition regardless of species or their preference by gypsy moth.[51]

They then examined results from 2 years of severe defoliation (>60% of canopy) on 3 pairs of stands (each pair with 1 thinned and 1 unthinned/control stand). One pair had

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[45] *Id.* (citing Muzika & Liebhold 2000 at 99 ("[A]lthough silviculture is implemented at the stand level, it is obvious … that the influence of insects occurs at the landscape level."); Muzika 2017 at 3430 (citation omitted)).
[46] *Id.* (citing A.M. Liebhold et al., What Causes Outbreaks of Gypsy Moth in North America?, 42 Population Ecology 257, 263-65 (2000) ("Liebhold et al. 2000"); Muzika & Liebhold 2000 at 103 ("Most defoliator species exist in a highly complex trophic web with their hosts and natural enemies. As a result of this complexity, manipulation of the habitat to enhance a single part of this food web may not always result in the expected outcome.")).
[47] *Id.* (citing R.W. McEwan et al., Multiple Interacting Ecosystem Drivers: Toward an Encompassing Hypothesis of Oak Forest Dynamics Across Eastern North America, 34 Ecography 244, 253 (2011); D.C. Dey et al., An Ecologically Based Approach to Oak Silviculture: A Synthesis of 50 Years of Oak Ecosystem Research in North America, 13(2) Revista Columbia Forestal 201, 202 (2010) ("Dey et al. 2010")).
[48] Dr. Muzika Declaration at ¶ 37 (citing R.M. Muzika et al., Effects of Silvicultural Management on Gypsy Moth Dynamics and Impact: An Eight-Year Study, 261, 261 *in* PROCEEDINGS: POPULATION DYNAMICS, IMPACTS, AND INTEGRATED MANAGEMENT OF DEFOLIATING INSECTS (M.L. McManus & A.M. Liebhold, eds. USDA Forest Service 1998) ("Muzika et al. 1998")).
[49] *Id.* (citing Muzika et al. 1998 at 261).
[50] *Id.* (citing Muzika et al. 1998 at 261).
[51] *Id.* (citing Muzika et al. 1998 at 261).

identical defoliation, a second pair had greater defoliation in the unthinned/control stand, and a third pair had greater defoliation in the thinned stand.[52]

While there was less overstory mortality in thinned stands than unthinned stands with comparable levels of defoliation, they were unable to determine that thinning significantly altered rates of gypsy moth mortality caused by parasitoids or pathogens.[53] Ultimately, results revealed that egg mass densities, moth survivorship, and gypsy moth mortality from natural enemies differed little between stands that received silvicultural treatments and those that did not.[54]

Their study comported with previous research that silvicultural thinning had no effect on predation of gypsy moth.[55] Ultimately they concluded that "… it seems unlikely the thinning could reduce the frequency or intensity of gypsy moth outbreaks by enhancing the activity of natural enemies."[56]

In 2014, Callie Schweitzer and her colleagues published the results of a study that investigated the possibility of regenerating oak and increasing oak vigor with silvicultural treatments.[57] Treatments implemented during the study are summarized below.

A. Shelterwood with reserves- Residual basal area of 10-25 ft^2 per acre. Oaks were favored for residual trees to promote increased forest health and improve habitat for wildlife and plant species. Regeneration beneath reserve trees intended to create a two-aged stand structure;

B. Oak woodland- Thinning to 45–70 ft^2 per acre followed by prescribed burning every 3–5 years. White oaks favored as residual trees to increase hard mast production and bat habitat;

C. Thinning- Reducing tree density allows residual trees to take advantage of improved growing conditions. Result should be increased tree vigor, larger crown diameters, continued or improved diameter growth, and increased capacity to survive defoliation;

D. Oak shelterwood- All basal area removed from midstory and understory without making canopy gaps in the overstory. Undesirable tree species in midstories and

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[52] *Id.* (citing Muzika & Liebhold 2000 at 101).
[53] *Id.* (citing Muzika et al. 1998 at 261).
[54] *Id.* (citing Muzika et al. 1998 at 261).
[55] *Id.* (citing Muzika et al. 1998 at 267 (citing S.T. Grushecky, Effects of Gypsy Moth-Oriented Silvicultural Thinnings on Small Mammal Populations and Rates of Predation on Gypsy Moth Larvae and Pupae, M.S. Thesis (West Virginia University 1995)); Muzika & Liebhold 2000 at 102 ("Many authors have advocated silvicultural procedures that might increase natural enemy abundance and/or activity. The logic behind these mechanisms is easy to understand … the evidence supporting these mechanisms is … scant.")).
[56] *Id.* (citing Muzika et al. 1998 at 267).
[57] Dr. Muzika Declaration at ¶ 38 (citing Schweitzer et al. 2014 at 401).

understories treated with chemical herbicide. Overstory to be removed after sufficient advanced oak regeneration present in order to create even-aged, oak-dominated stand;

E. Control- No treatment.[58]

It is not clear that the modest increases of oak regeneration observed with some treatments in this study were enough to ensure oak would remain a significant component of the treated stands.[59] Advanced regeneration of oaks that are greater than 7 feet tall is preferred when evaluating oak regeneration potential of mixed hardwood stands.[60] The authors measured oak regeneration in response to Treatments A, B, and D, and the Control Treatment. In this study, there was very little regeneration of 4.5 feet or taller oak.[61] The Control plots had the same or greater regeneration of this size class than that recorded in Treatments B and D.[62]

Total oak regeneration in the Control plots was greater than in any single treatment.[63] In fact, the only size class for which there was greater oak regeneration than in the Control plots was > 4.5 foot tall oaks in Treatment A.[64] In other words, it is arguable that the silvicultural treatments had no effect on oak regeneration at all.[65]

Even if the silvicultural treatments increased oak regeneration to some degree, it is unlikely that the observed regeneration was enough to maintain oak in the treated plots. Across all treatments and size classes, regeneration of red maple – which is not favored by gypsy moths – was greater than oak regeneration.[66] For the > 4.5 feet tall size class, red maple regeneration was 3 to 12 times greater than oak regeneration.[67] The dominance of red maple is significant because "[w]hen stands that are dominated by oaks in the overstory and non-oaks (e.g. maples) in the mid and understory are harvested, prolific stump sprouting of the non-oaks readily outcompetes the small oak reproduction."[68]

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[58] *Id.* (citing Schweitzer et al. 2014 at 403).
[59] Dr. Muzika Declaration at ¶ 39 (citing Schweitzer et al. 2014 at 406 tbl. 3.
[60] *Id.* (citing P.H. Brose et al., Prescribing Regeneration Treatments for Mixed-Oak Forests in the Mid-Atlantic Region, 9 tbl. 2.1 (USDA Forest Service General Technical Report NT-33 2008) (April 2008) ("Brose et al. 2008") (assigning greater weight to oaks more than 7 feet tall observed during regeneration plot assessment); Dey et al. 2010 at 214 ("[H]aving an abundance of large advance reproduction is key to successful oak regeneration.")).
[61] *Id.* (citing Schweitzer et al. 2014 at 406 tbl. 3 (three years after treatment density of > 4.5 feet tall oak was 17 stems per acre (SPA) in Treatment A; 2 SPA in Treatment B; 4 SPA in Treatment D; 4 SPA in the Control)).
[62] *Id.* (citing Schweitzer et al. 2014 at 406 tbl. 3).
[63] Dr. Muzika declaration at ¶ 40 (citing Schweitzer et al. 2014 at 406 tbl. 3).
[64] *Id.* (citing Schweitzer et al. 2014 at 406 tbl. 3).
[65] *Id.*
[66] Dr. Muzika declaration at ¶ 41 (citing Schweitzer et al. 2014 at 406 tbl. 3).
[67] *Id.* (citing Schweitzer et al. 2014 at 406 tbl. 3).
[68] *Id.* (citing Dey et al. 2010 at 208).

As with regeneration, it is likely that the silvicultural treatments in this study had no positive effect on oak vigor at all. Tree vigor is "the overall physiological condition or 'health' of a tree in a given environment."[69] In 2000, Dr. Muzika authored a paper with Andrew Liebhold in which they stated "… effective use of vigour classifications for determining potential mortality has not been demonstrated with defoliators."[70]

Schweitzer et al. theorized that silvicultural treatments would increase the vigor of trees retained following silvicultural treatments.[71] Their data, however, do not support this. Across all size classes, oak vigor in the Control plots increased by 0.15.[72] This improvement was approximately equal to the increase in oak vigor for Treatment C and more than double the increase for Treatment B.[73] Oak vigor for Treatment A decreased from 1.88 to 2.49.[74] Only Treatment D resulted in oak vigor that was appreciably greater than oak vigor observed in the Control plots.[75]

However, vigor of oaks ≥ 23.6 inches dbh decreased in all four treatments and the Control.[76] The decrease in Treatment D was less than that observed for the control; however, reductions in vigor following Treatments A, B, and C, were 7 to 27 times greater than that in the Control.[77]

Nor did Schweitzer et al. achieve their goals "to improve forest health and productivity and to increase resilience to … insect defoliation and oak decline."[78] There is no evidence that the silvicultural treatments implemented in the study improved forest health and productivity. More importantly, their study did not evaluate the resilience of the treated stands to gypsy moths because gypsy moths were not present in their study area.[79]

In short, the best scientific information does not support theories in Gottschalk's Silvicultural Guidelines that timber harvest—especially a clearcut with reserves treatment—will reduce susceptibility to gypsy moth defoliation.

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[69] Dr. Muzika declaration at ¶ 42 (citing Gottschalk 1993 at 35).
[70] Dr. Muzika declaration at ¶ 43 (citing Muzika & Liebhold 2000 at 101).
[71] *Id.* (citing Schweitzer et al. at 402.
[72] *Id.* (citing Schweitzer et al. 2014 at 407 tbl. 4).
[73] *Id.* (citing Schweitzer et al. 2014 at 407 tbl. 4).
[74] *Id.* (citing Schweitzer et al. 2014 at 407 tbl. 4).
[75] *Id.* (citing Schweitzer et al. 2014 at 407 tbl. 4) (oak vigor increased by 0.33 for Treatment D)).
[76] *Id.* (citing Schweitzer et al. 2014 at 407 tbl. 4).
[77] Dr. Muzika declaration at ¶ 43 (citing Schweitzer et al. 2014 at 407 tbl. 4) (decreases in vigor of oaks ≥ 23.6 inches dbh were: -3.74 in Treatment A; -0.99 in Treatment B; -1.25 in Treatment C; -0.08 in Treatment D; -0.14 in the Control)).
[78] Dr. Muzika declaration at ¶ 44 (citing Schweitzer et al. 2014 at 401).
[79] *Id.* (citing Schweitzer et al. 2014 at 402 ("Gypsy moth is estimated to spread to the [study area] over the next 15-30 years….")).

b. Predicting vulnerability to mortality from gypsy moth defoliation is very difficult, if not impossible.

According to Dr. Muzika, reducing vulnerability to gypsy moth would require evaluation and successful manipulation of many interrelated factors, and researchers have not found this to be practical at the stand or landscape level.[80]

As with regeneration, it is likely that the silvicultural treatments in this study had no positive effect on oak vigor at all. Tree vigor is "the overall physiological condition or 'health' of a tree in a given environment."[81] In 2000, I authored a paper with Andrew Liebhold in which we stated "… effective use of vigour classifications for determining potential mortality has not been demonstrated with defoliators."[82]

Many factors affect whether a susceptible tree will die as a result of defoliation[83]:

> Whether a tree succumbs to mortality, or merely experiences a short-term reduction in growth increment following defoliation depends on the following factors: the tree species; the intensity, duration, and frequency of defoliation; the tree's physiological condition at the time of defoliation[84]; and the presence of secondary-action organisms such as *Armillaria* spp. and *Agrilus bilineatus.* These factors do not act independently; rather, it is their action in combination that determines the final outcome.[85]

Gottschalk recognized this also, explaining "[v]ulnerability to mortality … is affected by so many interrelated factors and varies so widely that is very difficult, if not impossible, to

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[80] Dr. Muzika declaration at ¶ 45.
[81] *See* Gottschalk 1993 at 35 (citation omitted).
[82] Muzika & Liebhold 2000 at 101.
[83] Dr. Muzika declaration at ¶ 47 (citing Burton et al. 2015 at 504 ("Tree mortality varies widely due to variation in defoliation intensity and duration, tree species, and site and environmental conditions.") (citations omitted); Eisenbies et al. 2007 at 684 ("[T]ree species, the frequency, intensity, an duration of defoliation, the physiological condition of the tree before defoliation, and the presence and efficiency of secondary-action organisms all play a potential role in determining post defoliation tree mortality.")).
[84] Dr. Muzika declaration at ¶ 47 (citing Davidson et al. 1999 at 77 (stating that a tree's physiological condition is "[t]the greatest single indicator of the likelihood of mortality … at the time of defoliation.")).
[85] *Id.* (citing Davidson et al. 1999 at 76; Gottschalk 1993 at 32 ("The severity, frequency, and distribution of defoliation, site and stand factors, environmental conditions, invasion by secondary insects and diseases, and tree vigor all interact to produce the effects of defoliation (vulnerability) on the tree and stand.")).

predict with precision."[86] Additionally, characteristics of the site in which a susceptible tree is located may affect vulnerability.[87]

Uncertainty as to whether an individual tree will die as a result of defoliation scales up to the stand and landscape so that it is very difficult to predict whether there will be large-scale mortality following a gypsy moth outbreak.[88] Stands generally need "a relatively high proportion of resistant species (>70% of basal area)" to be considered less vulnerable to large-scale mortality.[89]

Consequently, researchers have concluded that "it is difficult to formulate silvicultural treatments that will have consistent results [because] … it is very difficult to predict the repercussions of an attack [by gypsy moths]."[90] Stated differently, while it is theoretically possible to decrease the vulnerability of a stand by selectively removing "the least vigorous trees," identifying trees that are most likely to die as a result of severe defoliation is very difficult. Therefore, managing vulnerability at the stand or landscape level may not be possible.[91]

c. Harvesting non-preferred tree species will not reduce susceptibility or vulnerability to gypsy moth.

Moreover, Dr. Muzika points out that the Forest Service's proposal for indiscriminate harvest of both oaks and non-oaks[92] contradicts one of the most commonly advocated strategies for reducing risk of forest ecosystems to invasive pests: promoting diversity of tree species.[93] Stands composed of multiple tree species are naturally resistant to gypsy moths because not all tree species will be attacked by moths.[94] Gypsy moths prefer oak species and other species, such

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[86] Dr. Muzika declaration at ¶ 48 (citing Gottschalk 1993 at 8).
[87] *Id.* (citing Davidson et al. 1999 at 76 (describing "specific site factors" that may determine susceptible and resistant forest types)).
[88] *Id.* (citing Davidson et al. 1999 at 77 ("The probability of mortality depends on a complex interaction of many different factors, biotic and abiotic. This … variability makes the … accurate prediction of mortality extremely difficult.")).
[89] *Id.* (citing Eisenbies et al. 2007 at 689 (citing Davidson et al. 1999)).
[90] *Id.* at 690 (citing Muzika & Liebhold 2000 at 101) ("Studies have determined that tree mortality often represents a multi-decadal process and that losses in tree vigour may be evident long before an insect defoliation episode…. It therefore becomes difficult to predict which individual trees will die from insect defoliation, given simple defoliation estimate or vigour estimates at a particular point in time. The lack of predictive ability represents a substantial impediment when attempting to pre-empt mortality.").
[91] Dr. Muzika declaration at ¶ 50 (citing Muzika & Liebhold 2000 at 103).
[92] *Id.* at ¶ 51 (citing Scoping notice at 4).
[93] *Id.* (citing Q. Guo et al., Tree Diversity Regulates Forest Pest Invasion, 116(15) Proceedings of the National Academy of Sciences 7382, 7385 (2019)).
[94] *Id.* (citing J.S. Elkington & A.M. Liebhold, Population Dynamics of Gypsy Moth in North America, 35 Annual Review of Entomology 571, 584 (1990) ("Elkington & Liebhold 1990")).

as red maple, are less preferred.[95] Additionally, it has been suggested that tree species diversity in a stand confers resistance by hosting a broader array of predators and pathogens than would be found in lower diversity stands.[96] Regardless of the mechanism, "[o]utbreaks rarely occur in stands dominated by nonpreferred host species."[97] Research has shown that mortality rates in stands attacked by gypsy moths are greater in stands with greater proportions of oaks.[98] In this case, the Forest Service proposes to remove non-oaks in approximately 1,366 acres of national forest with the goal of establishing stands dominated by oak. Research on susceptibility and vulnerability of forest stands to gypsy moths provides no support for this.

d. Dilemma for Land Managers

Dr. Muzika points out that because oak is both ecologically and economically important,[99] managing oak vis à vis gypsy moths may put the Forest Service in a dilemma.[100] Such is the case with the Forest Service's current proposal: the agency desires to "maintain a significant oak component" in an ecosystem infested with gypsy moths, which preferentially attack oak. The Forest Service's current proposal creates the "[o]bvious conflict[]" described by Muzika & Liebhold 2000: increasing resistance to gypsy moths entails reducing the amount of oak on the landscape, but managing for oak preserves both oak's ecological importance and economic importance.[101] Removing oak from the landscape "… would be both economically and ecologically disruptive."[102]

This dilemma forces the Forest Service to choose between two different courses of action: (A) manage for ecological integrity in an area generally infested by gypsy moth by managing for non-oaks to reduce susceptibility and vulnerability, or (B) managing for oak regeneration.

If the Forest Service decides to prioritize "managing for the gypsy moth," it must consider whether active management is appropriate at all, and if so, whether the best available scientific information supports any silvicultural method as a proven method to reduce susceptibility or vulnerability to gypsy moth.

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95 *Id.* (citing C.B. Davidson et al., Tree Mortality Following Defoliation by the European Gypsy Moth (*Lymantria dispar* L.) in the United States: a Review, 45(1) Forest Science 74, 75 tbl. 1 (1999)).
96 *Id.* (citing P.H. Burton et al., Options for Promoting Recovery and Rehabilitation of Forests Affected by Severe Insect Outbreaks, in RESTORATION OF BOREAL AND TEMPERATE FORESTS 495, 506 (J.A. Stanturf ed., CRC Press 2d ed. 2015)).
97 *Id.* (citing Elkington & Liebhold 1990 at 584; Eisenbies et al. 2007 at 689 (citing Davidson et al. 1999) (Stands need "relatively high proportion of resistant species (>70% of basal area)" to be considered less vulnerable to large-scale mortality))).
98 *Id.* (citing Davidson et al. 1999 at 79).
99 Dr. Muzika declaration at ¶ 52 (citing D.C. Dey et al. 2010 at 202; Brose et al. 2008 at 4-5 (USDA Forest Service General Technical Report NT-33 2008)).
100 *Id.* (citing Muzika & Liebhold 2000 at 103 (noting that eliminating preferred host species in order to reduce susceptibility ". . . represents an ecological and economic dilemma.")).
101 *Id.* at 101.
102 *Id.*

If, on the other hand, the Forest Service prioritizes "managing for oak regeneration" in these units, it could consider other silvicultural methods. There is a body of scientific literature related to oak regeneration, which the Forest Service does not appear to be invoking here.[103]

It is critical to recognize though that managing for oak regeneration would be an economic rather than an ecological decision. The objective of pre-salvage harvest is to realize the economic potential of an oak stand before it is lost.[104] That is why Gottschalk included it as a possible technique in a "guidebook for foresters whose goal is timber production."[105] No published studies of which I am aware have shown (or even attempted to show) that a clearcut with reserves treatment—as proposed by the Forest Service here—will restore or maintain ecological integrity of an oak forest that may be infested by gypsy moths in the future.

In sum, the best available science does not support the use of a clearcut with reserves treatment to reduce the risk or extent of future gypsy moth outbreaks, or to increase resilience to possible future defoliation.

e. Scientific conclusions regarding this proposal

Based on the above, it is Dr. Muzika's professional opinion that the Forest Service's proposal contradicts the best available scientific information regarding ecological integrity in an area generally infested by gypsy moth.[106] In sum, Dr. Muzika concludes:

- The Forest Service wants to cut live oaks in oak-dominated stands now so that the stands will regenerate to "maintain a significant oak component."[107] The Forest Service also intends to cut non-oak species "to give the oak stump sprouts the best chance to succeed in dominating the regenerated stand."[108] These objectives run counter to body of scientific literature that advises tree species diversity and reducing the component of oak and other highly preferred species.[109] By promoting oak dominance in a

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[103] Dr. Muzika declaration at ¶ 53 (citing D.C. Dey et al., An Ecologically Based Approach to Oak Silviculture: A Synthesis of 50 Years of Oak Ecosystem Research in North America, 13(2) Revista Columbia Forestal 201, 202 (2010); K.C. Steiner et al., Oak Regeneration Guidelines for the Central Appalachians, 25(1) Northern Journal of Applied Forestry 5 (2008); S.L. Clark and C.J. Schweitzer, Stand dynamics of an oak woodland forest and effects of a restoration treatment on forest health, 381 Forest Ecology and Management 258-267 (2016); Brose et al. 2008; J.S. Rentch, Crown Class Dynamics of Oaks, Yellow-Poplar, and Red Maple after Commercial Thinning in Appalachian Hardwoods: 20-Year Results, 26(4) Northern Journal of Applied Forestry156 (2009)).

[106] Dr. Muzika declaration at ¶ 55.
[107] Dr. Muzika declaration at ¶ 56.
[108] *Id.*
[109] *Id.*

regenerated stand, the Forest Service is likely increasing the susceptibility of these stands to future gypsy moth defoliation.[110]

- Even if the Forest Service were decreasing the density of highly preferred oaks in these stands, this would not reduce the spread into other nearby oak forest. [111] Accordingly, changing stand composition through silviculture would not affect gypsy moth populations in the landscape.[112]

- The proposed regeneration harvest will not reduce susceptibility to gypsy moths by improving conditions for gypsy moth predators and pathogens.[113] Similarly, selective thinning is unlikely to reduce the frequency or intensity of outbreaks by enhancing conditions for natural enemies of the gypsy moth.[114]

- Even setting aside that oak regeneration is not a legitimate ecological goal to address the presence of gypsy moth, the proposed silvicultural treatments would not likely increase oak regeneration.[115] Tulip poplar and red maple often outcompete oak sprouts unless site indices are low. In that case, oaks already have a chance of rising to dominance without silvicultural intervention.[116] Nor are the silvicultural treatments likely to increase oak vigor.[117]

- As Gottschalk acknowledged in 1993, it is "very difficult, if not impossible" to predict vulnerability with any precision.[118] There is no evidence in the project file that the proposed regeneration logging is designed to reduce stand vulnerability to mortality following gypsy moth defoliation.[119] The Forest Service seems not to have even made efforts to develop a project that would do so, having failed to analyze the many relevant site conditions that affect vulnerability, such as the intensity, duration, and frequency of any previous defoliation in the proposed units.[120]

- Because the best scientific information related to ecological integrity in areas infested by gypsy moth does not support the proposed clearcut with reserves logging to regenerate oak, the Farm Bill's Insect and Disease Infestation CE does not appear to apply to this proposal.[121]

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[110] *Id.*
[111] Dr. Muzika declaration at ¶ 57.
[112] *Id.*
[113] Dr. Muzika declaration at ¶ 58.
[114] *Id.*
[115] Dr. Muzika declaration at ¶ 59.
[116] Dey et al. 2010 at 931, 933.
[117] *Id.*.
[118] Dr. Muzika declaration at ¶60.
[119] Dr. Muzika declaration at ¶ 60.
[120] *Id.*
[121] Dr. Muzika declaration at ¶ 61.

2. The best available science does not indicate a need for intervention.

After reviewing data about conditions in the general area and the proposed units, Dr. Muzika concluded that there does not appear to be any need for active management of gypsy moth in this project area.[122]

The above scientific information shows that silvicultural practices generally do not reduce susceptibility to gypsy moth defoliation or vulnerability to mortality following defoliation in treated stands or the surrounding area.[123] In addition, there does not appear to be any need for active management of gypsy moth in this project area.[124]

a. There is no evidence that gypsy moth has caused a need for ecological restoration or maintenance in the project area.

Based on data from the project area and proposed units, Dr. Muzika found no compelling evidence that the ecological integrity of the area is in need of maintenance or restoration simply because gypsy moth has ingested the general area.[125] Moreover, it is likely that the proposed management would do more harm than good to the ecological integrity of the area.[126]

Ms. Bier's field surveys show that to the extent the gypsy moth is active in the proposed units at all; it is at very low densities.[127] In all seven working areas of the project, Ms. Bier found a total of 6 gypsy moth caterpillars in 2 working areas (Caseknife and Tunnel Hollow).[128] Moreover, only 3 potentially viable gypsy moth egg masses were found: 2 in the Dismal area and 1 in the Caseknife area.[129]

In addition, based on the absence and/or minimal amount of notable damage and/or mortality in Ms. Bier's plots, it is unlikely that severe defoliation previously occurred in most units.[130] Lastly, the vigor and health of trees appears good.[131] Of the 870 overstory plot tree crowns sampled, 77% were classified as Good vigor and 16% were classified as Fair vigor.[132] Only 1% were classified as Poor vigor.[133]

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[122] Dr. Muzika declaration at ¶ 63.
[123] Dr. Muzika declaration at ¶ 62.
[124] Dr. Muzika declaration at ¶ 63.
[125] *Id.*
[126] *Id.*
[127] Dr. Muzika declaration at ¶ 64.
[128] *Id.* (citing J. Bier report at 3).
[129] *Id.*
[130] Dr. Muzika declaration at ¶ 65.
[131] *Id.*
[132] *Id.*
[133] *Id.*

None of these conditions point to a need for ecological maintenance or restoration simply because the project area is within a generally infested area.[134] And certainly none of these conditions indicate these units would be a "priority projects … to reduce the risk or extent of, or increase resilience to, insect or disease infestation."[135]

The mere presence of gypsy moth in such low densities does not mean defoliation and stand damage are looming.[136] Gypsy moth populations can persist in low densities for long periods of time.[137] And some low-density gypsy moth populations may go extinct without any management.[138] This is true whether the gypsy moth arrives in uninfested areas or along the leading edge.[139]

Many of the dynamics that appear to regulate gypsy moth populations at these low densities are outside the control of land managers.[140] For example, small mammals appear to be important at regulating low-density gypsy moth populations.[141] So does the gypsy moth fungal pathogen *Entomophaga maimaiga*, which appeared in 1996.[142] Studies indicate that regional weather influences (directly and indirectly) both of these.[143]

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134 Dr. Muzika declaration at ¶ 66.
135 16 U.S.C. 6591a(d)(1).
136 Dr. Muzika declaration at ¶ 67.
137 *Id.* (citing A.M. Liebhold et al., What Causes Outbreaks of the Gypsy Moth in North America?, 42 Population Ecology 257, 258 fig. 1 (2000) (showing periods of two decades or more during which gypsy moth activity in New England was very low) ("Liebhold et al. 2000")).
138 *Id.* (citing P.C. Tobin et al., The Ecology, Geopolitics, and Economics of Managing *Lymantria dispar* in the United States, 58(3) Int'l. J. of Pest Mgmt. 195, 198 (2012) ("Tobin et al. 2012")).
139 *Id.* (citing Tobin et al. 2012 at 198).
140 Dr. Muzika Declaration at ¶ 68.
141 *Id.* (citing J.S. Elkington & A.M. Liebhold, Population Dynamics of Gypsy Moth in North America, 35 Annual Review of Entomology 571, 574-76 (1990) ("Elkington & Liebhold 1990"); D.M. Johnson et al., Geographical Variation in the Periodicity of Gypsy Moth Outbreaks, 29 Ecography 367, 372 (2006) ("Predation by small mammals is considered the single most important factor affecting low-density gypsy moth populations…"); Muzika & Liebhold 2000 at 102 ("The largest source of mortality affecting low-density gypsy moth populations in North America is predation, mostly caused by small mammal predators")).
142 *Id.* (citing C. Asaro et al., Impacts of oak decline, gypsy moth and native spring defoliators on the oak resource in Virginia, Oak Symposium: Sustaining Oak Forests in the 21st century through Science-based Management, 20 (2019); C. Asaro et al., Outbreak History (1953-2014) of Spring Defoliators Impacting Oak-Dominated Forests in Virginia, with Emphasis on Gypsy Moth (*Lymantria dispar* L.) and Fall Cankerworm (*Alsophila pometaria* Harris), 61 American Entomologist 174, 181 (2015)).
143 Dr. Muzika declaration at ¶_ (citing Liebhold et al. 2000 at 257, 261-263; J.R. Reilly et al., Impact of *Entomophaga maimaiga* (Entomopthorales: Entomopthoraceae) on Outbreak Gypsy Moth Populations (Lepidoptera: Erebidae): The Role of Weather, 43 Environmental Entomology 632 (June 2014); Muzika & Liebhold 2000 at 103 (Stand manipulations to increase gypsy moth mortality by an abundance of a specific natural enemy will not necessarily reduce outbreak

It is unpredictable which populations will later reach outbreak levels.[144] It is most likely the interaction of a complex set of abiotic and biotic variables that allow gypsy moth populations to reach outbreak levels.[145]

When considering whether any gypsy moth-related intervention is appropriate, land managers must consider gypsy moth population levels.[146] Two commonly used tools to measure gypsy moth density are pheromone traps and counting overwintering egg masses.[147]

Pheromone traps are useful for detecting and delineating new infestations. [148] Thus, they are "mostly used in isolated populations outside of the generally infested area and in areas along the expanding front of the gypsy moth infestation" as with the Slow the Spread Program.[149] Gypsy moths, however, have been present in the forest surrounding the proposed treatments for over a decade. Thus, "more intensive surveys" are needed to identify "rising populations."[150]

Therefore, it is more appropriate to use egg mass counts—a survey method relied upon to make decisions concerning control in "the generally infested area."[151]

Although there is considerable variation in the amount of defoliation that occurs in stands where 100 to 1000 egg masses are present, [152] research has shown that oak stands are unlikely to suffer noticeable defoliation when egg mass surveys detect less than 1,000 egg masses per acre.[153] And while a threshold of 250 egg masses per acre has been used for intervention, this threshold would be waste of resources for lad managers trying to reduce susceptibility and vulnerability to gypsy moth for ecological purposes: "[i]f a manager's objective is to prevent noticeable defoliation, growth loss, or mortality, then initiating treatment

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frequency in stand because defoliators exist in "highly complex trophic web with their hosts and natural enemies" and manipulating the habitat to enhance a single part of this food web is difficult); Muzika et al. 1998 at 267 (thinning had no effect on predation of gypsy moth)).

144 Dr. Muzika declaration at ¶ 69.

145 *Id.* (citing Liebhold et al. 2000 at 263-65; J.R. Foster *et al.*, Spatial dynamics of a gypsy moth defoliation outbreak and dependence on habitat characteristics, Landscape Ecology, 1-2, 9 (March 2013) ("Spatial propagation of outbreak populations remains poorly understood, in part because defoliation effects are often ephemeral and difficult to quantify" but "may reveal processes that drive disturbance behavior….Spatial patterns are increasingly used to explain and predict defoliation outbreaks…") (internal citations omitted)).

146 Dr. Muzika declaration at ¶ 70 (citing Liebhold et al. 1994 at 1).

147 *Id.* (citing Liebhold et al. 1994 at 1).

148 *Id.* (citing Liebhold et al. 1994 at 1).

149 *Id.* (citing Liebhold et al. 1994 at 1).

150 *Id.* (citing A.M. Liebhold et al., Gypsy Moth Egg Sampling for Decision-Making: a Users' Guide, at 1 (USDA Forest Service NA-TP-04-94 1994) (emphasis added) ("Liebhold et al. 1994")).

151 Dr. Muzika Declaration at ¶ 71 (citing Liebhold et al. 1994 at 1; A.M. Liebhold, Forecasting Defoliation Caused by the Gypsy Moth from Field Measurements, 22 Environmental Entomology 26, 26-31 (Feb. 1993)).

152 Dr. Muzika declaration at ¶ 72 (citing Liebhold et al. 1994 at 16 fig. 7).

153 Dr. Muzika declaration at ¶ 72 (citing Liebhold et al. 1994 at 19 fig. 8).

at 250 egg masses per acre would show little or no return on the expense of treatment."[154] Additionally, intervention at low egg mass densities "… may result in the needless treatment of many stands that would never become defoliated[.]"[155]

Again, Ms. Bier's field surveys of all 7 working areas, including 870 plots, resulted in only 3 potentially viable gypsy moth egg masses: 2 in the Dismal area and 1 in the Caseknife area.[156] The very low numbers that were observed indicate that egg mass densities that are far below thresholds for intervention. The clear conclusion of applying this research to the project area is that there is no basis for invoking gypsy moths as justification for silvicultural intervention at this time.[157]

b. The proposed silvicultural treatments would likely do more ecological harm than good.

There is an ever-growing body of literature that supports decisions by land managers not to actively intervene, particularly pre-emptively, in response to the presence of gypsy moth or other pests.[158] As several researchers concluded, [s]ince forest managers and researchers both have had limited success in predicting the occurrence of catastrophic events much before they occur, it is not practical to attempt to preempt the role of natural disturbances by harvesting stands prior to their occurrence."[159]

In 2006, forest ecology researchers undertook a study to "evaluate the hypothesis that active management can improve long-term ecosystem function by increasing ecosystem resilience and resistance."[160] They did so by comparing the effects of wind and insect disturbance on forest "ecosystem structure, composition, and function[,]" with the effects of "salvage and preemptive [timber] harvesting."[161] Noting that "[i]nsect and disease outbreaks often lead to increased harvesting of the host species, including preemptive cutting… and post-mortality salvage logging," the authors pointed out that the timber harvest "may generate more profound ecosystem disruption than the pest or pathogen itself."[162]

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[154] *Id.* (citing Liebhold et al. 1994 at 19-20).
[155] *Id.* (citing Liebhold et al. 1994 at 20).
[156] Bier report at 3.
[157] Dr. Muzika declaration at ¶ 72.
[158] Dr. Muzika declaration at ¶ 73 (citing Gottschalk 1993 at 2, Figure A (even Gottschalk's Silvicultural Guidelines, timber-focused as they were, recognized that in some conditions, it was better not to log trees in response to gypsy moth)).
[159] *Id.* (citing J. Aber et al., Applying Ecological Principles to Management of the U.S. National Forests, 6 Issues in Ecology 7, 13 (2000) ("Aber et al. 2000")).
[160] Dr. Muzika declaration at ¶ 74 (citing D.R. Foster & D.A. Orwig, Preemptive and Salvage Harvesting of New England Forests: When Doing Nothing is a Viable Alternative, 20(4) Conservation Biology 959, 960 (2006) ("Foster & Orwig 2006")).
[161] *Id.* (citing Foster & Orwig 2006 at 960).
[162] Dr. Muzika declaration at ¶ 74 (citing Foster & Orwig 2006 at 963 (citations omitted)).

Studying the silvicultural interventions related to infestation by hemlock woolly adelgid ("HWA"), an invasive insect, serve as a good example.[163] Kizlinski et al. compared the direct effects of infestation by HWA" and the indirect effects of HWA infestation, namely intensive logging.[164]

Kizlinski et al. found that HWA and logging impacted vegetation composition similarly but at different temporal and spatial scales.[165] HWA resulted in vegetation changes that were more gradual and more localized than vegetation changes following logging.[166] Post-disturbance "forest floor dynamics" differed in HWA-infested and logged sites because of the latter allowing much more light to reach the forest floor.[167] Whereas logging creates large and often uniform openings in a forest canopy, HWA disturbance changed forest structure in a manner that is similar to natural disturbances, which create gaps "… of mixed sizes depending on cause."[168]

Unlike HWA, logging "dramatically altered nitrogen cycling" compared to HWA-infested plots and undamaged plots.[169] In addition to causing "rapid nutrient losses from the disturbed area," the authors stated that post-logging nitrification could have long-term effects on "site fertility."[170]

These results bring to mind a cautionary statement made by another team of researchers that included Kurt Gottschalk: "A key objective in management decisions after insect outbreaks should be to reduce susceptibility to future insect attack, so care must be taken to promote rather than to compromise the inherent resilience of temperate and boreal forests."[171]

Indeed, in 2015 a team of researchers, again including Kurt Gottschalk, stated "… that any decision to undertake active management must be explicitly weighed against the option of doing nothing—of letting ecosystem recovery proceed unaided…for which a solid

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[163] Dr. Muzika declaration at ¶ 75. HWA are a more aggressive invasive than gypsy moths because it disperses in a variety of ways, it reproduces twice per year, and it has no predators native to North America. Dr. Muzika declaration at ¶_ (citing M.L. Kizlinski et al., Direct and Indirect Ecosystem Consequences of an Invasive Pest on Forests Dominated by Eastern Hemlock, 29 Journal of Biogeography 1489, 1490 (2002) ("Kizlinski et al. 2002")).
[164] *Id.* (citing Kizlinski et al. 2002 at 1490).
[165] *Id.* (citing Kizlinski et al. 2002 at 1500).
[166] *Id.* (citing Kizlinski et al. 2002 at 1496-98).
[167] *Id.* (citing Kizlinski et al. 2002 at 1498-99).
[168] *Id.* (citing Aber et al. 2000).
[169] *Id.* (citing Kizlinski et al. 2002 at 1500).
[170] *Id.* (citing Kizlinski et al. 2002 at 1500).
[171] *Id.* (citing P.J. Burton et al., Options for Promoting the Recovery and Rehabilitation of Forests Affected by Severe Insect Outbreaks, *in* RESTORATION OF BOREAL AND TEMPERATE FORESTS 495, 510 (John A. Stanturf ed., CRC Press 2d ed. 2015) ("Burton et al. 2015")).

understanding of forest stand dynamics is required."[172] Burton et al. described an "intervention continuum" that included options ranging from intensive management to doing nothing.[173]

They further explained "[t]here is typically no need or incentive for active forest rehabilitation after an insect outbreak if overstory mortality is low, or if the understory is already well stocked with vigorous seedlings and saplings or is soon expected to be so."[174] The authors concluded that, '[p]rocesses of natural ecosystem recovery typically are more desirable, less intrusive, and less costly than active intervention."[175] The researchers concluded "[a]ll evidence suggests that harvesting exerts greater impacts on ecosystem processes than leaving disturbed or stressed forests intact."[176]

Here, Dr. Muzika finds that the conditions do not weigh on favor of the Forest Service's proposed regeneration logging.[177] As explained above, there is no evidence that that the ecological integrity of the area has been reduced because gypsy moth is in the general area or units. [178] And as further explained above, the best available scientific information does not support silvicultural activities as an effective way to reduce susceptibility or vulnerability to gypsy moth.[179] Moreover, the proposed clearcut with reserves treatments would likely to do more ecological harm than good for this the area.[180]

3. Gottschalk's Guidelines improperly prioritize timber production over ecological integrity.

In addition to the above, Dr. Muzika cautions that Gottschalk's Silvicultural Guidelines are not suited to this situation.[181]

Gottschalk's report is "primarily a guidebook for foresters whose goal is timber production, it does not balance timber production with the various (and sometimes competing)

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[172] Dr. Muzika declaration at ¶ 75 (citing Burton et al. 2015 at 507).
[173] *Id.* (citing Burton et al. 2015 at 507-10).
[174] *Id.* (citing Burton et al. 2015 at 507, 508 tbl 24.1 (identifying considerations that support no active intervention in response to an insect outbreak including "[n]o personal or community safety concerns" and "[s]atisfactory levels of overstory survival ….")).
[175] *Id.* (citing Burton et al. 2015 at 508).
[176] *Id.* (citing Foster & Orwig 2006 at 966).
[177] Dr. Muzika declaration at ¶ 76.
[178] *Id.*
[179] *Id.* (citing R.M. Muzika et al., Effects of Silvicultural Management on Gypsy Moth Dynamics and Impact: an Eight-Year Study, *in* PROCEEDINGS: POPULATION DYNAMICS, IMPACTS, AND INTEGRATED MANAGEMENT OF FOREST DEFOLIATING INSECTS 261, 261 (M.L. McManus & A.M. Liebhold eds., USDA Forest Service General Technical Report NE-247 1998); Muzika & Liebhold 2000 at 103-104).
[180] Dr. Muzika declaration at ¶ 76.
[181] Dr. Muzika declaration at ¶ 77.

land uses that the Forest Service must provide. [182] Nor does it grapple with how to protect the resources aside from timber that the Forest Service must.

The purpose and focus of the Farm Bill Insect and Disease CE, however, is not timber production. Rather, the CE applies only to activities that restore or maintain ecological integrity—which may or may not involve timber production at all. But because prioritization of timber production is "baked into" the Guidelines, the Guidelines do not guide the land manager to consider non-silvicultural options that may better serve ecological integrity.

If any silvicultural intervention is appropriate, *see* above section at 17-22, the Forest Service should consider other guidance or frameworks that prioritize ecological integrity above all (including timber production).[183] While ecological restoration and timber harvest activities are not mutually exclusive, nor are they equivalent.[184] As a result, the Forest Service cannot assume that the recommendations in the Silvicultural Guidelines would constitute ecological restoration or maintenance activities.[185] Indeed, the best available science does not support that the proposed regeneration logging in these units would constitute ecological restoration.[186]

In 2015, Gottschalk *et al.* recommend using a "scorecard" approach to identify the urgency and intensity of appropriate forest rehabilitation actions after insect outbreaks.[187] This approach would be more appropriate for the Forest Service than application of the 1993 Silvicultural Guidelines, because it does not assume timber production is the priority.[188] Rather, it is a flexible tool that allows decisionmakers to emphasize ecological integrity as the priority, while also considering other values for land use, as well as the severity of the outbreak, ecological degradation, and environmental impacts. [189]

B. This proposal violates the Forest Plan.

In order to use the Farm Bill Insect and Disease CE, proposed treatments must be consistent with the Jefferson National Forest Land and Resource Management Plan.[190] The project, however, appears inconsistent with the forest plan direction and standards for much of the proposed harvest units.

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182 Dr. Muzika declaration at ¶ 78 (citing Gottschalk 1993 at 1).
183 Dr. Muzika declaration at ¶ 80.
184 *Id.*
185 *Id.*
186 *Id.*
187 Dr. Muzika declaration at ¶ 81 (citing Burton et al. 2015 at 509).
188 *Id.* (citing Burton et al. 2015 at 509).
189 *Id.* (citing Burton et al. 2015 at 509). *See* scorecard, which is attached to Dr. Muzika's declaration.
190 16 U.S.C. § 6591b(e) ("All projects and activities carried out under this section shall be consistent with the land and resource management plan established under section 1604 of this title for the unit of the National Forest System containing the projects and activities.").

1. Forest plan standards defining rotation ages for regeneration harvests preclude harvest in all but five cutting units.

Several of the proposed logging units are located in the following management prescriptions, which each have a standard requiring that regeneration harvests in upland hardwoods be managed with rotation ages of 120-180 years:

- 7B – Scenic Corridors;
- 7E2 – Dispersed Recreation Areas-Suitable;
- 8A1 – Mix of Successional Habitat in Forested Landscapes; and
- 9A1 – Source Water Protection Areas. [191]

The "Upland Hardwoods" working group is composed of the following Forest Communities, which are comprised of the listed Forest Types:

- Dry-Mesic Oak Forest: comprised of Forest Types 51, 53, 54, 55;
- Dry and Dry-Mesic Oak-Pain Forest: comprised of Forest Types 42, 43, 45, 46, 47, 48;
- a portion of the Dry and Xeric Oak Forest: comprised of Forest Types 52, 57, 59, 60.[192],[193]

Nearly all of the proposed units fall within these forest types. In addition, nearly all of the stands proposed for harvest are less than 120 years old. Accordingly, regeneration logging in these areas would be inconsistent with a forest plan standard requiring regeneration harvests in upland hardwoods be managed with rotation ages of 120-180 years.

Moreover, while Forestwide Standard FW-113 would allow harvest to occur before a stand reaches its rotation age "in order to meet the long-term desired condition of a particular management prescription," the desired conditions for management prescriptions 7B, 7E2, 8A1, and 9A1 would not be furthered by the proposed regeneration logging.[194] Lastly, FW-113

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[191] *See* Forest Plan at 3-91 (Timber Management Standard 7B-012); 3-105 (Timber Management Standard 7E2-010); 3-115 (Timber Management Standard 8A1-014); 3-154 (Timber Management Standard 9A1-013).
[192] *See* Forest plan at 2-32.
[193] *Id.* Appendix D at D-8.
[194] *See, e.g.*, Forest plan at 3-88 to 3-90 (7B Scenic Corridors: "Relatively longer rotation ages and a lower percentage of early successional forest in these areas reflect a 'low intensity' approach to vegetation management and the higher priority of recreation and scenic values. Timber harvesting operations focus on what is retained in the stand, not on wood fiber production."); 3-104 (7E2 Dispersed Recreation Areas-Suitable: "Timber harvesting operations focus on what it retained in the stand, not on wood fiber production. Timber harvest is carefully timed to be subtle. Group selections, individual tree selections, thinnings, and shelterwood harvests are predominantly used. Clearcutting may occasionally be used to open up vistas, create spatial diversity along travelways, decrease straight line effect of cleared utility corridors, create watchable wildlife openings, for insect and disease suppression, or for salvage/scenic rehabilitation); 3-152 (9A1 Source Water Protection Areas: "Relatively longer rotation ages and a

prohibits regeneration logging before "culmination of mean annual increment."[195] Most of these stands are under 100 years old and likely have decades before they reach culmination of mean annual increment.

2. The Phase II proposal is inconsistent with other forest plan standards.

Proposed logging in a number of other management prescription areas appears inconsistent with the forest plan:

- 6B Old Growth Forest Communities Dependent on Fire: A portion of Unit 9 in the Gatewood Reservoir area is located in 6B. The management emphasis for 6B is "to restore or maintain old-growth conditions."[196] Accordingly, 6B areas are "unsuitable for timber production."[197] And while standard 6B-004 implies that gypsy moths may be "eradicated or suppressed to prevent a loss of the old growth community," biological controls methods are favored.[198] Moreover, field data does not indicate any presence of gypsy moth in this area and as explained throughout these comments, timber harvest is not a scientifically sound method to suppress or eradicate the gypsy moth.

- 6C Old Growth Forest Communities Associated with Disturbance: Portions of units 2, 3, 4, 7, and 8 in Bromley Hollow are classified as 6C. These areas are managed for old-growth conditions and "most of the area will contain forest communities where no forest management activities or intervention will take place."[199] Creating large openings by clearcutting is inconsistent with the desired condition for 6C areas: "[m]ost of the area will contain forest canopies that are continuous, interspersed with small gaps from natural causes, with little evidence of past human activity."[200]

  Moreover, 6C areas Standard 6C-009 states that these areas are unsuitable for timber production.[201] Additionally, the forest plan prescribes scenic integrity objectives for 6C areas. Clear-cutting is inconsistent with preserving high scenic integrity.

- 7B Scenic Corridors: Units 1 and 2, and a portion of unit 3 in the Walker Mountain area are classified as 7B. These areas are managed for "high quality

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lower percentage of early successional forest in these areas reflect a 'low intensity' approach to vegetation management and the higher priority of protecting drinking water.").

[195] *See* Forest plan at 2-32 ("Regeneration harvesting cuts are not scheduled prior to culmination of annual increment.").

[196] *Id.* at 3-77.

[197] *Id.* at 3-79 (Standard 6B-009).

[198] *Id.* at 3-78.

[199] Forest plan at 3-81.

[200] *Id.* at 3-81.

[201] *Id.* at 3-83.

scenery."[202] While "low intensity" timber harvest is permitted, the proposed a clearcut with reserves treatment is not low intensity. [203] Rather, clearcutting is an extreme form of timber management: one study suggested clearcutting as a viable management option for plantation forests where all tree species in the stand are vulnerable, the insect outbreak is severe, and the management goal is to transition the stand to non-forest.[204]

Additionally, standard 7B-011 defines sideboards for clearcutting.[205] While clear-cutting is authorized for insect suppression, there is no evidence that silviculture in any form can suppress gypsy moths.[206] In fact, gypsy moth suppression is accomplished almost exclusively using biological or chemical control.[207] Lastly, as stated above, these units likely do not meet the minimum age requirement for harvest under standard 7B-012.[208]

- 7E2 Dispersed Recreation Areas-Suitable: Units 16, 17, and 18 in the Dismal working area are located within the 7E2 management prescription.[209] These areas are managed for dispersed recreation.[210] Any timber harvest in these areas should be "compatible with the recreational and aesthetic values of these lands."[211] Accordingly, management standard 7E2-007 limits timber production to areas where "hunting recreation and watchable wildlife are emphasized."[212] What is the management emphasis of proposed units located in 7E2 areas?

  Standard 7E2-006 allows for vegetation management in order to "[r]educe insect and disease hazard."[213] However, as detailed throughout these comments, there is no evidence that the silvicultural treatments the Forest Service is proposing will reduce hazard(s) associated with gypsy moths. The proposed treatments are also inconsistent with standard 7E2-008, which states that "… group selection,

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202 *Id.* at 3-88.
203 *Id.* at 3-89; J. Aber et al., Applying Ecological Principles to Management of the U.S. National Forests 6 Issues in Ecology at 16 fig. 9 (contrasting the biological legacy of natural disturbances and clearcuts).
204 *See* K.M. Waring & K.L. O'Hara, Silvicultural Strategies in Forest Ecosystems Affected by Introduced Pests 209 Forest Ecology and Mgmt. 27, 35 tbl. 1 (2005).
205 Forest plan at 3-90 ("Clearcutting may only be used to open up vistas, create spatial diversity along travelways, …, create watchable wildlife openings, for insect and disease suppression, or for scenic rehabilitation.").
206 See Muzika 2017 at 3428-3430.
207 *See* Tobin et al. 2012 at 200-203.
208 *See id.* at 3-91 (defining a rotation age of 120-180 years for upland hardwoods).
209 The scoping notice states that Dismal units 16 and 17 are located partially in management prescription 8A1, which conflicts with project maps provided by the Forest Service.
210 *Id.* at 3-102.
211 *Id.*
212 *Id.* at 3-105.
213 *Id.* at 3-104 (defining standard 7E2-006).

thinning and shelterwood treatments[]" should be emphasized in 7E2 areas, and that thinning is "commonly used to develop park-like stands and larger trees for aesthetic reasons."[214] While the plan allows for the possibility of clear cutting in these areas, , plan standards favor less intensive modes of timber harvest. [215]

Lastly, as stated above, standard 7E2-010 imposes a minimum stand age requirement of 120 years for regeneration harvests.[216] These stands are 60 to 80 years old and are decades away from the minimum rotation age for upland hardwoods in 7E2 areas.[217]

- <u>8A1 Mix of Successional Habitats in Forested Landscapes</u>: Proposed units in 8A1 are located in Bromley Hollow, Caseknife, Dismal, Gatewood Reservoir, and Walker Mountain areas. As stated above, these units likely do not meet the minimum age requirement for harvest under standard 8A1-014.[218] It appears that of the 29 proposed units in 8A1, only one may be of sufficient age to satisfy this age requirement.

  Additionally, clearcutting is allowed in 8A1 areas "only when necessary to achieve <u>specific wildlife habitat objectives</u>."[219] The Forest Service has provided no specific wildlife habitat objectives that satisfy standard 8A1-012. The only reference to wildlife habitat in the scoping notice states "[t]he long-term maintenance of an oak component in these stands provides benefits to wildlife." This statement hardly qualifies as sufficient to justify clearcutting under standard 8A1-012.

- <u>9A1 Source Water Protection Areas</u>: Proposed units in 9A1 are located in the Caseknife, Gatewood Reservoir, Peak Creek, and Tunnel Hollow areas. These areas are intended to protect clean water sources.[220] Vegetation management activities in 9A1 areas should result in forest stands that are "…resistant of large scale disturbances."[221] The forest plan emphasizes timber harvest in the form of commercial thinning to create "park-like stands and larger trees for aesthetic reasons."[222] Additionally, standard 9A1-013 imposes a minimum stand age requirement of 120 years for regeneration harvests.[223] Clearcutting would be inconsistent with the forest plan because clearcutting is not an appropriate method for timber harvest in 9A1 areas.

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[214] *Id.* at 3-105.
[215] *Id.* at 3-104 ("Clearcutting may occasionally be used…").
[216] *Id.* at 3-105 (defining standard 7E2-010).
[217] Scoping notice at 5.
[218] Forest Plan at 3-115.
[219] *Id.* (defining standard 8A1-012) (emphasis added).
[220] Forest plan at 3-151.
[221] *Id.* at 3-153 (defining standard 9A1-008).
[222] *Id.* at 3-154 (defining standard 9A1-012).
[223] *Id.*

- 12B Remote Backcountry Recreation Non-Motorized: A portion of unit 3 in the Walker Mountain area is classified as 12B. These areas are managed for remote backcountry recreation.[224] These areas are "shaped by natural processes" and there are no "noticeable deviations" from the "character of the natural appearing and cultural landscapes."[225] Accordingly, these areas are unsuitable for timber production.[226] Clearcutting is not consistent with these goals, Additionally, standard 12B-004 instructs the agency to "first consider biological controls, hand-control methods, and pesticides" when combatting insect outbreaks.[227]

3. The proposal may exceed annual acreage limitations for timber harvest.

The Incidental Take Statement (ITS) for the Indiana bat assumes taking of bats through habitat manipulation (e.g., timber sales, road construction, prescribed burning, control line construction, development of recreation areas, special uses, etc.) on up 16,800 acres per year.[228] The ITS estimated that all habitat manipulation activities excluding prescribed fire would impact approximately 1,800 acres per year.[229]

Between Phases I and II, the District is now proposing over 2,600 acres of timber harvest that will occur in the same general timeframe. And this does not take into account the timber harvest that other Districts within the Jefferson National Forest (JNF) are planning. How many additional acres of timber harvest on the JNF are planned or are being planned during the timeframe for implementing this project?

Exceeding limits in the ITS would constitute an unlawful take under the Endangered Species Act and increasing this limit would require re-initiation of consultation with USFWS and modification of the Biological Opinion (BO) and ITS. [230] Additionally, if the District and JNF intend to exceed the estimates and impacts analyzed in the Forest Plan Final Environmental Impact Statement (FEIS), a supplemental EIS would be required to analyze, consider, and disclose the full impacts of planned timber harvest and its associated effects on resources such as soils, sedimentation and erosion, and non-native invasive species. Exceeding the amounts estimated and analyzed in the Plan and FEIS would constitute a substantial changes from the

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[224] *Id.* at 3-191.
[225] *Id.*
[226] *Id.* at 3-192 (defining standard 12B-007).
[227] *Id.*
[228] U.S. Fish and Wildlife Service, Biological Opinion for 2003 Revised Jefferson National Forest Land and Resource Management Plan, 33 (Jan. 13, 2003) (attached).
[229] Biological Opinion at 33; 24 (prescribed burning during summer could: (a) kill or injure Indiana bat by burning or smoke inhalation, especially death to young bats that cannot fly; (b) consume standing snags, thus removing potential roost trees; and (c) kill suitable living roost trees by heat/flames).
[230] Id. at 35.

chosen alternative that is highly relevant to environmental concerns and which will affect the resources of the JNF "in a significant manner."[231]

C. <u>This project was not collaboratively developed.</u>

The Insect and Disease CE also requires that a project be "… developed and implemented through a collaborative process that includes multiple interested persons representing diverse interests."[232] The collaborative process must also be "transparent and nonexclusive."[233]

We acknowledge the efforts undertaken by the District so far, including a pre-scoping notice, scoping notice, and 2 open houses. We also look forward to the field trip planned for July 2019. We also recognize there is no single framework for collaboration. However, collaboration is certainly more than hosting public meetings and accepting comments, if this input does not in any way shape the direction of the project. Collaborative development of a project, by definition, implies that an outcome, product, or decision has not been made before the development process begins. In this case, the Forest Service initiated Phase I and Phase II by announcing its intent to conduct regeneration harvests to ostensibly address gypsy moth threat in the area. There was never any open discussion about whether another course of action would be more appropriate, despite the many times we tried and offered science to support alternatives. Meaningful collaboration should involve "alter[ing] Project design to address feedback."[234]

D. <u>The Forest Service cannot salvage trees under Insect and Disease CE.</u>

The Insect and Disease CE does not apply to salvage harvest of trees killed by gypsy moth damage, because salvage does not restore or maintain ecological integrity in an area impacted by gypsy moth. If the District wants to pursue salvage, it can consider the Salvage CE. It is notable, though, that fieldwork did not reveal many recently dead trees in the stands surveyed.

IV. <u>**Other Issues**</u>

A. <u>Old Growth</u>

The Insect and Disease CE requires a project "maximize[] the retention of old-growth and large trees, as appropriate for the forest type, to the extent that the trees promote stands that are resilient to insects and disease."[235] We are glad that the District has conducted some old

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[231] <u>See</u> <u>Dubois v. Dept. of Agric.</u>, 102 F.3d 1273, 1292 (1st Cir. 1996), citing <u>Marsh v. Or. Nat. Res. Council</u>, 490 U.S. 360, 378 (1989); <u>see also</u> <u>see</u> <u>Northwoods</u>, 323 F.3d at 411.
[232] 16 USC § 6591b(b)(1)(C).
[233] *Id.*
[234] *See Greater Hells Canyon Council v Stein*, 2018 WL 3966289 at *15 (D. Or. 2018).
[235] 16 USC § 659b(b)(1)(A).

growth surveys as there is likely a significant amount of old growth within the project area.[236] The District must make clear though how this project will maximize retention of large trees also.

Based on conversations with District staff, it is our understanding that the District intends to remove all existing old growth from harvest units and/or ensure all old growth is left intact. We strongly support that approach. Should the Forest Service decide to move forward with any aspect of this project, we urge the agency to document that commitment in the Decision Memo and/or Decision Notice/Finding of No Significant Impact.

Old growth communities "are rare or largely absent" in Southeastern forests, perhaps occupying about one half of one percent (0.5%) of the total forest acreage.[237] For that reason, the agency is making efforts to address the restoration of old growth, which is a "missing portion of the southern forest ecosystems."[238] Old growth forest takes centuries to develop, so it is irreplaceable on a human time scale if it is replaceable at all.[239] Given the rarity and importance of old growth forest in the Southern Appalachians and the little existing old growth forest that has been identified in the field on the Eastern Divide District, it would be difficult to harvest any existing old growth without having significant impacts. These circumstances would preclude the use of a CE and would likely require an EIS.[240]

We firmly believe that any existing old growth should be protected and not logged. The rarity of this forest type suggests extra caution should be taken when forest stands have the potential to be old growth.

Given the notorious unreliability of both stand age and stand type within FSVeg data, actual existing old growth, once inventoried on the ground, is likely to be significantly less than the pool of possible old growth. All old growth that is identified in and around the project working areas should be protected because logging old growth based on unverified assumptions about its existence elsewhere would be contrary to the evidence before the agency regarding the significance and rarity of old growth conditions. Such actions would be very difficult to justify, especially without an EIS.[241]

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[236] *See* J. Bier, Eastern Divide Insect and Disease Project Phase II, Jefferson National Forest: Summary of Fieldwork at p. 3-4 (attached).
[237] USDA-Forest Service, Southern Region, Guidance for Conserving and Restoring Old-Growth Forest Communities in the Southern Region: Report of the Region 8 Old-Growth Team, 1 (June 1997) ("Region 8 guidance").
[238] *Id.*
[239] *See Neighbors of Cuddy Mountain v. U.S. Forest Service*, 137 F.3d 1372, 1382 (9th Cir. 1998); *accord Idaho Sporting Congress v. Alexander*, 222 F.3d 562 (9th Cir. 2000).
[240] *See* Region 8 Guidance at 12-14 (When assessing whether there may be significant impacts, CEQ regulations require the District to consider the intensity or severity of impacts on historic or cultural resources as well as ecologically critical areas. 40 C.F.R. § 1508.27. This includes considering the severity of impacts on old growth forest, which holds biological, wildlife, recreational, research, scientific, educational, cultural, aesthetic, and spiritual values.).
[241] *See* Region 8 Guidance at 12-14 (Old growth forests hold biological, wildlife, recreational, research, scientific, educational, cultural, aesthetic, and spiritual values.).

We also urge the District to include buffers around old growth patches to avoid damage from damage from logging operations around the old growth patches. This damage reduces the ecological integrity of these important old growth patches. Recently, we saw a small patch of old growth white oak all killed by logging operations around and through it. The District should consider such design criteria for this project.

B. Collaborative implementation is also required.

Should the Forest Service move forward with this project, the Insect and Disease CE requires the agency to continue collaborative process through implementation.[242] Phase I of this project was authorized under the Insect and Disease CE, but the Forest Service has failed to maintain a dialogue with interested stakeholders. For example, there was significant resource damage associated with the first project implemented under Phase I.[243] The Forest Service should convene a public process to discuss what transpired, how it was addressed, and how similar issues will be avoided in the future. It was troubling to hear Forest Service personnel attempt to characterize implementation as a success and commenting that the operator's unauthorized actions were superior to what was authorized in the first place.

[242] *Id.*
[243] *See* USDA Forest Service, Field Review Pocahontas Timber Sale Unit 1 (attached).

Thank you for your consideration of these comments. As the project moves forward and additional information is generated (e.g., stand exams for all working areas, the BE/BA), we would like to review them and perhaps submit additional comments. Please let us know if you have any questions or would like to discuss these comments.

Sincerely,

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Eastern Divide Insect and Disease Project Phase II, Jefferson National Forest: Summary of fieldwork

by Jessica Bier[1]

OBJECTIVES

The United States Forest Service (USFS) is proposing a vegetation management project called the Eastern Divide Insect and Disease Project Phase II on the Jefferson National Forest. The project area is in Bland, Giles, Pulaski, and Wythe Counties, Virginia. The USFS proposes approximately 1,366 acres of regeneration logging, using the clearcut with reserves method, to "address forest health concerns resulting from past gypsy moth defoliation and current gypsy moth presence."

Jessica Bier conducted fieldwork in the project area from April to June 2019 for the Southern Environmental Law Center. The primary objectives were to (1) assess impacts from defoliation that may have occurred in recent years (e.g., crown damage, mortality); and (2) determine the levels of current gypsy moth populations in the areas.

METHODS

Rose-Marie Muzika., Ph.D., provided guidance regarding survey methods for this fieldwork. Meander surveys (a walk-through, routinely noting conditions) were conducted in a subset of units in each of the seven working areas. See attached plot maps. Species composition, crown conditions, and all egg masses seen along each meander route were noted.

Within the subset of units, fixed-radius plots (1/4 acre) were used to sample individual tree vigor/health. For all trees larger than 5 inches in diameter at breast height (dbh), within the plots, the following was recorded: crown condition (as a measure of vigor and tree health); the presence of mortality, egg masses and defoliation; and tree species composition.

- **Vigor-** Crown condition was used as a measure of vigor and tree health. A three-class rating system was used that generally follows the approach provided in the USFS'

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[1] Education
M.S. Ecology and Evolutionary Biology, University of Tennessee Knoxville, TN
B.S. Environmental Science, Ferrum College, Ferrum, VA

Relevant Work Experience
Forestry Technician, USFS Clinch RD George Washington and Jefferson NF, 2006-2016
Biological Technician, USFS Clinch RD George Washington and Jefferson NF, 2003-2006
Biological Technician, NPS Great Smoky Mountains NP, 1999-2003
Independent Contractor, Virginia Slow the Spread, 1993-1998 (placed gypsy moth pheromone traps on 500 meter and 1 kilometer grids in 3 counties, checked, and reported catch totals)

Photographic Guide to Crown Condition of Oaks: Use for Gypsy Moth Silvicultural Treatments.[2] See Table 1 below. For areas visited after leaf out (2nd week of May), levels of defoliation were estimated in the area of each plot, following Virginia's *Guide to Estimating Gypsy Moth Defoliation*.[3]

Table 1.

Vigor classes	Characteristics
Good	Extensive lateral branching, dieback is absent or minimal, wounds/canker are absent or minor, little or no epicormic branching. Foliage is healthy.
Fair	Moderate dieback (25-49% of branches are dead), epicormic branching may be present. Foliage density, size, and coloration are subnormal.
Poor	Major dieback (50% or more of branches are dead), epicormic branching is heavy, extensive wounds/cankers and/or signs of decay present. Foliage density, size, and coloration are subnormal.

- **Mortality***:* Prior to leaf out, trees were classified as dead if no fine branches with leaf buds were present. After leaf-out, trees were classified as dead if live foliage was absent.

- **Gypsy moth egg masses**: Surfaces of trees, stumps, and rocks within each plot were searched. In areas visited prior to leaf-out, upper trunks and large branches were searched using binoculars. In areas visited after leaf-out, foliage obstructed views of upper trunk and branches, so searches concentrated on tree trunks within 6 feet of ground level. Egg masses located below 6 ft. were classified as viable (laid in 2018) or not viable (laid in earlier years) based on appearance and feel/texture.

[2] Gottschalk and MacFarlane, USFS, *Photographic Guide to Crown Condition of Oaks: Use for Gypsy Moth Silvicultural Treatments* (Feb. 1993).
[3] Va. Dept. of Agriculture and Consumer Services, Virginia Cooperative Gypsy Moth Suppression Program: 2019 Guidelines for Participation Aerial Treatments, Appendix H, available at https://www.vdacs.virginia.gov/pdf/guide05a.pdf.

FINDINGS

- **Composition Summary**

The overstory in the units visited is dominated by one to several oak species. Chestnut oak, scarlet oak, white oak, black oak, and northern red oak (in probable order of overall abundance), are found in units at varying percentages. White pine and/or yellow pine (primarily pitch pine, some table mountain, and possibly shortleaf) are also common overstory species. They have a scattered occurrence in many units, and are dominant overstory and/or midstory species in portions of some units (e.g. Caseknife Unit 5, Bromley Hollow Unit 6). Other hardwood species present in units include sourwood (the most abundant midstory species), red maple, blackgum, hickory, and tulip poplar.

- **Summary of Gypsy Moth Damage/Mortality**[4]

In many of the units, there is no notable damage and/or mortality, or it is minimal. It is unlikely that severe defoliation has previously occurred in these units. In units where damage is evident, it is mostly at low to moderate levels, and is patchily distributed. The plot data reflects this relatively low level of impacts. Of the 870 overstory plot tree crowns sampled, most appear healthy:

- 77% were classified as Good vigor,
- 16% were classified as Fair vigor,
- 1% were classified as Poor vigor, and
- 6% were dead.

It is worth noting that damage/dieback resulting from previous gypsy moth defoliation cannot be distinguished from decline and/or mortality caused by other factors that have also affected the project area (e.g. weather, competition, disease, other defoliators). Some of the observed damage and mortality may have been caused by these factors.

- **Summary of Gypsy Moth Egg Masses**

Although gypsy moth egg masses were seen in 5 of the 7 working areas, all that could be closely examined (i.e. were within reach) were from previous seasons and not viable. Three egg masses (two at Dismal, one at Caseknife) were probably from the current season based on appearance, but they were located up high so this could not be confirmed by touch. A total of 6 gypsy moth caterpillars were seen in 2 units within the Caseknife and Tunnel Hollow areas. None were seen in the 2 other areas (Bromley Hollow and Gatewood Reservoir) visited during the expected timeframe of peak gypsy moth caterpillar activity (mid-May to early June).

[4] Due to variability within units and the number of plots per unit, these results provide only an approximation of current conditions.

- **Summary of Current Defoliation by Gypsy Moth and/or other Defoliators**

Defoliation levels of oaks at the 4 areas visited after leaf out was very low (<10%). It was primarily limited to dime to quarter-sized holes, present at low densities. Higher levels were seen on a couple oaks along the access road and in the units at Caseknife. It is important to note that some defoliation in the units is attributable to defoliators other than gypsy moth caterpillars. For example, larvae of the oak sawfly, a native defoliator, were numerous in the area and seen actively feeding on oak leaves. Oak blotch leafminers and oak shothole leafminers are also likely to be present in the units, based on the appearance of herbivory damage.

The low number of viable egg masses and/or gypsy moth caterpillars, in addition to the absence of significant defoliation, indicate current population levels are quite low. Damage/defoliation from gypsy moth caterpillars does not appear to be an immediate threat to forest health in the project areas.

- **Specific Working Areas**

  - <u>Peak Creek Area</u>

Visited April 4, 2019.

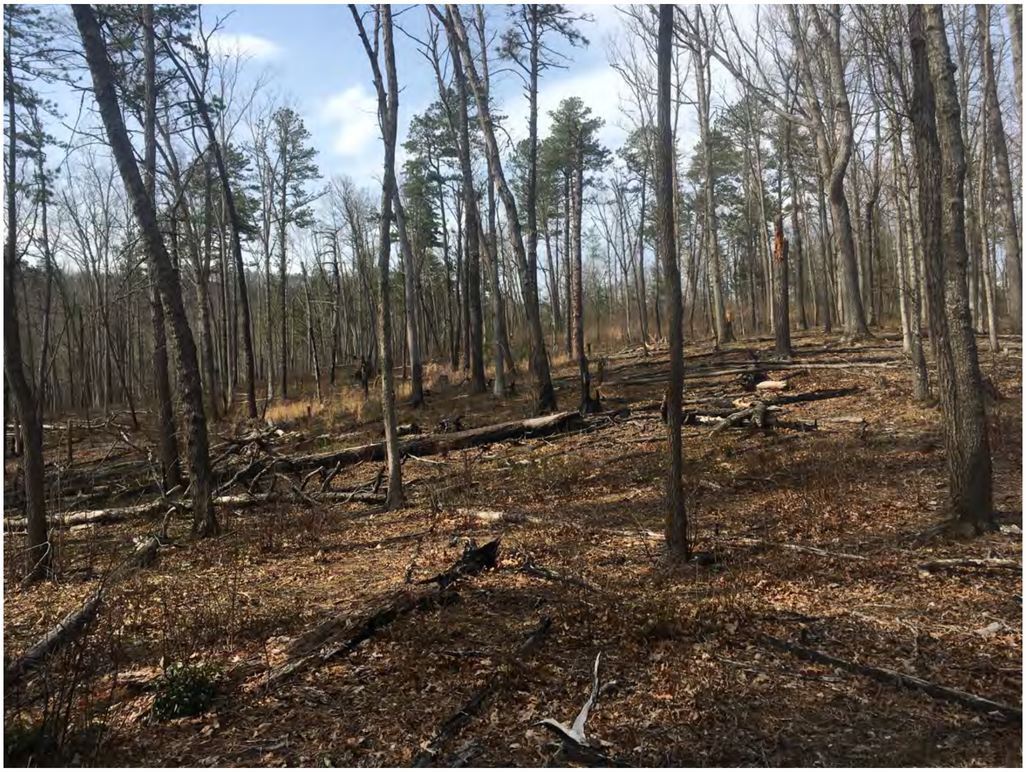
Unit 1 is mixed oak with scattered yellow pine and a few white pines. In Unit 2, oak and pitch pine are the primary overstory species. Unit 4 is mixed oak with a white pine component on the lower slopes, and yellow pine present on the upper slopes. Unit 5 is oak-pine; white pine is a primary overstory species.

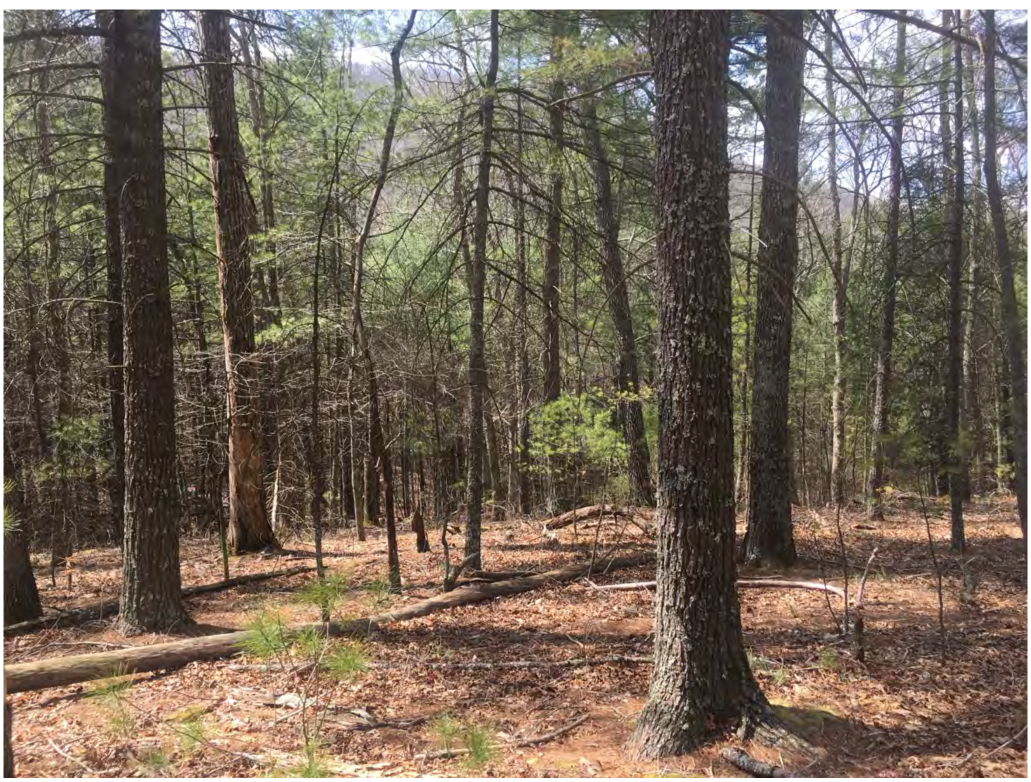
Units 1 and 2 are located within what is assumed to be a prescribed burn area. There was significant overstory mortality (over 30%) in portions of these units, and much of the midstory was topkilled. There is extensive acreage adjacent to the working area, north of FSR 707, where fire caused very high levels of mortality in both the midstory and overstory.

There is no apparent damage from past gypsy moth defoliation in the 4 units visited. Trees not impacted by the prescribed burning showed no signs of damage/dieback that typically results from severe defoliation, and no loss of fine branches was evident. No egg masses were found in any of the units.

Table 2. Peak Creek Plot Data

Unit	# of Plots	Vigor: Good	Vigor: Fair	Vigor: Poor	# of Dead Trees	# of New Egg Masses	% Defoliation
1	4	11	7	4	3	0	NA
2	2	3	3	3	1	0	NA
4	4	18	6	0	0	0	NA
5	4	19	2	1	1	0	NA
Total	**14**	**51** (62% of trees)	**18** (22% of trees)	**8** (10% of trees)	**5** (6% of trees)	**0**	**NA**


Peak Creek Area, Unit 2 inside Rx burn area


Peak Creek Area, Unit 4 with white pine component

- Walker Mountain Area

Visited April 27, 2019.

Units 1, 2, and the northern half of Unit 3 are mixed oak-hickory. Both white pine and yellow pine are numerous in the half of Unit 3 located south of SR 717, especially in the southern and western areas. Areas of potential old growth are present in Units 1 and 2, with numerous large/old white oak and chestnut oak.

Numerous water features (channelized, springs, seeps, wetlands) were seen in Units 1 and 2. Slopes near the northwestern boundary of Unit 1 are steep, with very little soil development.

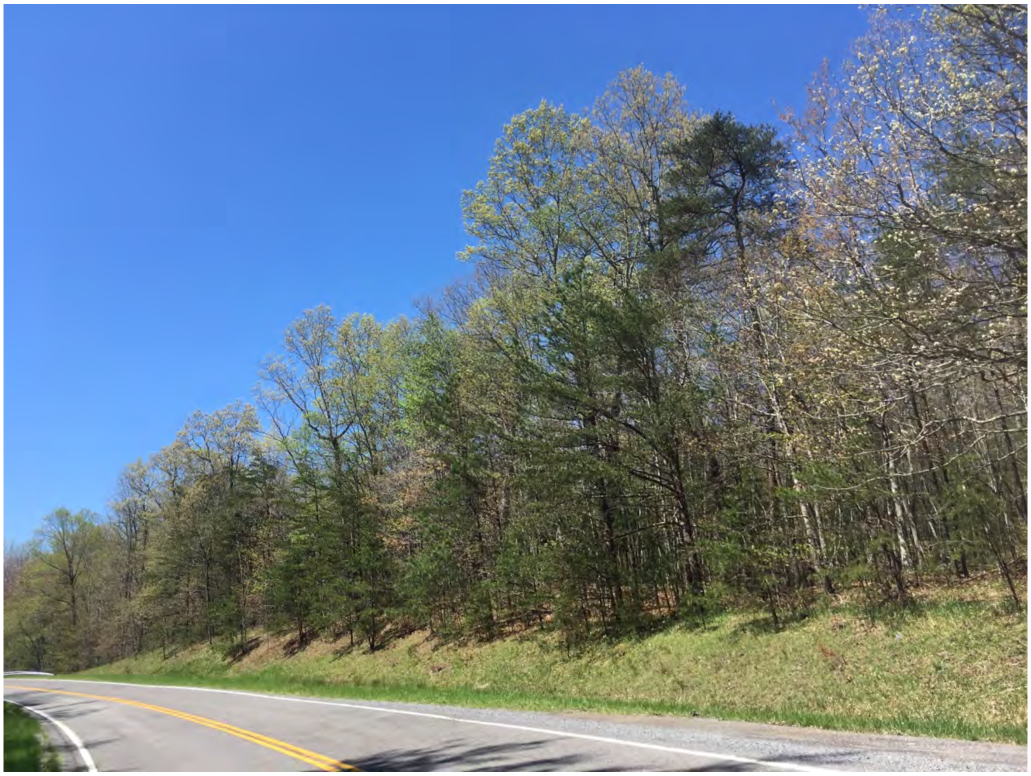
While visible impacts from past defoliation are evident in Units 1 and 2, a majority of the trees appear healthy, with low to moderate levels of dieback. There is scattered mortality, but it is limited to isolated/individual, or small groups, of trees. Good vigor trees with little damage were seen immediately adjacent to these snags. Lower levels of damage and mortality are present in Unit 3.

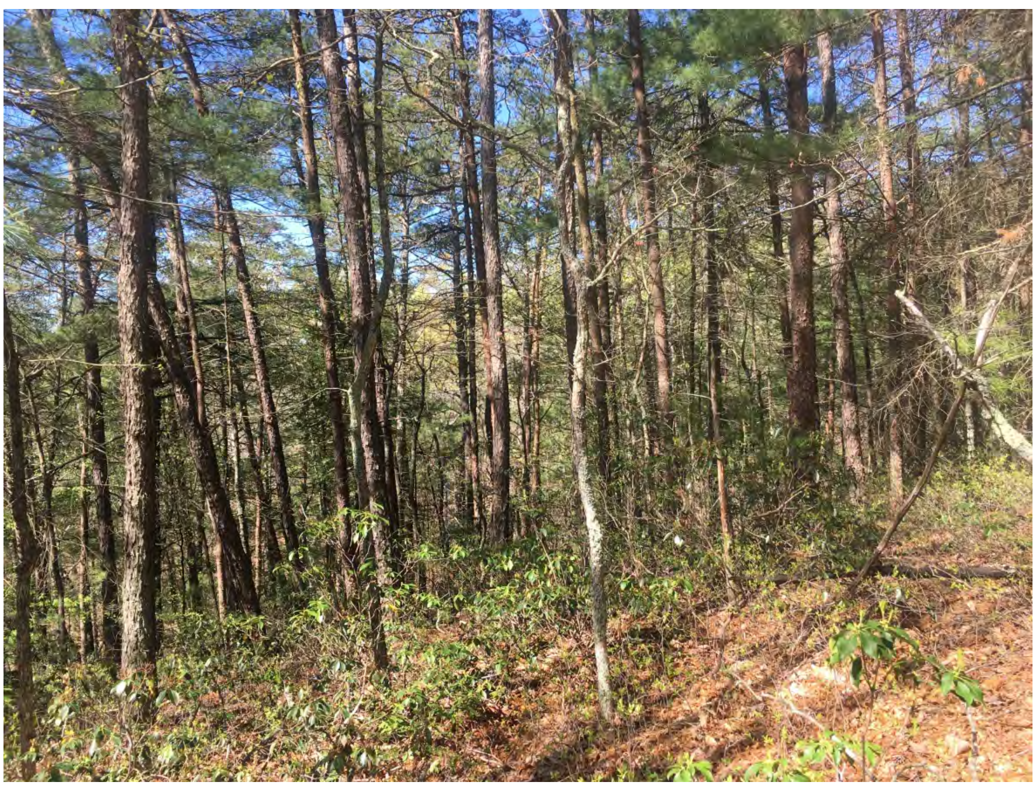
No viable egg masses were found. Several old egg masses and/or egg mass remnants were seen in a plot located in the NW corner of Unit 1, and several more were seen on an old chestnut oak outside of the plot.

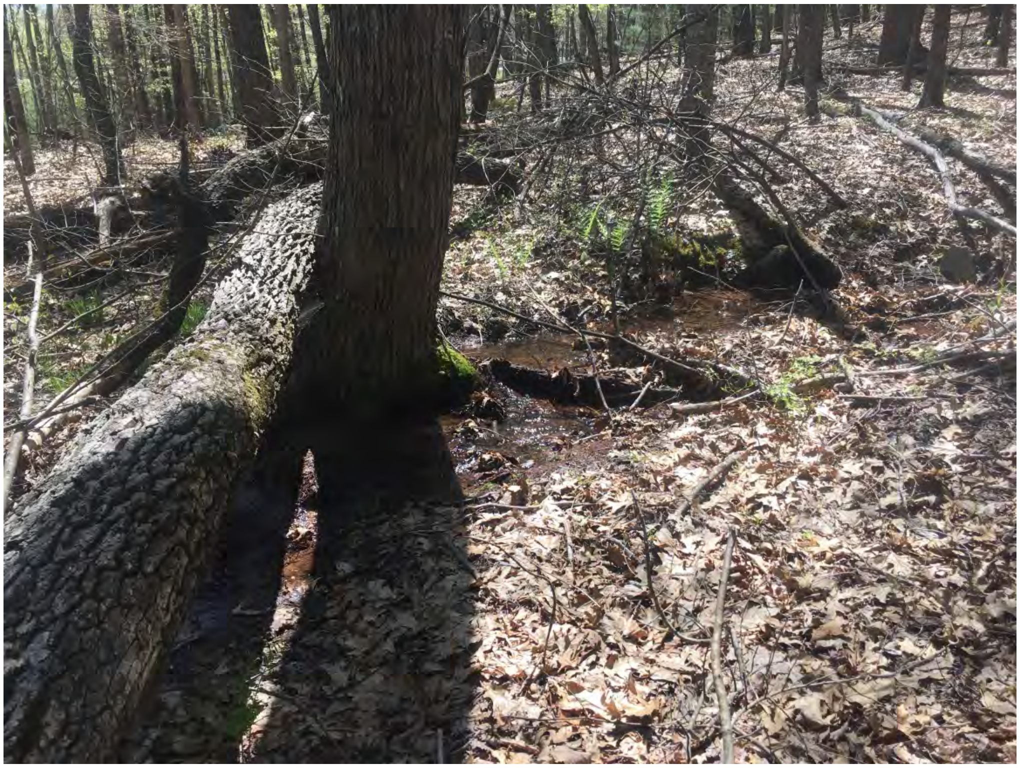
Table 3. Walker Mountain Plot Data

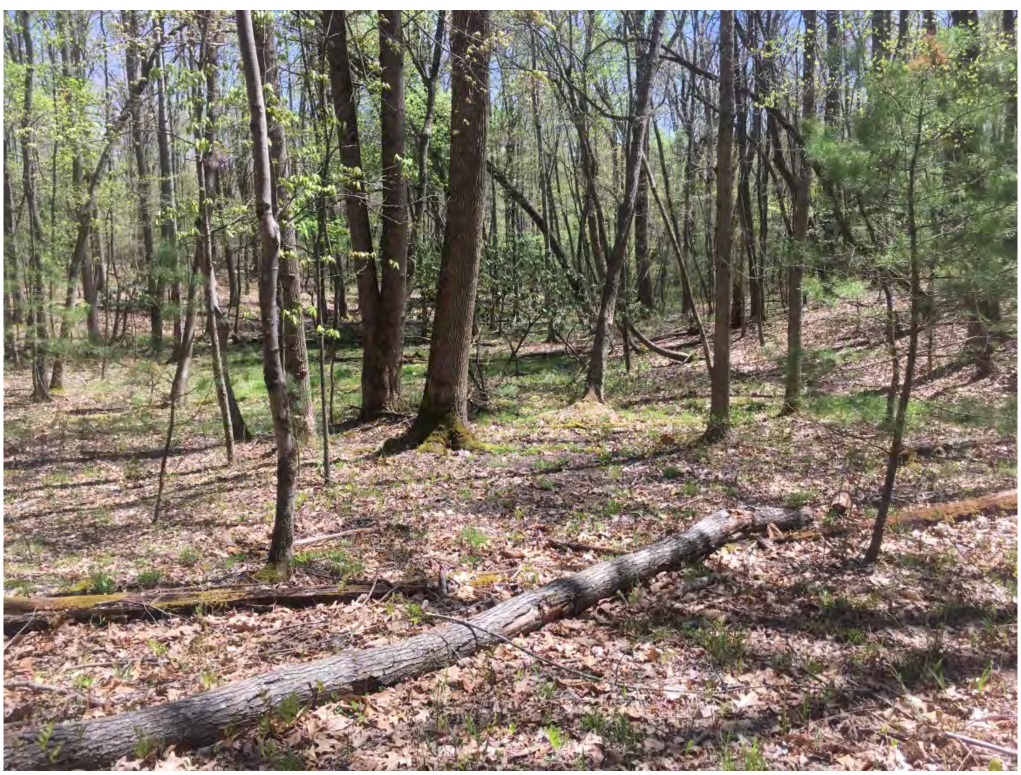
Unit	# of Plots	Vigor: Good	Vigor: Fair	Vigor: Poor	# of Dead Trees	# of New Egg Masses	% Defoliation
1	3	11	9	0	4	0	NA
2	4*	19	5	0	2	0	NA
3	6	45	15	0	3	0	NA
Total	**13**	**75** (66% of trees)	**29** (26% of trees)	**0** (0% of trees)	**9** (8% of trees)	**0**	**NA**

*One of the plots located just outside unit boundary.


Walker Mountain Area, Unit 3 north of SR 717, showing healthy oak crowns.


Walker Mountain Area, Unit 3 south of SR 717, showing significant pine component


Walker Mountain area, spring


Walker Mountain area, wetland


Walker Mountain Area, Unit 1 isolated mortality


Walker Mountain Area, Unit 1 old egg mass remnants

- Dismal Area

Visited April 13, 2019 and May 1, 2019.

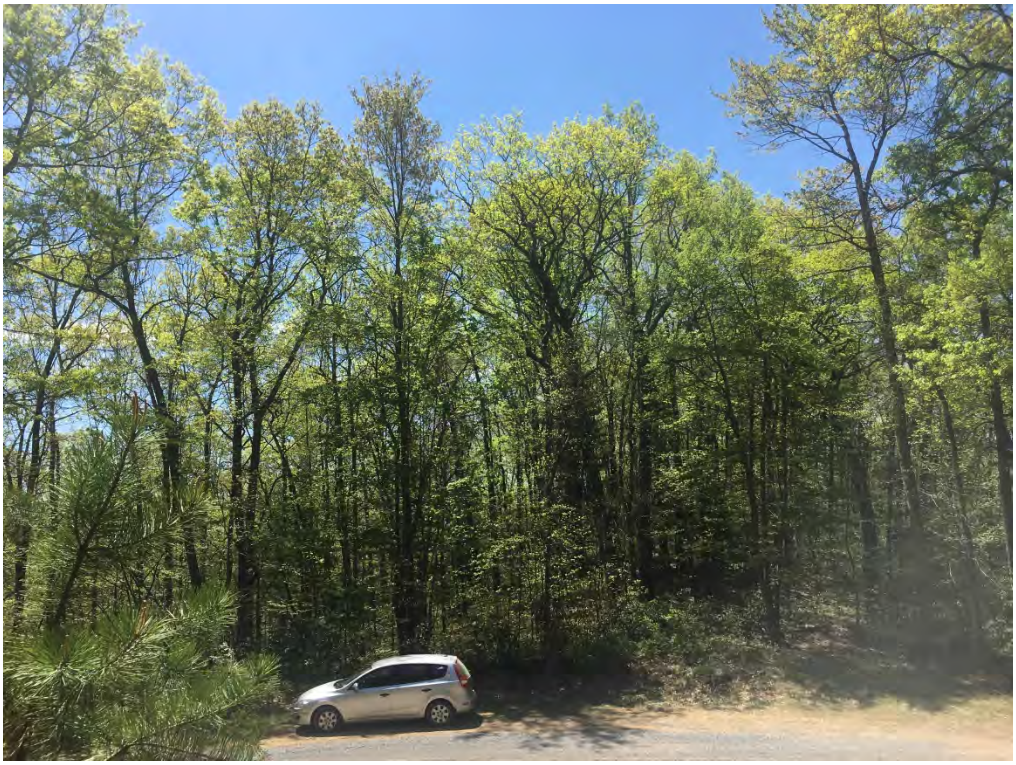
All units are mixed oak, with chestnut oak and scarlet oak being the most abundant species. Units 10, 11, and 12 have scattered white and yellow pine. Yellow pine appears to have once been present at much higher densities. There were several dead and down yellow pine in these units, at various stage of decay, as well as a few dead, still standing.

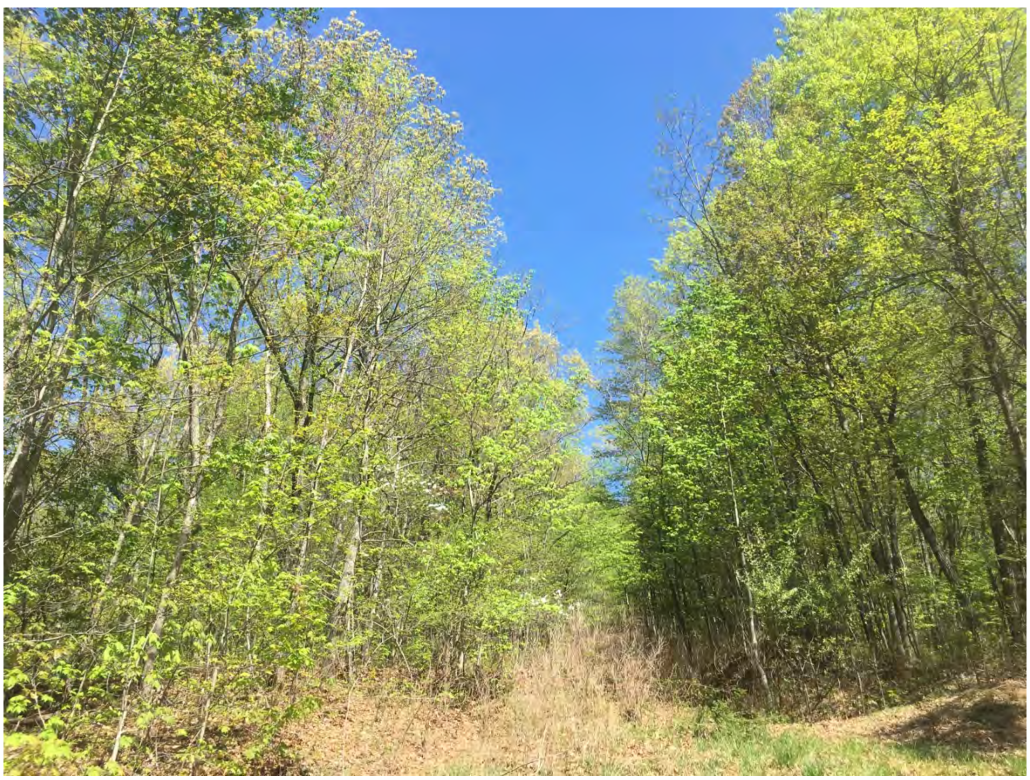
Where present, damage from past defoliation is mostly minor, with scattered moderate levels of damage/dieback, primarily in Units 10 and 12. Very few dead trees were seen in the units.

Two egg masses were found, both located above 6 feet, precluding the determination of whether they were viable. They did have a very different appearance (intact/sound with pinprick holes visible) from old masses seen in other areas and appeared recently hatched. Based on appearance, they are likely from this season.

Table 4. Dismal Area Plot Data

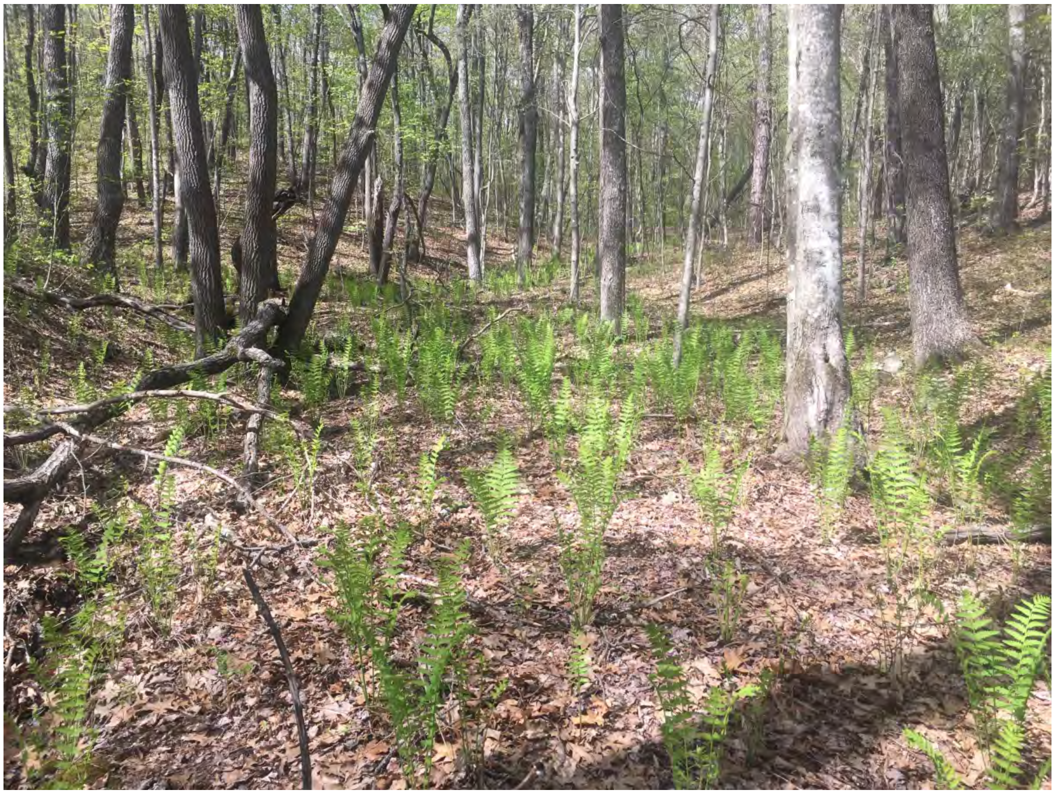
Unit	# of Plots	Vigor: Good	Vigor: Fair	Vigor: Poor	# of Dead Trees	# of New Egg Masses	% Defoliation
7	5	32	2	0	1	0	NA
9	5	26	3	0	2	0	NA
10	3	21	4	0	0	1*	NA
11	3	15	1	0	1	1*	NA
12	4	20	7	0	1	0	NA
18	5	25	10	1	0	0	NA
Total	**25**	**139** (81% of trees)	**27** (16% of trees)	**1** (0% of trees)	**5** (3% of trees)	**2***	**NA**

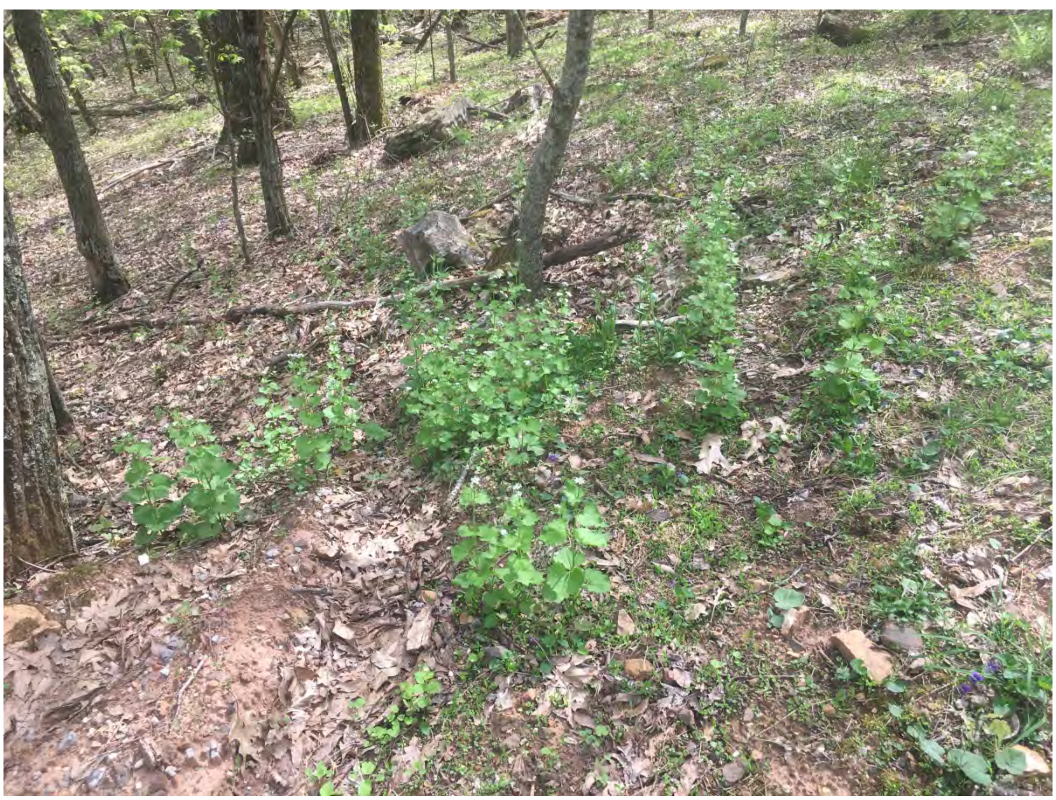

Dismal area, Unit 10 from road, showing healthy crowns


Dismal Area, Unit 9 on both sides of interior trail, showing healthy crowns

Dismal Area, Unit 12, area with many young/small diameter oaks

Dismal area, Unit 12 waterhole


Dismal area, Unit 7, probable wetland


Dismal area, Unit 7, non-native invasive Garlic mustard

- <u>Caseknife Area</u>

Visited May 13, 2019.

The units visited are all mixed oak, with chestnut oak, scarlet oak, and black oak being the primary oak species. There is also a white pine component present in Unit 5. Unit 2 contains notably large dbh/old oaks (up to 37” dbh). These larger trees are primarily confined to the ridgetop portion of the unit. Units 2 and 3 have a relatively high density of smaller oaks (<12” dbh), in addition to remnants from an older age class.

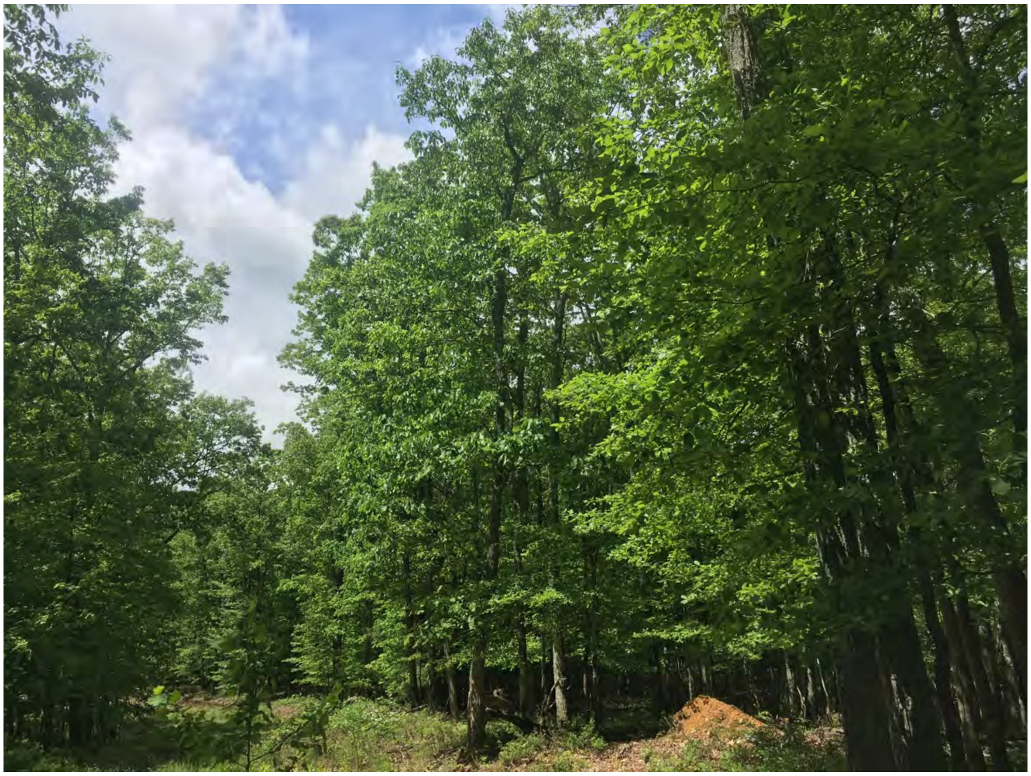
Crown damage is minor in a majority of the unit areas, with some scattered pockets of both moderate and severe damage/dieback. Isolated, individual mortality is present, primarily in Units 3 and 5.

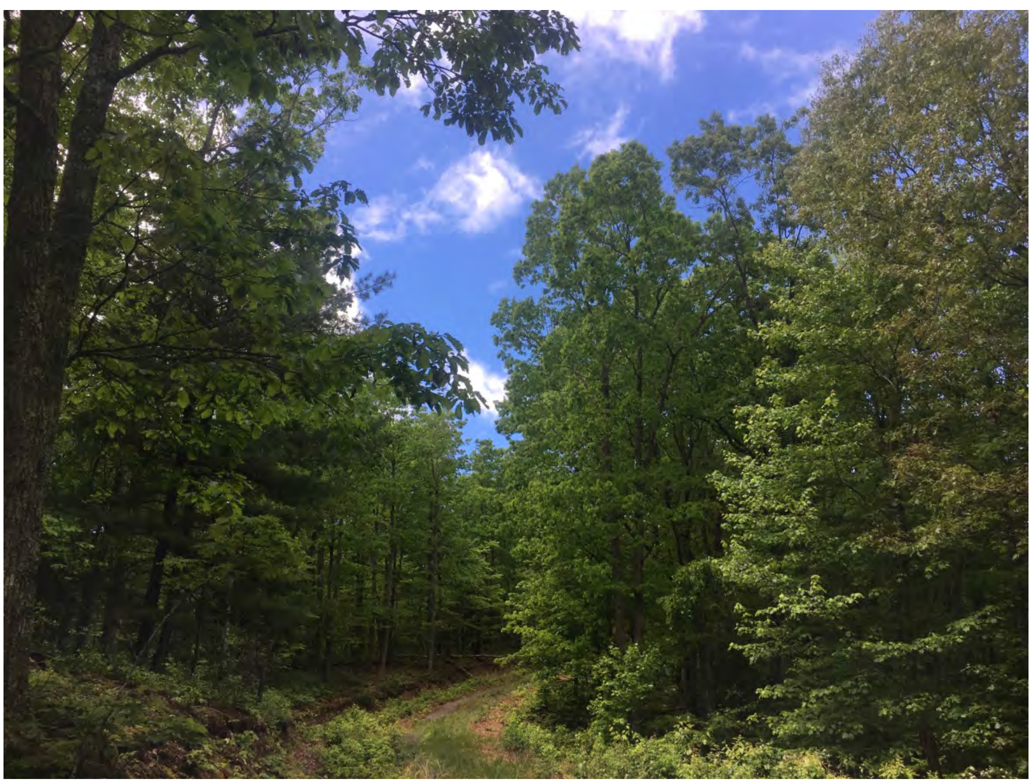
Three egg masses were found in Unit 3: 1 inside and 2 outside a plot. Based on the sound appearance and presence of small pinholes, the one found inside a plot appeared to be viable and recently hatched. The other two were located higher on the trunks, so could not be definitively classified as old or new. Based on appearance, they were most likely from previous seasons.

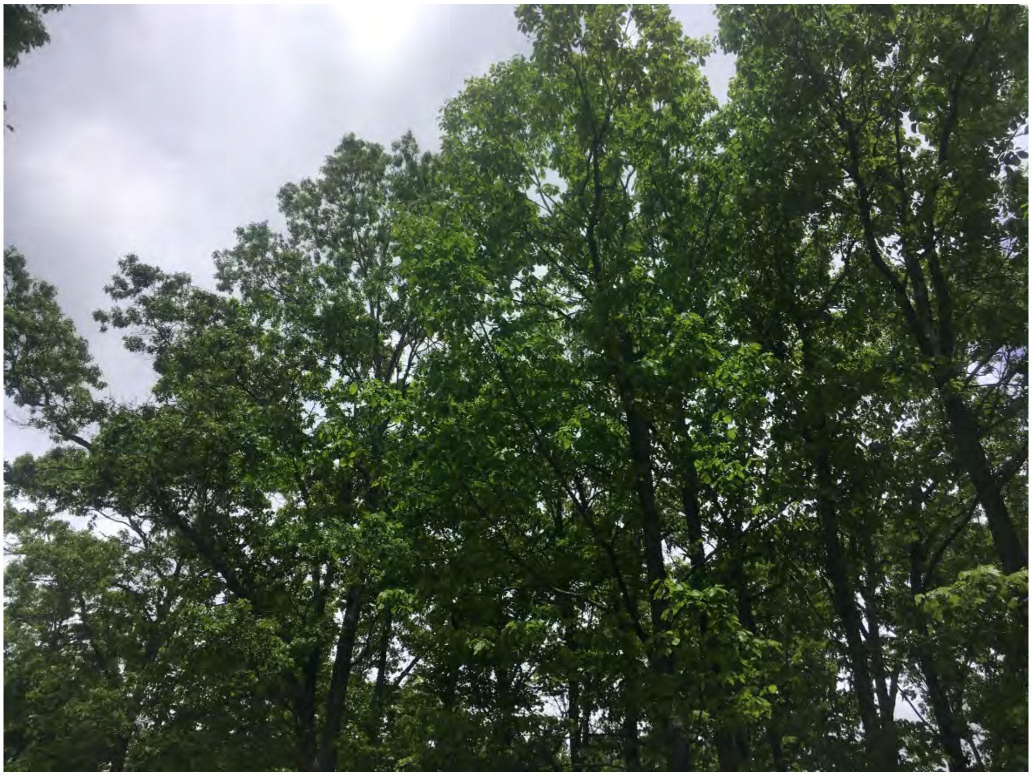
Four gypsy moth caterpillars were seen: 3 inside a Unit 3 plot and 1 immediately outside this plot. Defoliation in this area and in all other plot areas did not exceed 10%. Herbivory in the unit areas appeared primarily as scattered dime- to quarter-sized holes, mostly in lower leaves. There was noticeable defoliation (still at lower levels) along the transmission line access road. The road opening allowed close examination of lower branches on several trees where defoliation was occurring, and sawfly larvae appeared to be responsible for most of the ongoing defoliation.

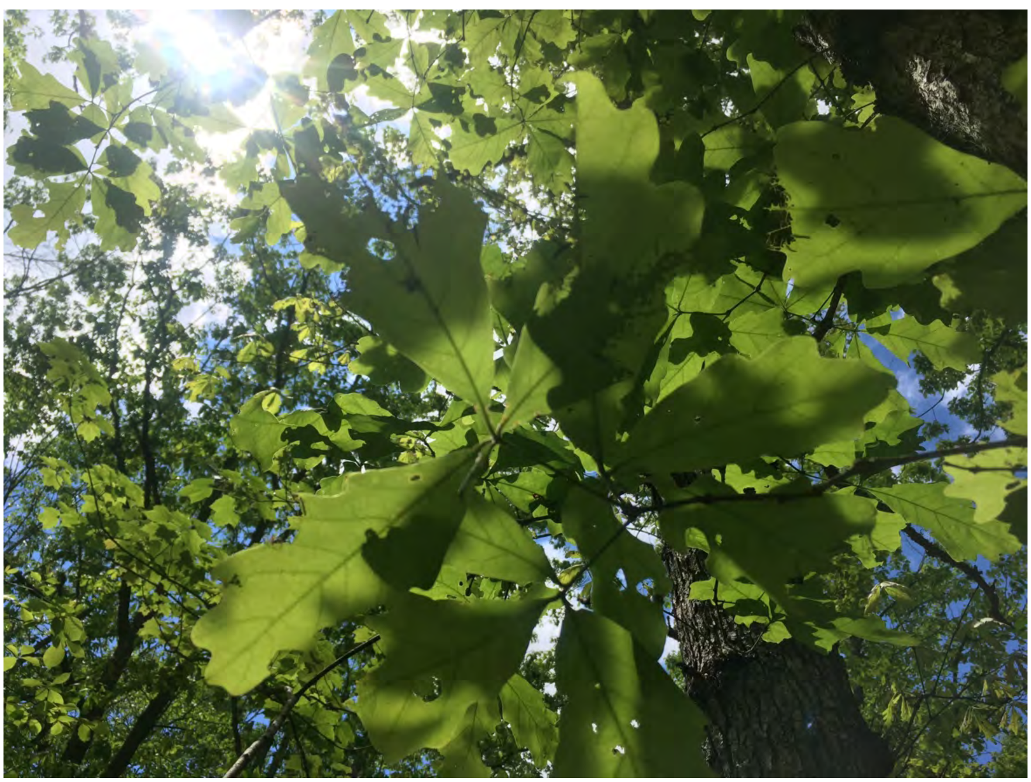
Table 5. Caseknife Area Plot Data

Unit	# of Plots	Vigor: Good	Vigor: Fair	Vigor: Poor	# of Dead Trees	# of New Egg Masses	% Defoliation
2	4	24	3	0	0	0	<10%
3	5	23	7	0	1	1	<10%
5	6	32	7	0	1	0	<10%
6	2	11	1	0	0	0	<10%
Total	**17**	**90** (79% of trees)	**18** (16% of trees)	**0** (0% of trees)	**6** (5% of trees)	**1**	**NA**


Caseknife Area, Unit 3, showing healthy oak crowns.


Caseknife area, Unit 5, showing healthy oak crowns.


Caseknife area, Unit 3, healthy crowns along Forest Service road


Caseknife Area, Unit 5, sawfly larvae herbivory on white oak


Caseknife Area, access road, sawfly larvae

- <u>Bromley Hollow Area</u>

Visited May 24, 2019.

The predominant overstory species in Unit 3 are chestnut oak, white oak, and black oak. Both white pine and yellow pine are present, with yellow pines more numerous on the upper slopes and ridgetops. Unit 4 was unique with regards to the presence of a number of mature northern red oak. Units 5, 7, and 8 appeared to have a higher site index than most units visited, and included some larger diameter tulip poplar and white pine, in addition to vigorous white oaks. There are numerous large/old white oaks in Unit 8, and a portion of this unit may be characterized as old growth. Chestnut oak and yellow pine are the primary overstory species in Unit 6.

Two stream channels with unique morphology are located in Unit 5, in addition to numerous seeps, springs, and ephemeral channels below FSR 6031. Much of the area is also very rocky.

With the exception of Unit 6, damage from possible past defoliation is either absent or at low levels in the units visited. The majority of trees showed no signs of damage. Two isolated clumps of mortality (3 and 4 trees in ~¼ acre) were seen in Unit 5, though they were surrounded by healthy trees, so causal agent of their decline is uncertain.

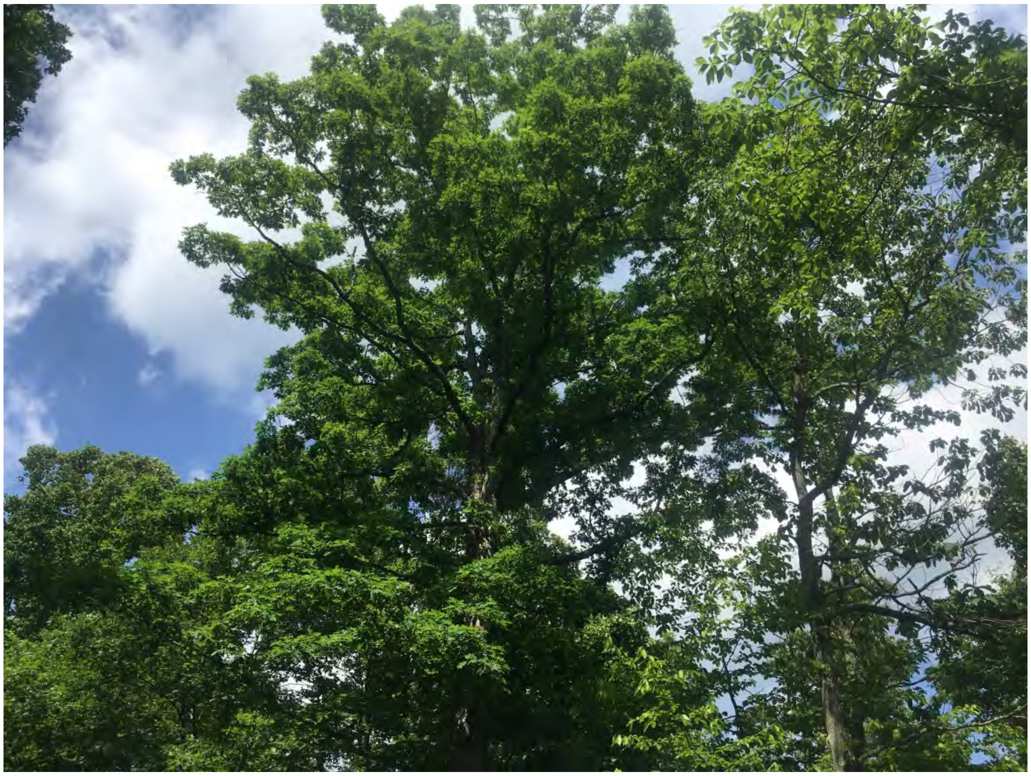
There are higher levels of overstory mortality in portions of Unit 6. Many of the dead trees are in advanced stages of decay (no bark, loss of all smaller diameter limbs, outer couple inches rotten), indicating they died several years ago. It did not appear that many of the live trees are in an active state of decline.

The only significant defoliation observed was on sourwoods; some had been 100% defoliated. Several lettered sphinx moth caterpillars were seen on the forest floor, and are presumably responsible for the defoliation of sourwoods.

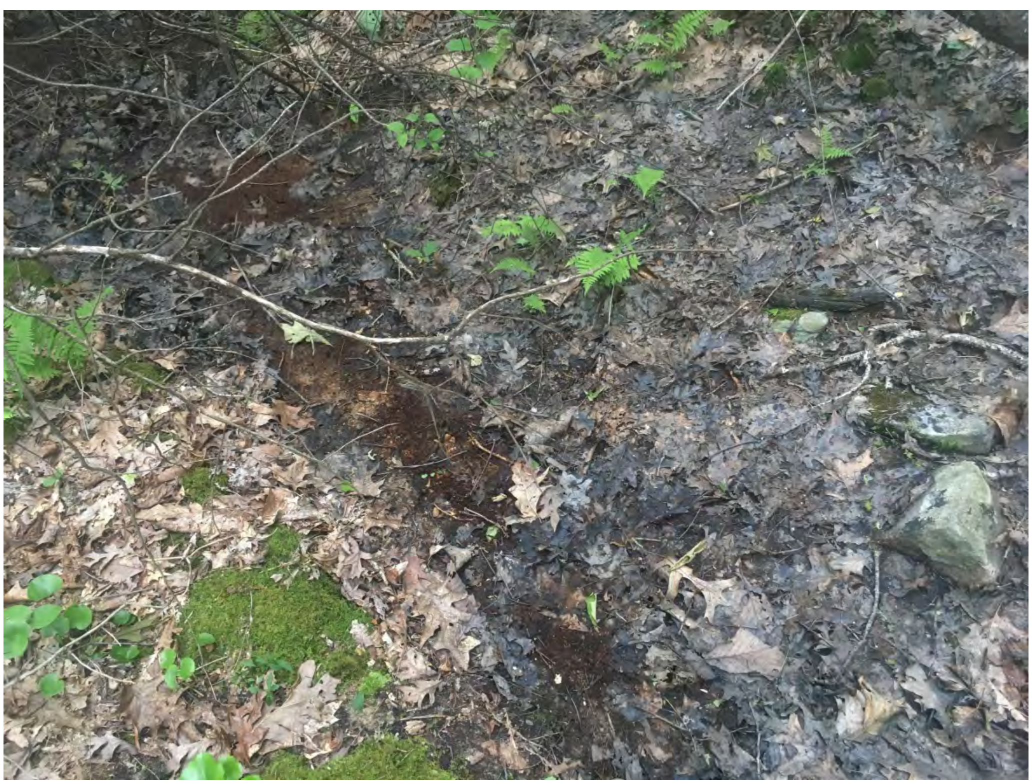
No egg masses were found within the plots. Three old, mostly decomposed egg masses were seen outside plots in Unit 3.

Table 6. Bromley Hollow Area Plot Data

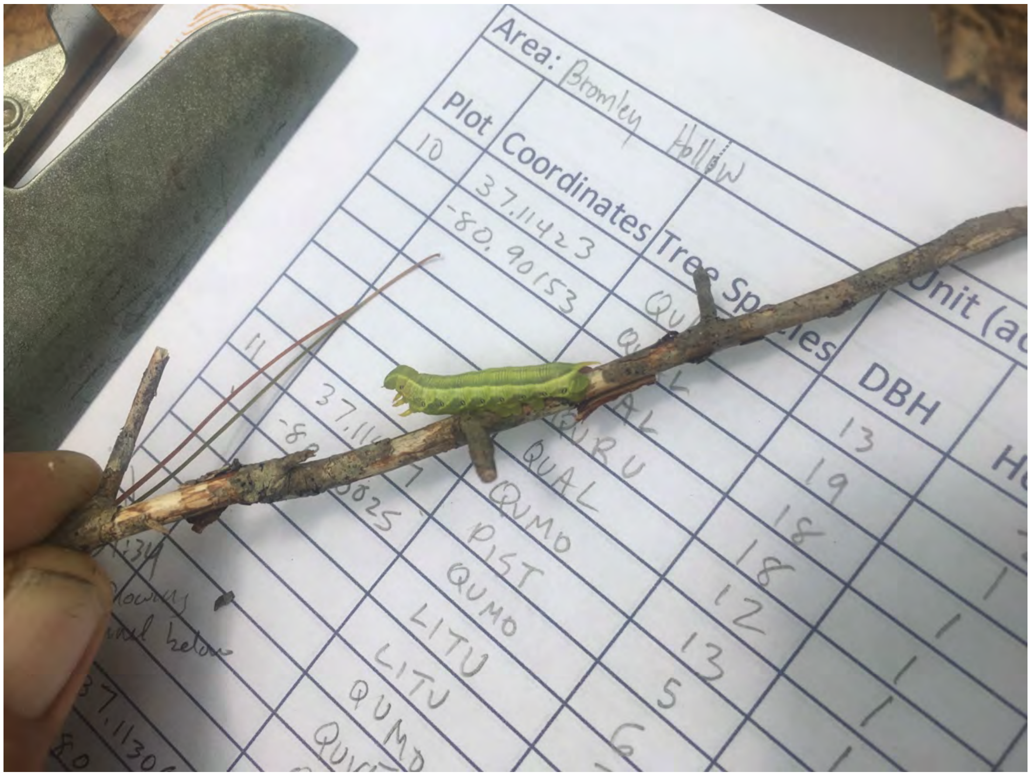
Unit	# of Plots	Vigor: Good	Vigor: Fair	Vigor: Poor	# of Dead Trees	# of New Egg Masses	% Defoliation
3	7	39	4	0	0	0	<10%
4	2	4	1	0	2	0	<10%
5	5	27	3	0	3	0	<10%
6	3	7	1	0	6	0	<10%
7	2	9	2	0	0	0	<10%
8	2	10	0	0	0	0	<10%
Total	**21**	**96** (81% of trees)	**11** (9% of trees)	**0** (0% of trees)	**11** (9% of trees)	**0**	



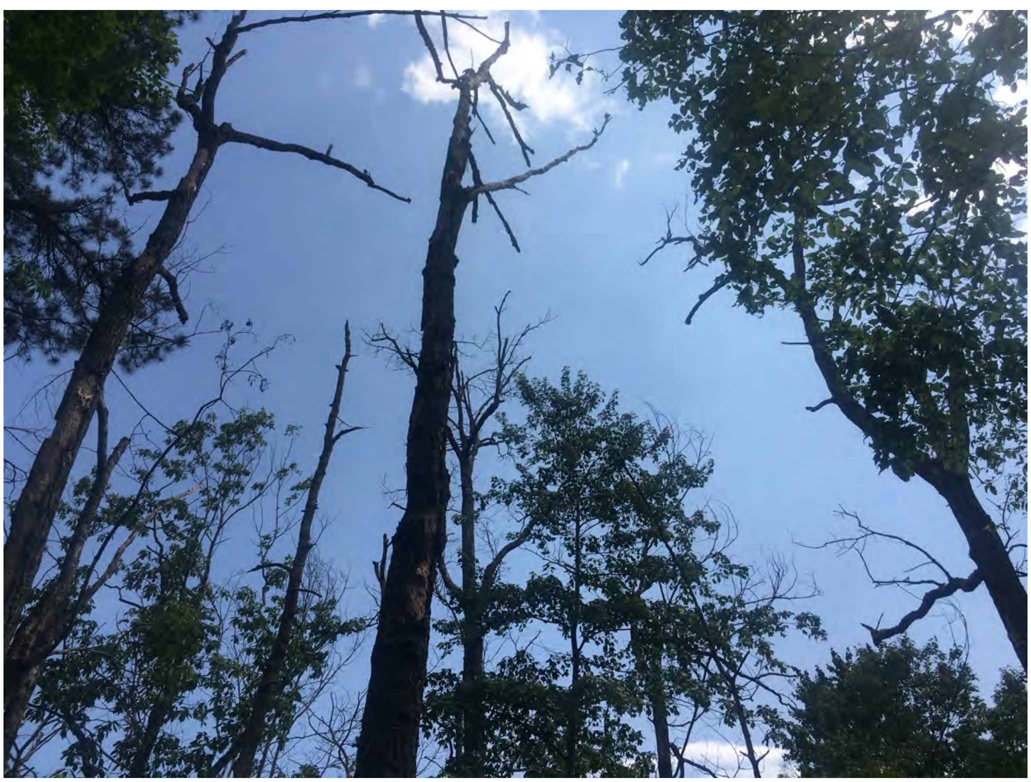
Bromley Hollow, between Units 6 and 7, healthy white oak crowns

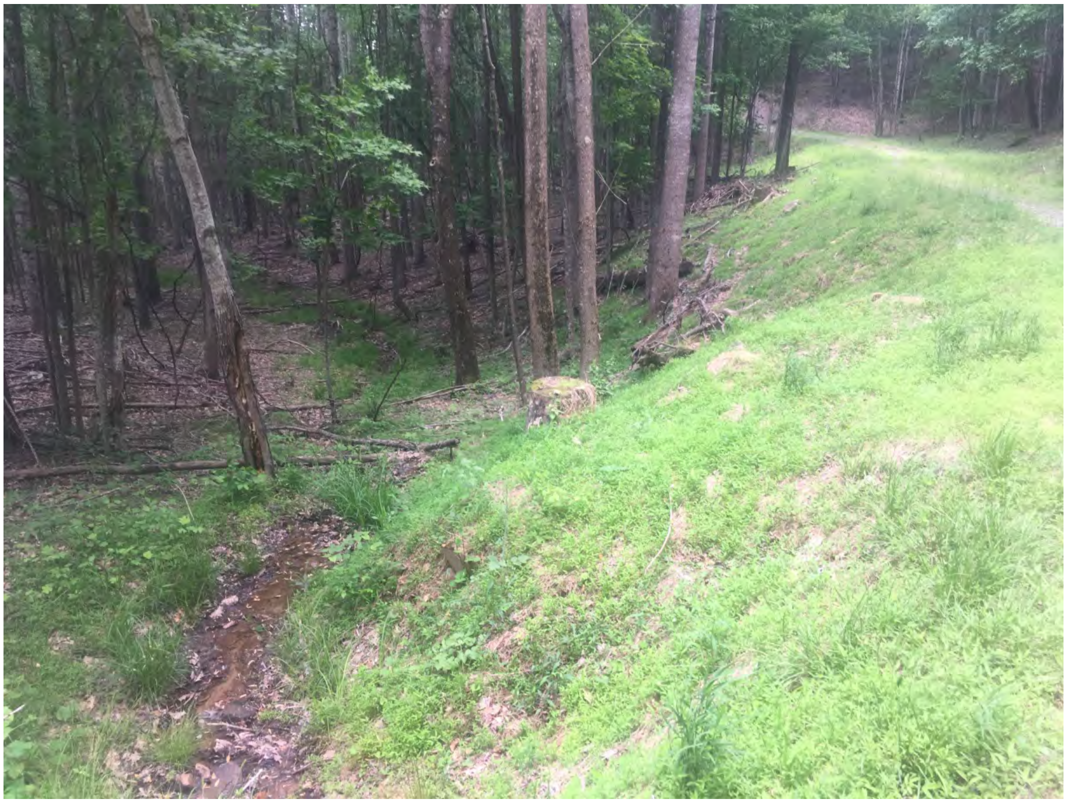


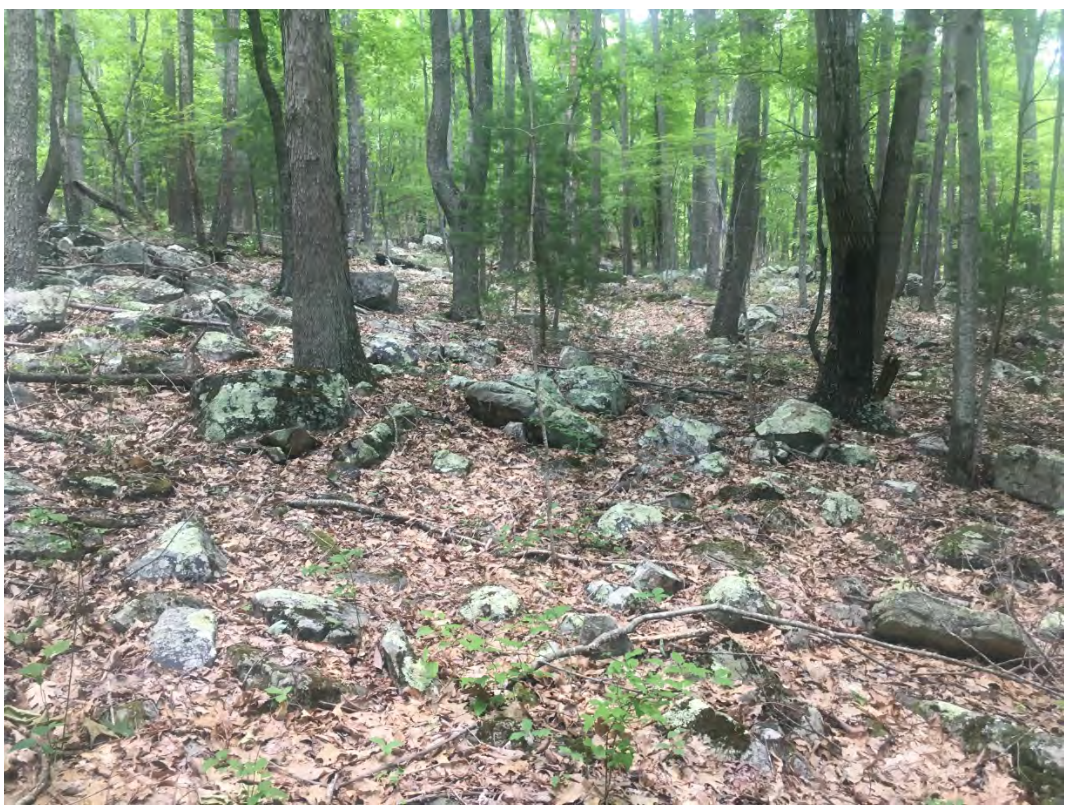
Bromley Hollow area, Unit 5, one of many ephemeral streams and seeps



Bromley Hollow, Unit 5, lettered sphinx moth caterpillar, sourwood defoliator


Bromley Hollow Area, Unit 6, area of high levels of mortality


Bromley Hollow area, non-native invasive stiltgrass along FS Road 6031


Bromley Hollow area, Unit 5, showing rocky conditions

- Tunnel Hollow Area

Visited May 27, 2019.

Chestnut oak is the dominant overstory species in all units visited. Unit 1 contains an area on the SW-NE oriented ridge that appears much younger than the rest of the unit, and is a mix of white pine (8-12" dbh) and oak (4-8"). Pines are numerous in Unit 2 south of the interior road. Northern red oak and tulip poplar are present in the western finger of Unit 5.

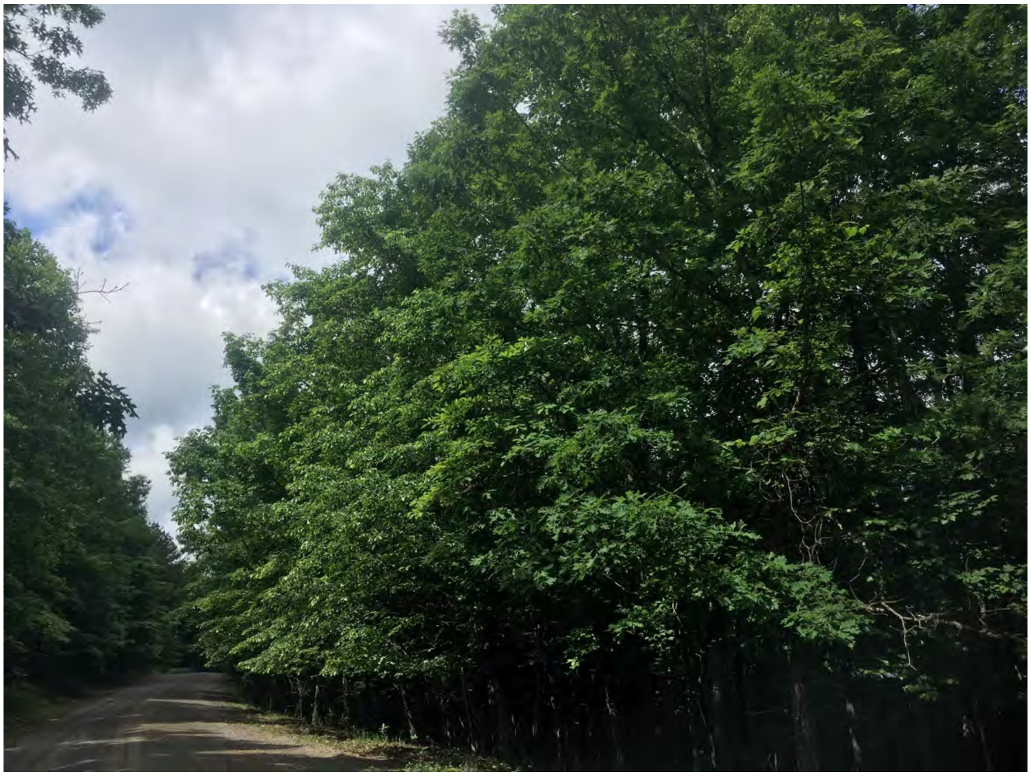
Impacts from previous defoliation is primarily limited to minor levels of dieback. Higher amounts of moderate, and some severe, crown damage were seen in Unit 1, outside of the plots. Widely scattered, isolated mortality is present in this unit as well.

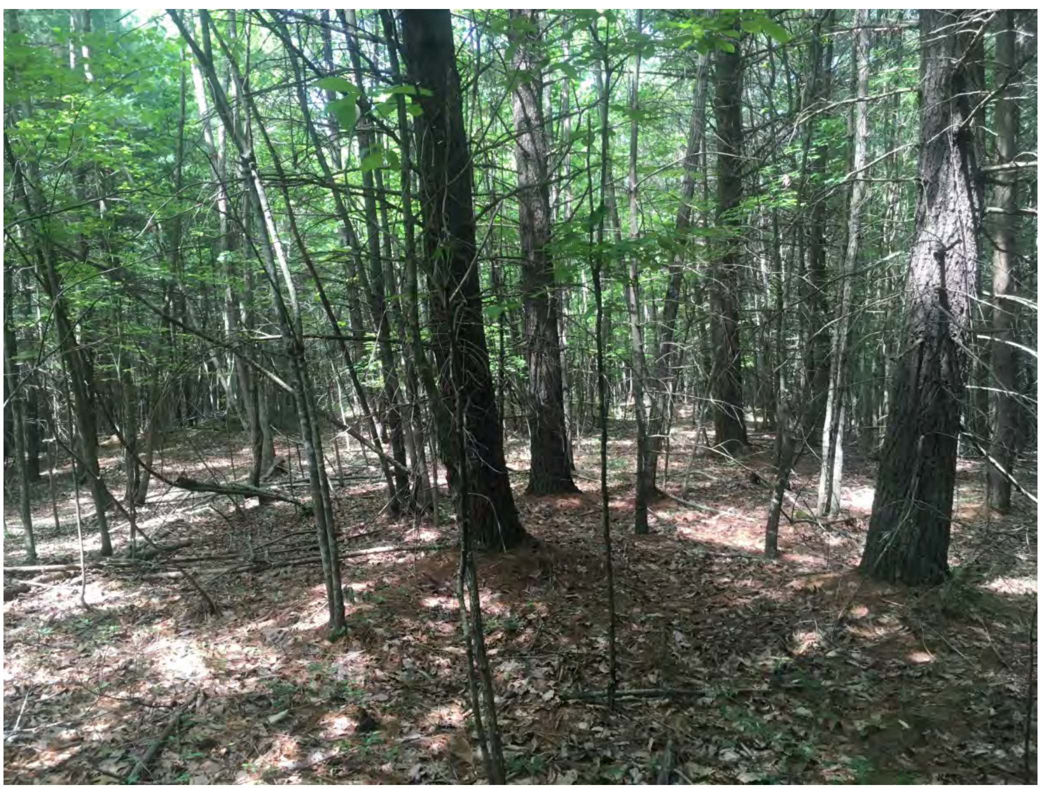
Two gypsy moth caterpillars were found in Unit 1. Defoliation levels in the vicinity of these caterpillars, and throughout the units, was <10%. Strong winds the prior day had broken out many small branches, which provided the opportunity for a close look at several foliage samples. Dime- to quarter-sized holes, similar to those seen at Caseknife, were present at low densities in many leaves.

No viable egg masses were found. Egg masses from previous seasons were found in all units: 3 in Unit 1, 1 in Unit 2, 1 in Unit 4, and 26 in Unit 5.

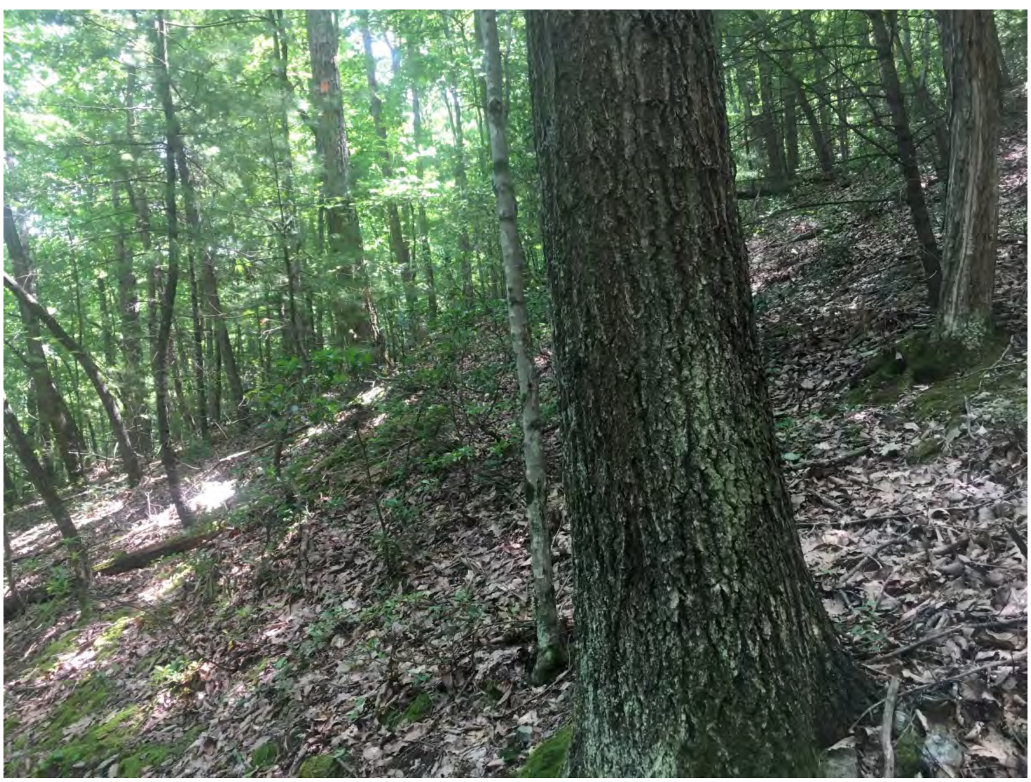
Table 7. Tunnel Hollow Area Plot Data

Unit	# of Plots	Vigor: Good	Vigor: Fair	Vigor: Poor	# of Dead Trees	# of New Egg Masses	% Defoliation
1	5	30	4	0	2	0	<10%
2	5	26	3	0	3	0	<10%
4	5	26	2	0	3	0	<10%
5	5	32	0	0	2	0	<10%
Total	**20**	**114** (86% of trees)	**9** (7% of trees)	**0** (0% of trees)	**10** (8% of trees)	**0**	

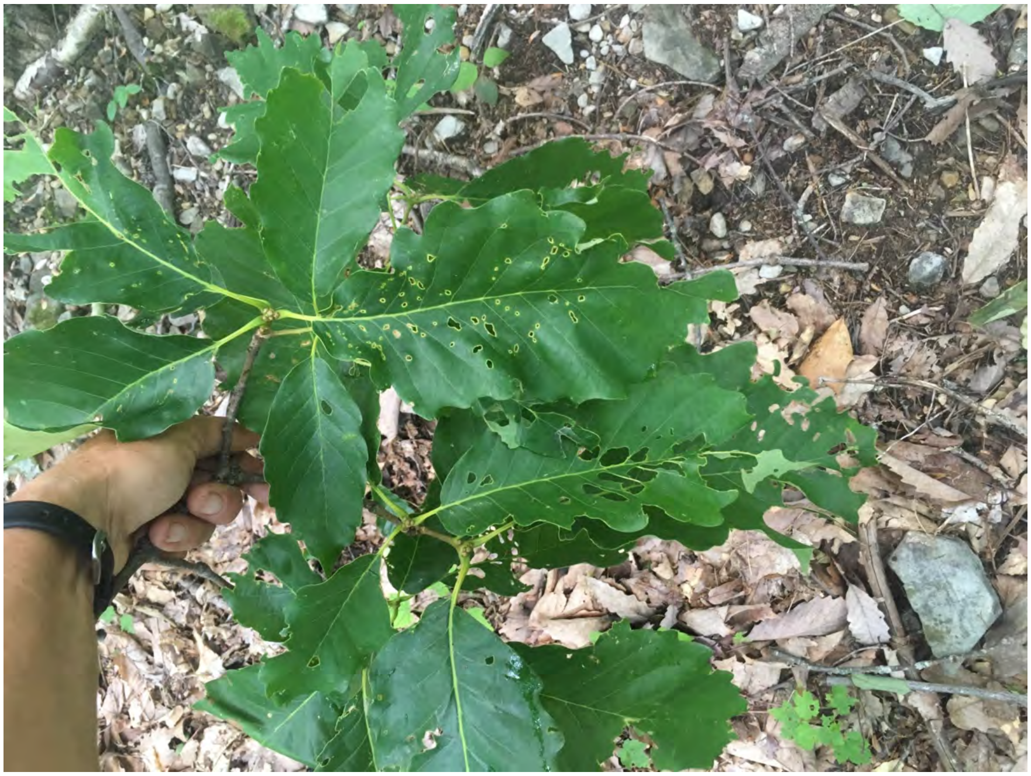

Tunnel Hollow Area, Unit 2 on right of SR 610, showing healthy crowns

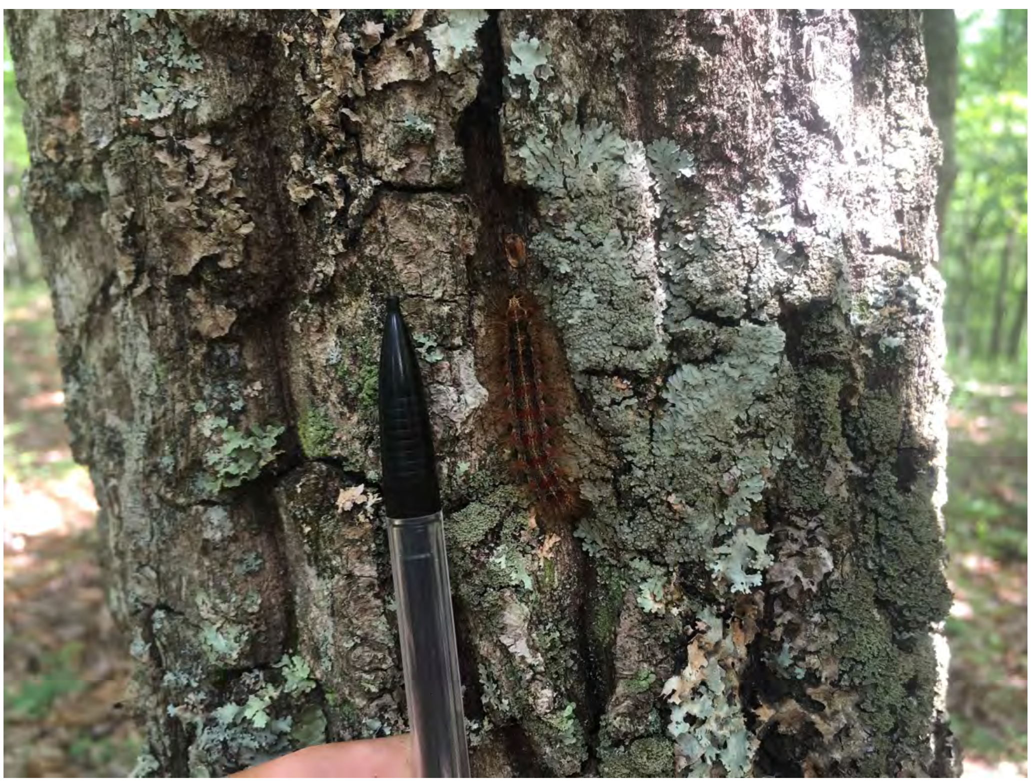

Tunnel Hollow Area, Unit 1, white pine stand

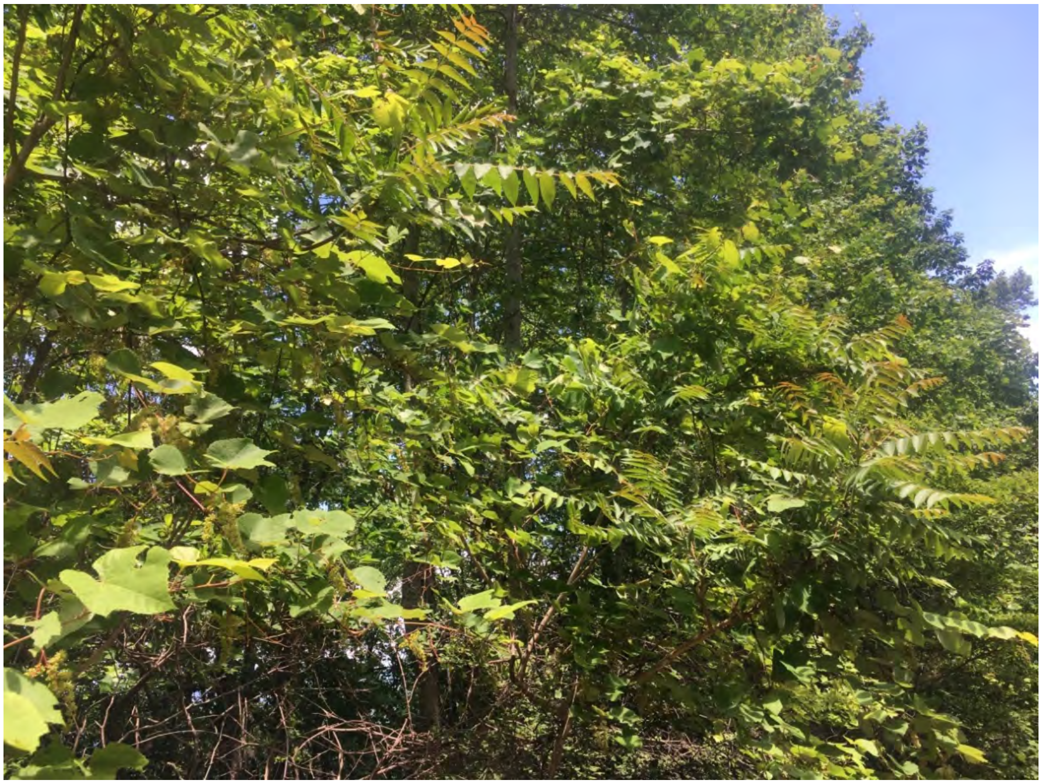
Tunnel Hollow Area, Unit 2, yellow-pine dominated area

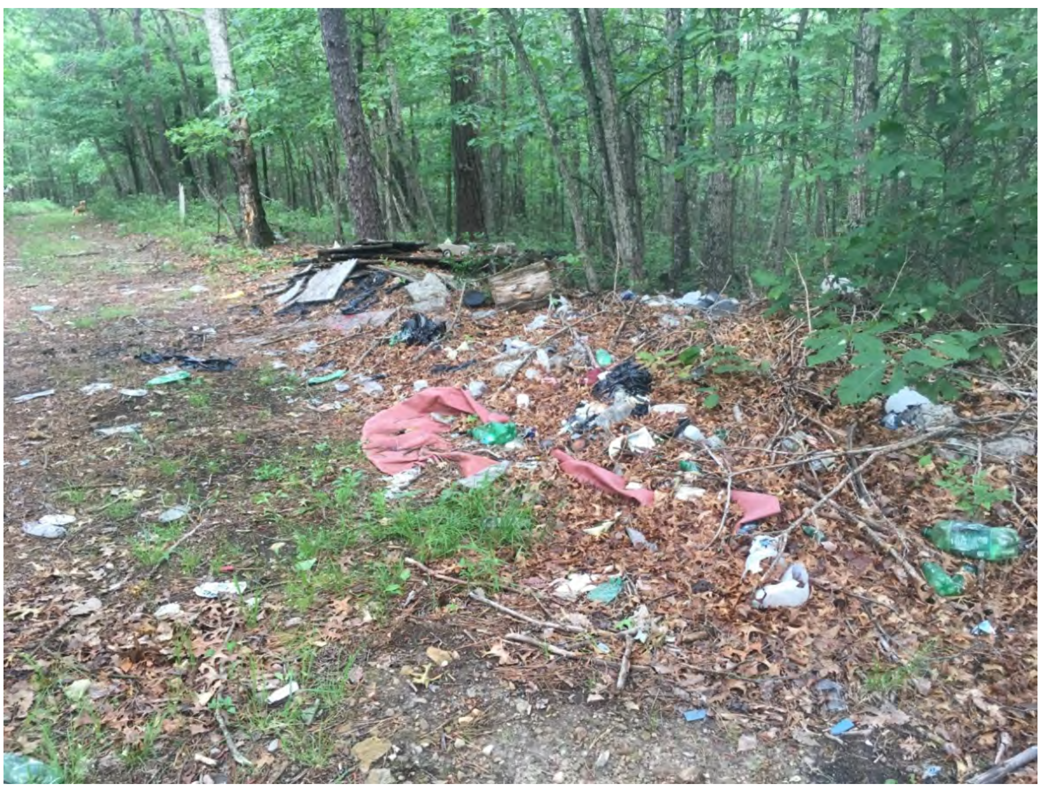


Tunnel Hollow Area, Unit 9, steep area


Tunnel Hollow, Unit 5, example of low-level herbivory


Tunnel Hollow, Unit 1, gypsy moth caterpillar


Tunnel Hollow Area, Unit 4, non-native invasive Ailanthus


Tunnel Hollow area, Unit 2, significant amounts of trash

- Gatewood Reservoir Area

Visited June 3, 2019.

All visited units are oak-dominated. Yellow pine and/or white pine acre are scattered throughout, and are dominant overstory and/or midstory species in portions of Units 8 and 9. Scattered stands of healthy, high vigor white oaks are also present. There is a small area of Unit 9 that appears to have been harvested more recently, based on the presence of 4-6" dbh trees of coppice origin where the cut stumps are still discernable.

There are noteworthy number of well-established nonnative invasive plant species in the area: Oriental bittersweet, Ailanthus, lespedeza, multiflora rose, Japanese stiltgrass, wineberry, and Japanese barberry are all present.

No damage from past defoliation was observed in Unit 3. In the other units, damage is mostly minor. There are some scattered areas of moderate damage, and a few isolated pockets of severe damage. Higher levels of dieback were seen on many larger scarlet oak, but it could not be determined if this was defoliation-induced damage, or if it is due to senescence. There are a notable number of dead and down yellow pine, and a smaller number of dead and down oaks, both in advanced stages of decay, particularly in Units 8 and 9. Obviously, this mortality is from some event preceding gypsy moth defoliation in 2015 and 2016.

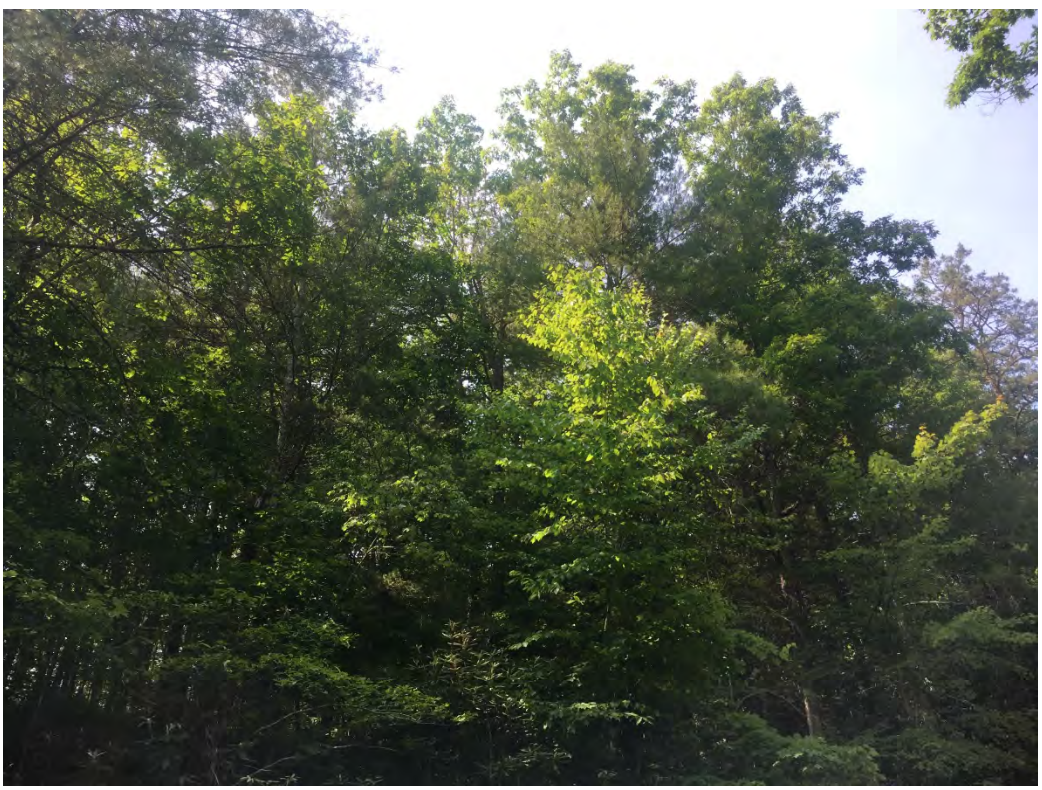
No egg masses or gypsy moth caterpillars were found in the units.

Ongoing oak defoliation was at very low levels (<10%) and appeared to be primarily as scattered dime-sized holes. Defoliation (up to 100%) of several sourwoods was seen, most likely the result of lettered sphinx moth caterpillars.

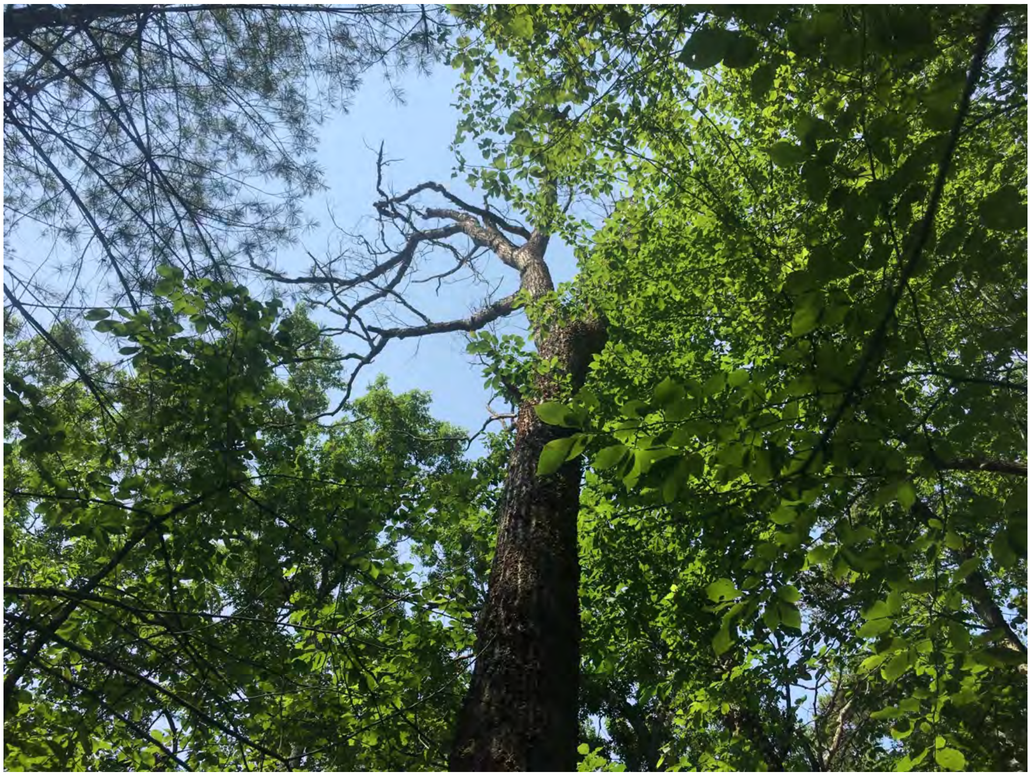
Table 8. Gatewood Area Plot Data

Unit	# of Plots	Vigor: Good	Vigor: Fair	Vigor: Poor	# of Dead Trees	# of New Egg Masses	% Defoliation
3	4	21	1	0	1	0	<10%
8	7	33	11	0	3	0	<10%
9	8	40	7	0	5	0	<10%
10	2	12	4	0	0	0	<10%
Total	**21**	**106** (77% of trees)	**23** (17% of trees)	**0** (0% of trees)	**9** (6% of trees)	**0**	

Gatewood Reservoir Area, Unit 9, showing healthy canopy

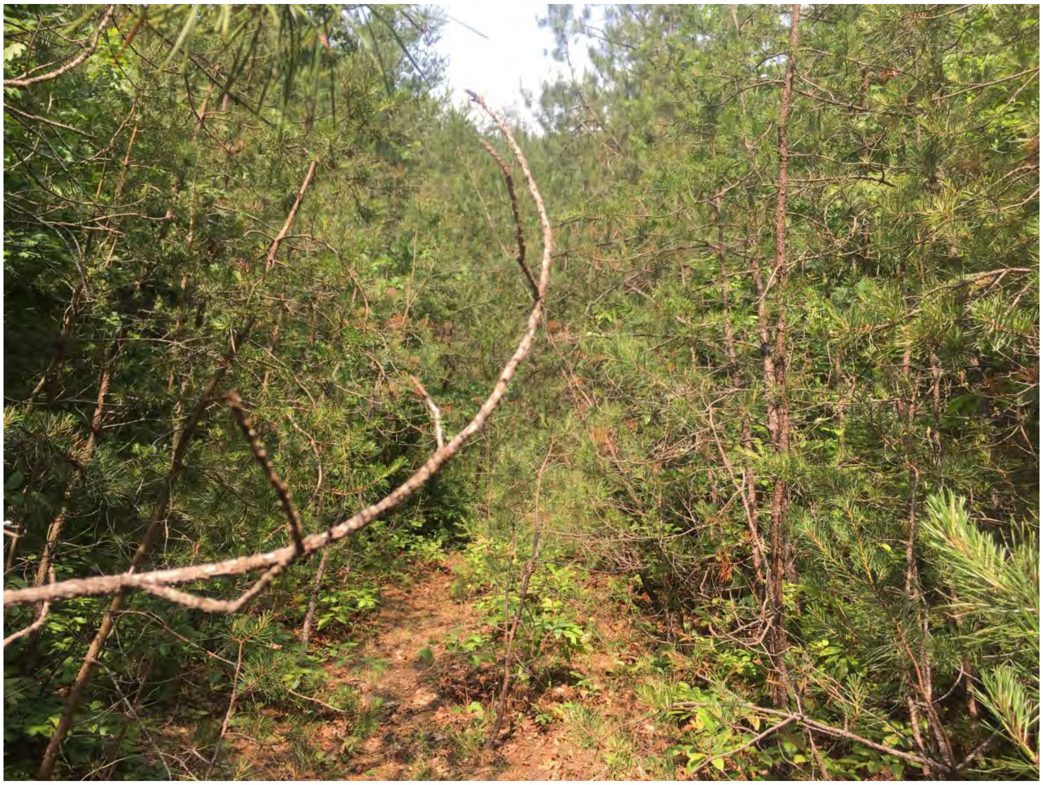


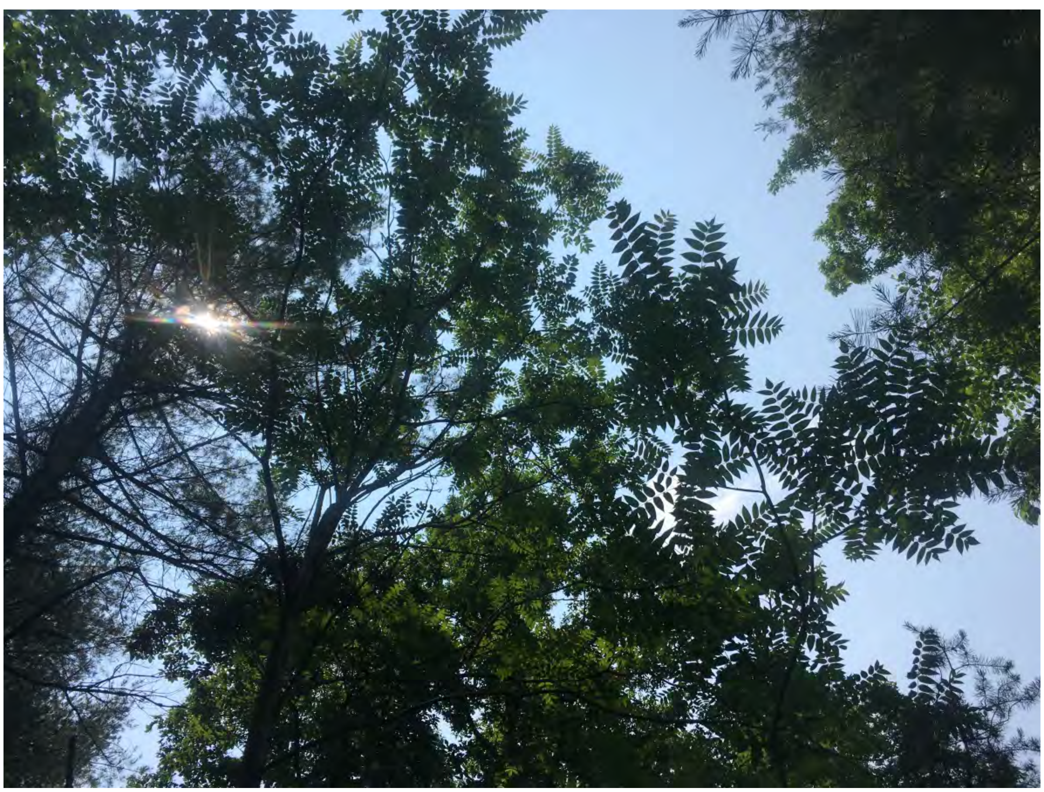
Gatewood Reservoir Area, Unit 5 from SR 710, showing healthy canopy



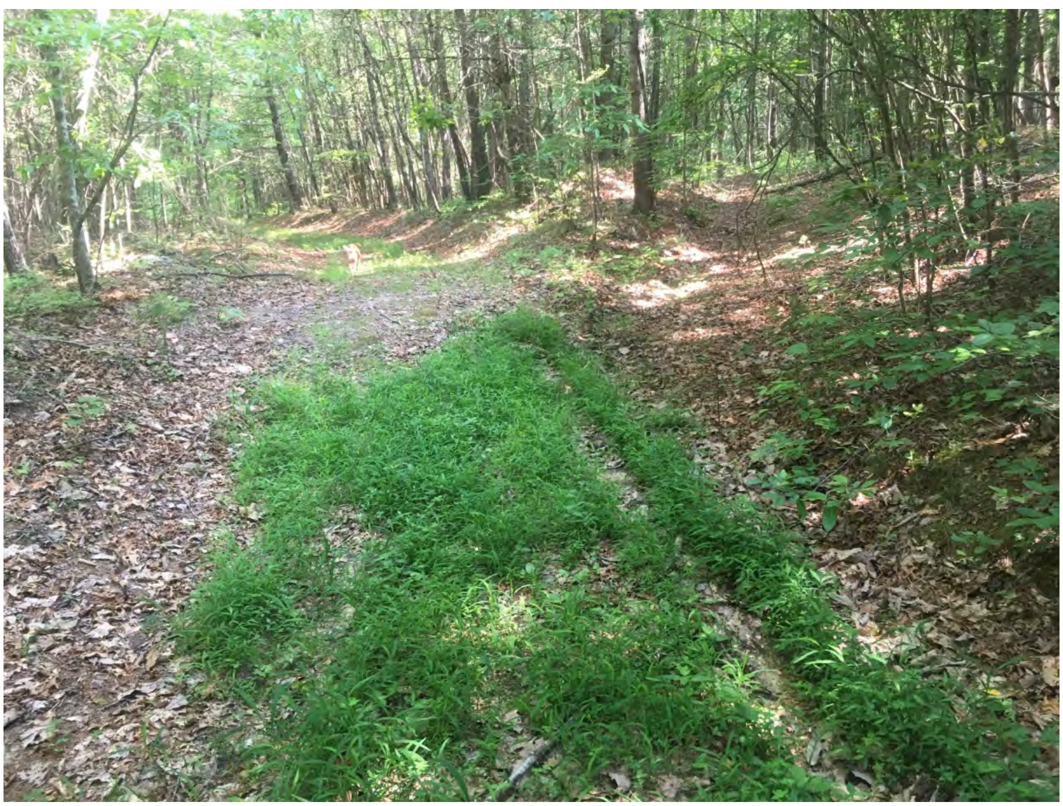
Gatewood Reservoir Area, Unit 9 scarlet oak snag with adjacent healthy trees

Gatewood Reservoir, access road to Unit 3, example of herbivory


Gatewood Reservoir Area, Unit 10, dense yellow pine regeneration


Gatewood Reservoir Area, non-native invasive Ailanthus along FS Road 6871


Gatewood Reservoir Area, non-native invasive Oriental bittersweet along FS Road 6871


Gatewood Reservoir Area, Unit 3, non-native invasive Japanese stiltgrass in old access roadbed

<u>DECLARATION OF ROSE-MARIE MUZIKA, PH. D.</u>

I, Rose-Marie Muzika, Ph. D., declare as follows:

A. Qualifications

1. My name is Rose Marie Muzika. I am over 18 years of age and competent to make this declaration.

2. My Curriculum Vitae is attached.

3. I earned a Ph. D. in forestry from Michigan State University in 1989. I earned an M.Sc. degree in Biology from Clarion University of Pennsylvania and a BA in biology from Seton Hill University.

4. I was a Professor of Forestry for 19 years at the University of Missouri. I taught courses in Forest Ecology, Forest Health & Protection, Field Ecology, and Silviculture.

5. I have been employed by the US Forest Service as an ecologist and an entomologist .From 1989 to 1991 I was a research entomologist with a Pacific Northwest Research Station Unit I LaGrande, OR. I was then an ecologist on the Monongahela National Forest (1991-1992), and research ecologist at the Forest Service research unit in Morgantown, WV.

6. For the past 25 years, I have conducted research in forest health, forest disturbance ecology and applied ecology.

7. Among my research publications are manuscripts that describe gypsy moth population dynamics, the ecological effects of gypsy moth, mortality agents of oak, and secondary pests of oaks. I worked with Kurt Gottschalk on several manuscripts, which are described below and attached to this statement for consideration.

8. I have published in a number of peer-reviewed journals including: Forest Science; Forest Ecology & Management; Ecological Monographs; Populations Dynamics; Agricultural and Forest Entomology; Canadian Journal of Forest Research; Plant Disease; Environmental Entomology, among many others.

9. I have served as an Associate Editor for the following Journals: Northern Journal of Applied Ecology; Ecological Monograph; Ecology; Forest Ecology & Management; Frontiers in Forests and Global Change. I have reviewed manuscripts for at least 15 different journals.

10. I am a member of: the Society of American Foresters; The Forest Stewards Guild; American Association for the Advancement of Science; The Forest History Society, and the American Society of Environmental History.

B. Project Review

11. I have reviewed all publicly available project documents for the U.S. Forest Service's (USFS) proposed Eastern Divide Gypsy Moth Phase II Project on the Eastern Divide District of the Jefferson National Forest.

12. I have also reviewed Forest Service documents provided to me by the Southern Environmental Law Center (SELC) by June 17, 2019. I understand SELC received these documents in response to Freedom of Information Act requests.

13. I have also reviewed the Insect and Disease Categorical Exclusion provided for in the Farm Bill of 2014.

C. Gypsy moth within the project area and surrounding landscape

14. The best scientific information is clear that site-specific data are critical to deciding if active forest management is appropriate for a forest stand and selecting from a suite of appropriate silvicultural treatments: "This process requires stand examination to determine the present overstory, understory, and site conditions; stand analysis to assess the stand's characteristics and potential for future growth and regeneration; [and] gypsy moth population monitoring to determine the potential for defoliation."[1] Field data are also critical for making an informed decision that active management is not necessary.[2]

15. This project area lies within a generally infested area, which means that reproducing gypsy moth populations occur in this area. This landscape condition, however, does not mean that gypsy moths are present at all sites within the infested area. Accordingly, it is incorrect to assume those gypsy moths are present or an imminent threat in all stands of oak forest within the project area. Nor can one assume that previous outbreaks and defoliation within the generally infested area occurred within all oak stands contained in the project area. Rather, gypsy moths are likely present in various stands, at varying population levels, causing varying degrees of risk and/or damage, at various times.

16. There are several ways to estimate the gypsy moth population levels across the landscape and in the proposed units, including (A) gypsy moth trap counts, (B) aerial survey to delineate defoliation, and (C) egg mass surveys, and (D) and field surveys of defoliation, damage, and mortality.

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[1] K.W. Gottschalk, Silvicultural Guidelines for Forest Stands Threatened by the Gypsy Moth at 1 (USDA Forest Service General Technical Report NE-171 1993) ("Gottschalk 1993"). *See also* P.H. Brose et al., Prescribing Regeneration Treatments for Mixed-Oak Forests in the Mid-Atlantic Region at 8 (USDA Forest Service General Technical Report NRS-33 2008) ("One of the keys to accurately evaluating the regenerative potential of a mixed-oak stand is to simultaneously consider the species present, the abundance, size, and spatial distribution of reproduction and trees, and factors limiting successful regeneration.") ("Brose et al. 2008"); *and* R. M. Muzika, Opportunities for Silviculture in Management and Restoration of Forests Affected by Invasive Species, 19 Biological Invasions 3419, 3429 (2017) ("Development and use of … [Gottschalk's] silvicultural guidelines require advanced evaluation of specific characteristics of the forest such as the abundance of host species and appropriateness of management or restoration.") ("Muzika 2017").

[2] *See* D.R. Foster & D.A. Orwig, Preemptive and Salvage Harvesting of New England Forests: When Doing Nothing is a Viable Alternative, 20(4) Conservation Biology 959, 966-68 (2006) (Contrasting the relative negative impacts of disturbances, such as insect outbreaks, and active silvicultural management intended to increase resilience to disturbance) ("Foster & Orwig 2006").

<u>Gypsy moth trap counts</u>

17. The Slow the Spread program has used pheromone traps to trap male moths in this general area. Based on trap counts, regular occurrences of gypsy moths have been recorded in the general area since 2006.[3]. Since that time, moth captures have become more common. In 2015 there were several traps with high numbers reported (>300), primarily limited to an area immediately east of the I77 corridor. This high-count area expanded in 2016, to include much of Bland County, and spilled over into a limited area of Wythe and Pulaski. There was then a notable decrease for almost all traps; with counts from 2017 and 2018 approximating the numbers reported in 2014. The below tables provide trap count numbers near the 7 working areas of this project. In 2018, trap counts closest to the proposed units ranged from a low of 44 moths to a high of 175 moths.

Table 1. I-77 Area

	2018	2017	2016	2015
On SR 717 south of units	129	403	400	477
~6 mi to east of above	44	201	350	202

Table 2. Peak Creek

	2018	2017	2016	2015
3-4 miles to northwest	73	188	n/a	n/a
1 mile to west	n/a	n/a	275	425

Table 3. Dismal Area

	2018	2017	2016	2015	2014
1-2 m east of southern unit	175	152	229	250	10

Table 4. Caseknife

	2018	2017	2016	2015	2014
1-1.5 mi to west of units	150	48	250	71	30

Table 5. Gatewood Reservoir

	2018	2017	2016	2015	2014
On SR 710 below units	n/a	n/a	350	200	225

Table 6. Tunnel Hollow

	2018	2017	2016	2015	2014
~2 miles north	n/a	n/a	350	200	225
~3 miles south	n/a	n/a	180	26	12

[3] STS Decision support http://yt.ento.vt.edu/da/

Table 7. Bromley Hollow

	2018	2017	2016	2015	2014	2013	2012
~8 km southwest	73	188	n/a	n/a	n/a	n/a	n/a
~8 km southeast	63	68	n/a	n/a	n/a	n/a	n/a
~2-6 km southwest	n/a	n/a	225	228	44	10	7
~2-6 km southeast	n/a	n/a	225	155	29	125	103

Aerial surveys of defoliation

18. The Virginia Department of Forestry conducts aerial surveys to delineate areas with high levels of defoliation. Results from these surveys conducted in 2016, 2017, and 2018, were provided to SELC upon request.

19. Based on the survey results, very few stands included in the project have experienced severe defoliation during the past three years.[4]

20. Defoliation was not recorded in the units proposed in the Peak Creek, Caseknife, Tunnel Hollow, or Gatewood Reservoir areas.[5] With the exception of a small pocket detected in 2018 on Chestnut Mountain, north of the Gatewood Reservoir Area, defoliation was also not reported in nearby areas.[6]

21. In the Dismal Area, defoliation was documented in 2018, but was limited to portions of the two northernmost units.[7] In the Bromley Hollow Area, defoliation was recorded in 2016 in the eastern units.[8] Defoliation in the Walker Mountain Area was recorded in 2016 in almost all of Unit 1, a small portion of Unit 2, and the southern half of Unit 3.[9]

22. When considering intervention related to gypsy moth, it is critical to remember that other defoliators are responsible for some of the defoliation in the area.[10] For example, Ms. Bier documented the presence of larvae of the oak sawfly, a native defoliator, which were seen actively feeding on oak leaves. [11] Oak blotch leafminers and oak shothole leafminers are also likely to be present in the units, based on the appearance of herbivory damage.[12]

Field surveys in the proposed units

23. Trap counts and aerial defoliation surveys can help provide a big-picture understanding of the landscape-scale status of gypsy moth over time. However, they are of very limited use

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[4] *See* attached maps generated by SELC.
[5] *See id.*
[6] *See id.*
[7] *See id.*
[8] *See id.*
[9] *See id.*
[10] J. Bier Eastern Divide Insect and Disease Project Phase II, Jefferson National Forest, Summary of fieldwork at 3 ("Bier report").
[11] *Id.* at 15, 18.
[12] *Id.* at 4.

when considering, developing, and evaluating a proposed silvicultural project in specific stands to respond to gypsy moth. Site-specific field data is required for that.[13] Field data are also critical for making an informed decision as to whether active management is not necessary.[14]

24. The scoping notice and project file provide little to no current information regarding gypsy moth population monitoring information in the proposed units. Consequently, I was unable to review any site-specific data that the Forest Service may have considered prior to developing Phase 2 of the Eastern Divide project and proposing silvicultural prescriptions.

25. It was thus necessary to collect site-specific data in order to overcome this critical information gap. SELC hired Jessica Bier to visit each of the proposed treatment areas and (1) assess impacts from defoliation that may have occurred in recent years (e.g., crown damage, mortality); and (2) determine the levels of current gypsy moth populations in the areas.[15] I provided guidance to Jessica Bier regarding survey methods, which she applied. I have reviewed the data from her fieldwork.

26. Within plots in each working area, Ms. Bier recorded crown condition (as a measure of vigor and tree health); the presence of mortality, egg masses and defoliation; and tree species composition.[16] Ms. Bier found that many of the units had no notable damage and/or mortality from gypsy moth.[17] To the extent there was damage, it was generally at low to moderate levels and patchily distributed.

27. The majority of trees surveyed within the plots appear to be in good health. Ms. Bier classified 77% of the overstory trees surveyed in plots as having Good vigor.[18] Good vigor is characterized by extensive lateral branching; absent or minimal dieback, absent or minor wounds/canker, little or no epicormic branching; healthy foliage.[19]

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[13] Gottschalk 1993 at 1. *See also* Brose et al. 2008 at 8 ("One of the keys to accurately evaluating the regenerative potential of a mixed-oak stand is to simultaneously consider the species present, the abundance, size, and spatial distribution of reproduction and trees, and factors limiting successful regeneration."); *and* Muzika 2017 at 3429 ("Development and use of … [Gottschalk's] silvicultural guidelines require advanced evaluation of specific characteristics of the forest such as the abundance of host species and appropriateness of management or restoration.").

[14] *See* Foster & Orwig 2006 at 966-68 (Contrasting the relative negative impacts of disturbances, such as insect outbreaks, and active silvicultural management intended to increase resilience to disturbance).

[15] Bier report at 1.

[16] *Id.* at 1.

[17] *Id.* at 3.

[18] *Id.* at 3.

[19] *Id.* at 2.

Sixteen percent were classified as Fair vigor.[20] Fair vigor is characterized by moderate dieback (25-49% of branches are dead), possible epicormic branching, and subnormal foliage density, size, and coloration.[21]

Only 1% were classified as Poor vigor.[22] Poor vigor is characterized by major dieback (50% or more of branches are dead), heavy epicormic branching, extensive wounds/cankers, signs of decay, and subnormal foliage density, size, and coloration.[23] Six percent of the overstory plot trees were dead.[24]

28. Ms. Bier also found very few indications of live gypsy moths across the 7 working units. This included:
    - 6 gypsy moth caterpillars seen in 2 units (in the Caseknife and Tunnel Hollow areas, and
    - 3 egg masses that were, based on appearance, probably from the current season (2 in Dismal area, 1 in Caseknife area).
29. Ms. Bier also found very low levels of defoliation (<10%) in the areas she visited following leaf out in mid-May (Caseknife, Bromley Hollow, Tunnel Hollow, Gatewood Reservoir). Widespread defoliation and persistent mortality seem unlikely. Furthermore, there is no indication that a buildup of the population is occurring and therefore an outbreak in the next few years is unlikely. Consequently, there is no imminent threat of gypsy moth damage in the near future.

D. <u>The best scientific information regarding gypsy moth does not support Gottschalk's Silvicultural Guidelines.</u>

30. I understand the Farm Bill's Insect and Disease Infestation Categorical Exclusion (CE) applies to "priority projects … to reduce the risk or extent of, or increase resilience to, insect or disease infestation."[25] These must be "qualifying insect and disease projects" that "consider[ ] the best available scientific information to maintain or restore the ecological integrity, including maintaining or restoring structure, function, composition, and connectivity…."[26,27]

31. The Forest Service contends that the proposed regeneration logging "are based on the findings in <u>Silvicultural Guidelines for Forest Stands Threatened by Gypsy Moth</u> by Kurt W. Gottschalk."[28]

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[20] *Id.* at 3.
[21] *Id.* at 2.
[22] *Id.* at 3.
[23] *Id.* at 2.
[24] *Id.* at 3.
[25] 16 U.S.C. 6591a(d)(1).
[26] *See* FSH 1909.15 chapter 30, section 32.3(3).
[27] 16 U.S.C. 6591b(b)(1).
[28] Gottschalk 1993.

32. Gottschalk's recommendations were largely untested when they were published in 1993. In the introduction to his report, the author stated "[m]ost of the prescriptions have not been extensively tested. They are guides subject to modification using professional judgment to make them fit specific stands or management objectives." [29] Twenty-six years later, Gottschalk's guidelines remain largely unsupported by science.[30] In fact, "[d]espite decades of research and extensive implementation, there remains uncertainty about how successful these established [silvicultural] approaches are for limiting damage and mortality" from gypsy moth.[31]

33. The 1993 Silvicultural Guidelines highlighted stand susceptibility and stand vulnerability as determinants of potential impacts of gypsy moths on forests.[32] Gottschalk defined stand susceptibility as the probability of defoliation, given gypsy moth are present in a stand.[33] He defined stand vulnerability as the probability of tree mortality, given gypsy moths have defoliated a stand.[34] Decreasing stand susceptibility and vulnerability are objectives of silvicultural treatments directed at mitigating gypsy moth impacts.[35]

<u>Silviculture does not reduce susceptibility of oak-dominated ecosystems to gypsy moths.</u>

34. Theoretically, silviculture could reduce susceptibility of oak-dominated ecosystems to gypsy moths by (A) removing preferred host tree species; (B) improving conditions for gypsy moth predators and pathogens; and (C) increasing the health and vigor of oaks retained following thinning. In practice, however, silviculture has not succeeded in reducing susceptibility to gypsy moths.

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[29] Gottschalk 1993 at 1 ("Most of the prescriptions have not been extensively tested. They are guides subject to modification using professional judgment to make them fit specific stands or management objectives."). *See also id.* at 38 ("[T]hese results have not been extensively tested…").

[30] *See* R.M. Muzika & A.M. Liebhold, <u>A Critique of Silvicultural Approaches to Managing Defoliating Insects in North America</u>, 2 Agricultural and Forest Entomology 97, 98 (2000) ("Examples demonstrating the use of silviculture to successfully mitigate the impacts of defoliating insects are…limited.") ("Muzika & Liebhold 2000"); *and* Muzika 2017 at 3429 ("Despite the thoroughness of the development of [Gottschalks' 1993] guidelines, there have been few evaluations of them.") ("Muzika 2017"); *and* C. Schweitzer et al., <u>Proactive Restoration: Planning, Implementation, and Early Results of Silvicultural Strategies for Increasing Resilience against Gypsy Moth Infestation in Upland Oak Forests on the Daniel Boone National Forest, Kentucky</u>, 112 J. of Forestry 401, 402 (2014) ("A variety of both regeneration and intermediate stand treatments, …, need to be tested for their efficacy in mitigating for the susceptibility and vulnerability to gypsy moth and oak decline.") ("Schweitzer et al. 2000").

[31] Muzika 2017 at 3421. *See also id.* at 3429 ("Despite the thoroughness of the development of [Gottschalk's 1993] guidelines, there have been few evaluations of them."); *and* Muzika & Liebhold 2000 at 98.

[32] Gottschalk 1993 at 7-8.

[33] *Id.* at 7.

[34] *Id.* at 8.

[35] *See* Muzika & Liebhold 2000 at 98.

35. Forest stands that are most susceptible to defoliating insects are those in which preferred host tree species are abundant.[36] The proportion of a stand comprised of preferred host tree species is a powerful predictor of defoliation potential.[37] Oaks, in general, are highly preferred by gypsy moths.[38] Throughout their range in North America, gypsy moths are most commonly defoliating red oaks and white oaks.[39] Reducing susceptibility thus tends to focus on reducing the prevalence of preferred host trees within a stand.[40] The most common silvicultural means of doing so is by selectively thinning oak and other preferred host species.[41]

36. While the precise interrelationship of gypsy moths and oaks at large spatial scales remains undefined, there is scant evidence that changing stand composition through silviculture has any effect on gypsy moths.[42] Changing stand composition to one with a reduced density of preferred species and a higher density of non-preferred species renders a treated stand less appetizing to gypsy moths. [43] However, "it is not possible to reduce the actual spread of defoliating insect populations [through silviculture]."[44] In other words, even if gypsy moth density in a treated stand is decreased by reducing the density of highly preferred oak trees, gypsy moth spread into other areas is not reduced. There is not a "net loss" of gypsy moth density across the landscape.

    There are several possible explanations for this: (A) the scale at which silviculture is practiced – forest stands – is too small to affect processes that control gypsy moth spread

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[36] *See* Gottschalk 1993 at 7. *See also* Guo et al., Tree Diversity Regulates Forest Pest Invasion, 116(15) Proceedings of the National Academy of Sciences 7382, 7385 (2019) (finding greater tree species diversity diminished insect invasion success by reducing the availability of susceptible species) ("Guo et al. 2019").
[37] *See* C.B. Davidson et al., Tree Mortality Following Defoliation by the European Gypsy Moth (Lymantra dispar L.) in the United States: a Review, 45(1) Forest Science 74, 75 (1999) ("Davidson et al. 1999"). *See also* C. Hartl-Meier et al., Effects of Host Abundance on Larch Budmoth Outbreaks in the European Alps, 19 Agricultural and Forest Entomology 376, 376 (2017) (documenting the correlation between outbreaks of larch budworm and availability of their preferred host tree species, the European larch.).
[38] Davidson et al. 1999 at 75 tbl. 1..
[39] *See* Haynes et al., Geographic Variation in Forest Composition and Precipitation Predict the Synchrony of Forest Insect Outbreaks, 127(4) Oikos 634, 635 (2018) (citation omitted) ("Haynes et al. 2018").
[40] *See* Muzika & Liebhold 2000 at 99.
[41] *See id.*; Muzika 2017 at 3424; Davidson et al. 1999 at 75.
[42] *See* Muzika & Liebhold 2000 at 101 ("Actual empirical evidence to suggest that management aimed at changing species composition could be used to successfully control defoliators is scant.").
[43] Muzika & Liebhold 2000 at 103 ("There is little or no evidence that silviculture can be used for altering susceptibility other than by eliminating host species.").
[44] *Id.* at 101.

across a landscape;[45] (B) gypsy moth dynamics are controlled by a complex web of biological, chemical, and physical processes[46]; and (C) irrespective of the gypsy moth, landscape-scale oak dynamics in eastern North America are controlled by numerous factors including disturbance, climate, herbivory and land use.[47]

Accordingly, there is no compelling evidence that the ecological integrity of the area surrounding the treated stands (i.e., the surrounding landscape) is improved with silvicultural treatment.

37. Additionally, there is no evidence that silviculture reduces susceptibility to gypsy moths by improving conditions for gypsy moth predators and pathogens. In 1998, Kurt Gottschalk, Andrew Liebhold (Research Entomologist for the Forest Service's North Research Station), and I published results from a long-term study of the effects of presalvage and sanitation thinning on gypsy moth dynamics. We tested how thinning affected changes in gypsy moth egg mass density, patterns of within-generation gypsy moth survivorship, gypsy moth mortality caused by various parasitoids and pathogens, forest vegetation following thinning, and the long-term impact of gypsy moth populations.[48]

    In stands where oak accounted for less than 50% of the basal area, we applied a sanitation thinning. [49] Objectives were to reduce total stand basal area and preferentially remove species preferred by the gypsy moth (e.g. oak). [50] In stands where oak accounted for more than 50% of the basal area, we applied a presalvage thinning, with the objective of removing trees in poor condition regardless of species or their preference by gypsy moth.[51]

    We examined results from 2 years of severe defoliation (>60% of canopy) on 3 pairs of stands (each pair with 1 thinned and 1 unthinned/control stand). One pair had identical defoliation, a second pair had greater defoliation in the unthinned/control stand, and a third pair had greater defoliation in the thinned stand.[52]

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[45] *Id.* at 99 ("[A]lthough silviculture is implemented at the stand level, it is obvious … that the influence of insects occurs at the landscape level."). *See also* Muzika 2017 at 3430 (citation omitted).

[46] *See* A.M. Liebhold et al., What Causes Outbreaks of Gypsy Moth in North America?, 42 Population Ecology 257, 263-65 (2000) ("Liebhold et al. 2000"). *Accord* Muzika & Liebhold 2000 at 103 ("Most defoliator species exist in a highly complex trophic web with their hosts and natural enemies. As a result of this complexity, manipulation of the habitat to enhance a single part of this food web may not always result in the expected outcome.").

[47] *See* R.W. McEwan et al., Multiple Interacting Ecosystem Drivers: Toward an Encompassing Hypothesis of Oak Forest Dynamics Across Eastern North America, 34 Ecography 244, 253 (2011); *see also* D.C. Dey et al., An Ecologically Based Approach to Oak Silviculture: A Synthesis of 50 Years of Oak Ecosystem Research in North America, 13(2) Revista Columbia Forestal 201, 202 (2010) ("Dey et al. 2010").

[48] Muzika et al. 1998 at 261.

[49] *Id.*

[50] *Id.*

[51] Muzika et al. 1998 at 261.

[52] Muzika & Liebhold 2000 at 101.

While there was less overstory mortality in thinned stands than unthinned stands with comparable levels of defoliation, we were unable to determine that thinning significantly altered rates of gypsy moth mortality caused by parasitoids or pathogens. [53] Ultimately, results revealed that egg mass densities, moth survivorship, and gypsy moth mortality from natural enemies differed little between stands that received silvicultural treatments and those that did not.[54]

Our study comported with previous research that silvicultural thinning had no effect on predation of gypsy moth.[55] We concluded that "… it seems unlikely the thinning could reduce the frequency or intensity of gypsy moth outbreaks by enhancing the activity of natural enemies."[56]

38. In 2014, Callie Schweitzer and her colleagues published the results of a study that investigated the possibility of regenerating oak and increasing oak vigor with silvicultural treatments.[57] Treatments implemented during the study are summarized below.

    A. Shelterwood with reserves- Residual basal area of 10-25 ft^2 per acre. Oaks were favored for residual trees to promote increased forest health and improve habitat for wildlife and plant species. Regeneration beneath reserve trees intended to create a two-aged stand structure;

    B. Oak woodland- Thinning to 45–70 ft^2 per acre followed by prescribed burning every 3–5 years. White oaks favored as residual trees to increase hard mast production and bat habitat;

    C. Thinning- Reducing tree density allows residual trees to take advantage of improved growing conditions. Result should be increased tree vigor, larger crown diameters, continued or improved diameter growth, and increased capacity to survive defoliation;

    D. Oak shelterwood- All basal area removed from midstory and understory without making canopy gaps in the overstory. Undesirable tree species in midstories and understories treated with chemical herbicide. Overstory to be removed after sufficient advanced oak regeneration present in order to create even-aged, oak-dominated stand;

    E. Control- No treatment.[58]

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[53] Muzika et al. 1998 at 261.
[54] *Id.*
[55] *Id.* at 267 (citing S.T. Grushecky, Effects of Gypsy Moth-Oriented Silvicultural Thinnings on Small Mammal Populations and Rates of Predation on Gypsy Moth Larvae and Pupae, M.S. Thesis (West Virginia University 1995). *See also* Muzika & Liebhold 2000 at 102 ("Many authors have advocated silvicultural procedures that might increase natural enemy abundance and/or activity. The logic behind these mechanisms is easy to understand … the evidence supporting these mechanisms is … scant.").
[56] Muzika et al. 1998 at 267.
[57] Schweitzer et al. 2014 at 401.
[58] *Id.* at 403.

39. It is not clear that the modest increases of oak regeneration observed with some treatments in this study were enough to ensure oak would remain a significant component of the treated stands.[59] Advanced regeneration of oaks that are greater than 7 feet tall is preferred when evaluating oak regeneration potential of mixed hardwood stands.[60] The authors measured oak regeneration in response to Treatments A, B, and D, and the Control Treatment. In this study, there was very little regeneration of 4.5 feet or taller oak.[61] The Control plots had the same or greater regeneration of this size class than that recorded in Treatments B and D.[62]

40. Total oak regeneration in the Control plots was greater than in any single treatment.[63] In fact, the only size class for which there was greater oak regeneration than in the Control plots was > 4.5 foot tall oaks in Treatment A.[64] In other words, it is arguable that the silvicultural treatments had no effect on oak regeneration at all.

41. Even if the silvicultural treatments increased oak regeneration to some degree, it is unlikely that the observed regeneration was enough to maintain oak in the treated plots. Across all treatments and size classes, regeneration of red maple – which is not favored by gypsy moths – was greater than oak regeneration.[65] For the > 4.5 feet tall size class, red maple regeneration was 3 to 12 times greater than oak regeneration.[66] The dominance of red maple is significant because "[w]hen stands that are dominated by oaks in the overstory and non-oaks (e.g. maples) in the mid and understory are harvested, prolific stump sprouting of the non-oaks readily outcompetes the small oak reproduction."[67]

42. As with regeneration, it is likely that the silvicultural treatments in this study had no positive effect on oak vigor at all. Tree vigor is "the overall physiological condition or 'health' of a tree in a given environment."[68] In 2000, I authored a paper with Andrew Liebhold in which we stated "… effective use of vigour classifications for determining potential mortality has not been demonstrated with defoliators."[69]

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[59] *See id.* at 406 tbl. 3.
[60] *See* Brose et al. 2008 at 9 tbl. 2.1 (assigning greater weight to oaks more than 7 feet tall observed during regeneration plot assessment). *See also* Dey et al. 2010 at 214 ("[H]aving an abundance of large advance reproduction is key to successful oak regeneration.").
[61] *See* Schweitzer et al. 2014 at 406 tbl. 3 (three years after treatment density of > 4.5 feet tall oak was 17 stems per acre (SPA) in Treatment A; 2 SPA in Treatment B; 4 SPA in Treatment D; 4 SPA in the Control).
[62] *Id.*
[63] *Id.*
[64] *Id.*
[65] *Id.*
[66] *Id.*
[67] Dey et al. 2010 at 208.
[68] *See* Gottschalk 1993 at 35 (citation omitted).
[69] Muzika & Liebhold 2000 at 101.

43. Schweitzer et al. theorized that silvicultural treatments would increase the vigor of trees retained following silvicultural treatments.[70] Their data, however, do not support this. Across all size classes, oak vigor in the Control plots increased by 0.15.[71] This improvement was approximately equal to the increase in oak vigor for Treatment C and more than double the increase for Treatment B.[72] Oak vigor for Treatment A decreased from 1.88 to 2.49.[73] Only Treatment D resulted in oak vigor that was appreciably greater than oak vigor observed in the Control plots.[74]

However, vigor of oaks ≥ 23.6 inches dbh decreased in all four treatments and the Control.[75] The decrease in Treatment D was less than that observed for the control; however, reductions in vigor following Treatments A, B, and C, were 7 to 27 times greater than that in the Control.[76]

44. Nor did Schweitzer et al. achieve their goals "to improve forest health and productivity and to increase resilience to … insect defoliation and oak decline."[77] There is no evidence that the silvicultural treatments implemented in the study improved forest health and productivity. More importantly, their study did not evaluate the resilience of the treated stands to gypsy moths because gypsy moths were not present in their study area.[78]

In short, the best scientific information does not support theories in Gottschalk's Silvicultural Guidelines that timber harvest—especially a clearcut with reserves treatment—will reduce susceptibility to gypsy moth defoliation.

Predicting vulnerability to mortality from gypsy moth defoliation is very difficult, if not impossible.

45. Reducing vulnerability to gypsy moth would require evaluation and successful manipulation of many interrelated factors. Researchers have not found this to be practical at the stand or landscape level.

46. It is very difficult to predict impacts of gypsy moth outbreaks.[79] Even a tree that is completely defoliated may recover if it is not otherwise physiologically stressed.[80]

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[70] *See* Schweitzer et al. at 402.
[71] *Id.* at 407 tbl. 4.
[72] *Id.*
[73] *Id.*
[74] *Id.* (oak vigor increased by 0.33 for Treatment D).
[75] *Id.*
[76] *See id.* (decreases in vigor of oaks ≥ 23.6 inches dbh were: -3.74 in Treatment A; -0.99 in Treatment B; -1.25 in Treatment C; -0.08 in Treatment D; -0.14 in the Control).
[77] *Id.* at 401.
[78] *See id.* at 402 ("Gypsy moth is estimated to spread to the [study area] over the next 15-30 years….").
[79] *See* M.H. Eisenbies et al., Tree Mortality in Mixed Pine-Hardwood Stands Defoliated by the European Gypsy Moth (*Lymantria dispar* L.), 53(6) Forest Science 683, 689-90 (2007) ("Eisenbies et al. 2007").
[80] Davidson et al. 1999 at 76.

Consequently, trees can withstand multiple episodes of defoliation without dying.[81] For example, one study in Virginia showed that an average of 50% oak mortality was not achieved until three defoliation episodes had occurred.[82]

47. Many factors affect whether a susceptible tree will die as a result of defoliation[83]:

> "Whether a tree succumbs to mortality, or merely experiences a short-term reduction in growth increment following defoliation depends on the following factors: the tree species; the intensity, duration, and frequency of defoliation; the tree's physiological condition at the time of defoliation[84]; and the presence of secondary-action organisms such as *Armillaria* spp. and *Agrilus bilineatus.* These factors do not act independently; rather, it is their action in combination that determines the final outcome."[85]

48. Gottschalk recognized this also, explaining "[v]ulnerability to mortality … is affected by so many interrelated factors and varies so widely that is very difficult, if not impossible, to predict with precision."[86] Additionally, characteristics of the site in which a susceptible tree is located may affect vulnerability.[87]

49. Uncertainty as to whether an individual tree will die as a result of defoliation scales up to the stand and landscape so that it is very difficult to predict whether there will be large-scale

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[81] *Id.* at 76. *Accord* P.J. Burton et al., Options for Promoting the Recovery and Rehabilitation of Forests Affected by Severe Insect Outbreaks, in RESTORATION OF BOREAL AND TEMPERATE FORESTS 495, 506 (John A. Stanturf ed., CRC Press 2d ed. 2015) (citing studies that documented trees recovering from defoliation caused by several defoliator species, including gypsy moth) ("Burton et al. 2015"); *and* Gottschalk 1993 at 36 ("… trees can tolerate several years of defoliation and still survive.").

[82] Davidson et al. 1999 at 76.

[83] Burton et al. 2015 at 504 ("Tree mortality varies widely due to variation in defoliation intensity and duration, tree species, and site and environmental conditions.") (citations omitted); see also Eisenbies et al. 2007 at 684 ("[T]ree species, the frequency, intensity, an duration of defoliation, the physiological condition of the tree before defoliation, and the presence and efficiency of secondary-action organisms all play a potential role in determining post defoliation tree mortality.") (citations omitted).

[84] *See* Davidson et al. 1999 at 77 (stating that a tree's physiological condition is "[t]the greatest single indicator of the likelihood of mortality … at the time of defoliation.").

[85] *Id.* at 76. *See also* Gottschalk 1993 at 32 ("The severity, frequency, and distribution of defoliation, site and stand factors, environmental conditions, invasion by secondary insects and diseases, and tree vigor all interact to produce the effects of defoliation (vulnerability) on the tree and stand.").

[86] Gottschalk 1993 at 8.

[87] *See* Davidson et al. 1999 at 76 (describing "specific site factors" that may determine susceptible and resistant forest types).

mortality following a gypsy moth outbreak.[88] Stands generally need "a relatively high proportion of resistant species (>70% of basal area)" to be considered less vulnerable to large-scale mortality.[89]

50. Consequently, researchers have concluded that "it is difficult to formulate silvicultural treatments that will have consistent results [because] … it is very difficult to predict the repercussions of an attack [by gypsy moths]."[90] Stated differently, while it is theoretically possible to decrease the vulnerability of a stand by selectively removing "the least vigorous trees," identifying trees that are most likely to die as a result of severe defoliation is very difficult. Therefore, managing vulnerability at the stand or landscape level may not be possible. [91]

<u>Harvesting non-preferred tree species will not reduce susceptibility or vulnerability to gypsy moth.</u>

51. Moreover, the Forest Service's proposal for indiscriminate harvest of both oaks and non-oaks[92] contradicts one of the most commonly advocated strategies for reducing risk of forest ecosystems to invasive pests: promoting diversity of tree species.[93] Stands composed of multiple tree species are naturally resistant to gypsy moths because not all tree species will be attacked by moths.[94] Gypsy moths prefer oak species and other species, such as red maple, are less preferred.[95] Additionally, it has been suggested that tree species diversity in a stand confers resistance by hosting a broader array of predators and pathogens than would be found in lower diversity stands.[96] Regardless of the mechanism, "[o]utbreaks rarely occur in stands dominated by nonpreferred host species."[97] Research has shown that mortality rates in stands attacked by gypsy moths are greater in stands with greater

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[88] *See id.* at 77 ("The probability of mortality depends on a complex interaction of many different factors, biotic and abiotic. This … variability makes the … accurate prediction of mortality extremely difficult.").
[89] Eisenbies et al. 2007 at 689 (citing Davidson et al. 1999).
[90] *Id.* at 690 (citing Muzika & Liebhold 2000 at 101) ("Studies have determined that tree mortality often represents a multi-decadal process and that losses in tree vigour may be evident long before an insect defoliation episode…. It therefore becomes difficult to predict which individual trees will die from insect defoliation, given simple defoliation estimate or vigour estimates at a particular point in time. The lack of predictive ability represents a substantial impediment when attempting to pre-empt mortality.").
[91] Muzika & Liebhold 2000 at 103.
[92] Scoping notice at 4.
[93] *See e.g.*, Guo et al. 2019 at 7385.
[94] J.S. Elkington & A.M. Liebhold, <u>Population Dynamics of Gypsy Moth in North America</u>, 35 Annual Review of Entomology 571, 584 (1990) ("Elkington & Liebhold 1990").
[95] Davidson et al. 1999 at 75 tbl. 1.
[96] *See* Burton et al. 2015 at 506.
[97] Elkington & Liebhold 1990 at 584. *See also* Eisenbies et al. 2007 at 689 (citing Davidson et al. 1999) (Stands need "relatively high proportion of resistant species (>70% of basal area)" to be considered less vulnerable to large-scale mortality).

proportions of oaks.[98] In this case, the Forest Service proposes to remove non-oaks in approximately 1,300 acres of national forest with the goal of establishing stands dominated by oak. Research on susceptibility and vulnerability of forest stands to gypsy moths provides no support for this.

Dilemma for Land Managers

52. Because oak is both ecologically and economically important,[99] managing oak vis à vis gypsy moths may put the Forest Service in a dilemma.[100] Such is the case with the Forest Service's current proposal: the agency desires to "maintain a significant oak component" in an ecosystem infested with gypsy moths, which preferentially attack oak. The Forest Service's current proposal creates the "[o]bvious conflict[]" described by Muzika & Liebhold 2000: increasing resistance to gypsy moths entails reducing the amount of oak on the landscape, but managing for oak preserves both oak's ecological importance and economic importance.[101] Removing oak from the landscape "… would be both economically and ecologically disruptive."[102]

53. This dilemma forces the Forest Service to choose between two different courses of action: (A) manage for ecological integrity in an area generally infested by gypsy moth by managing for non-oaks in order to reduce susceptibility and vulnerability, or (B) managing for oak regeneration.

    If the Forest Service decides to prioritize "managing for the gypsy moth," it must consider whether active management is appropriate at all, and if so, whether the best available scientific information supports using any silvicultural method.

    If, on the other hand, the Forest Service prioritizes "managing for oak regeneration" in these units, it could consider other silvicultural methods. There is a body of scientific literature related to oak regeneration, which the Forest Service does not appear to be invoking here.[103]

54. It is critical to recognize though that managing for oak regeneration would be an economic rather than an ecological decision. The objective of pre-salvage harvest is to realize the economic potential of an oak stand before it is lost. That is why Gottschalk included it as a possible technique in a "guidebook for foresters whose goal is timber production."[104] No

[98] *See* Davidson et al. 1999 at 79.
[99] *See* D.C. Dey et al. 2010 at 202; *and* Brose et al. 2008 at 4-5.
[100] Muzika & Liebhold 2000 at 103 (noting that eliminating preferred host species in order to reduce susceptibility ". . . represents an ecological and economic dilemma.").
[101] *Id.* at 101.
[102] *Id.*
[103] *See* Dey et al. 2010 at 202; K.C. Steiner et al., Oak Regeneration Guidelines for the Central Appalachians, 25(1) Northern J. of Applied Forestry 5 (2008); S.L. Clark and C.J. Schweitzer, Stand dynamics of an oak woodland forest and effects of a restoration treatment on forest health, 381 Forest Ecology and Management 258-67 (2016); Brose et al. 2008; J.S. Rentch et al., Crown Class Dynamics of Oaks, Yellow-Poplar, and Red Maple after Commercial Thinning in Appalachian Hardwoods: 20-Year Results, 26(4) Northern J. of Applied Forestry 156 (2009).
[104] *See* Gottschalk 1993 at 1.

published studies of which I am aware have shown (or even attempted to show) that a clearcut with reserves treatment—as proposed by the Forest Service here—will restore or maintain ecological integrity of an oak forest that may be infested by gypsy moths in the future.

In sum, the best available science does not support the use of a clearcut with reserves treatment to reduce the risk or extent of future gypsy moth outbreaks, or to increase forest resilience to possible future defoliation.

Scientific conclusions regarding the Forest Service proposal

55. In my professional opinion, the proposed silvicultural treatment contradicts the best available scientific information regarding ecological integrity in the project area, which lies within an area generally infested by gypsy moth. As explained above, studies generally do not show that silvicultural treatments are effective at reducing susceptibility or vulnerability to gypsy moth infestation.[105] The proposed regeneration treatments using the clearcut with reserves method on 1,366 acres would not reduce the risk or extent of, or increase resilience to gypsy moth.

56. The Forest Service wants to cut live oaks in oak-dominated stands now so that the stands will regenerate to "maintain a significant oak component." The Forest Service also intends to cut non-oak species "to give the oak stump sprouts the best chance to succeed in dominating the regenerated stand." These objectives run counter to body of scientific literature that advises tree species diversity and reducing the component of oak and other highly preferred species. By promoting oak dominance in a regenerated stand, the Forest Service is likely increasing the susceptibility of these stands to future gypsy moth defoliation.

57. Second, even if the Forest Service were decreasing the density of highly preferred oaks in these stands, this would not reduce the spread into other nearby oak forest. Accordingly, changing stand composition through silviculture would not affect gypsy moth populations in the landscape.

58. The proposed regeneration harvest will not reduce susceptibility to gypsy moths by improving conditions for gypsy moth predators and pathogens. Similarly, selective thinning is unlikely to reduce the frequency or intensity of outbreaks by enhancing conditions for natural enemies of the gypsy moth.

59. Even setting aside that oak regeneration is not a legitimate ecological goal to address the presence of gypsy moth, the proposed silvicultural treatments would not likely increase oak regeneration. Tulip poplar and red maple often outcompete oak sprouts unless site indices are low. In that case, oaks already have a chance of rising to dominance without silvicultural intervention.[106] Nor are the silvicultural treatments likely to increase oak vigor.

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[105] *See* Muzika & Liebhold 2000 at 103-104.
[106] Dey et al. 2010 at 931, 933.

60. As Gottschalk acknowledged in 1993, it is "very difficult, if not impossible" to predict vulnerability with any precision. There is no evidence in the project file that the proposed regeneration logging is designed to reduce stand vulnerability to mortality following gypsy moth defoliation. The Forest Service seems not to have even made efforts to develop a project that would do so, having failed to analyze the many relevant site conditions that affect vulnerability, such as the intensity, duration, and frequency of any previous defoliation in the proposed units.

61. Because the best scientific information related to ecological integrity in areas infested by gypsy moth does not support the proposed clearcut with reserves logging to regenerate oak, the Farm Bill's Insect and Disease Infestation CE does not appear to apply to this proposal.

E. **The best available science does not support timber harvest in this situation.**

62. The above scientific information shows that silvicultural practices generally do not reduce susceptibility to gypsy moth defoliation or vulnerability to mortality following defoliation in treated stands or surrounding areas.

There is no evidence that gypsy moth has caused a need for ecological restoration or maintenance in the project area.

63. Based on data from the project area and proposed units, there is no compelling evidence that the ecological integrity of the area is in need of maintenance or restoration simply because gypsy moth is present in the general area. Moreover, it is likely that the proposed management would do more harm than good to the ecological integrity of the area.

64. Ms. Bier's field surveys show that to the extent the gypsy moth is active in the proposed units at all populations are at very low densities. In all seven working areas of the project, Ms. Bier found a total of 6 gypsy moth caterpillars in 2 working areas (Caseknife and Tunnel Hollow).[107] Moreover, only 3 potentially viable gypsy moth egg masses were found: 2 in the Dismal area and 1 in the Caseknife area.[108]

65. In addition, based on the absence and/or minimal amount of notable damage and/or mortality in Ms. Bier's plots, it is unlikely that severe defoliation previously occurred in most units. Lastly, the vigor and health of trees appears good. Of the 870 overstory plot tree crowns sampled, 77% were classified as Good vigor and 16% were classified as Fair vigor. Only 1% were classified as Poor vigor.

66. None of these conditions point to a need for ecological maintenance or restoration simply because the project area is within a generally infested area. And certainly none of these conditions indicate these units would be a "priority projects … to reduce the risk or extent of, or increase resilience to, insect or disease infestation."[109]

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[107] Bier report at 3.
[108] *Id.*
[109] 16 U.S.C. 6591a(d)(1).

67. The mere presence of gypsy moth in such low densities does not mean defoliation and stand damage are looming. Gypsy moth populations can persist in low densities for long periods of time.[110] And some low-density gypsy moth populations may go extinct without any management.[111] This is true whether the population is within the generally infested area or along or ahead of the leading edge of spread.[112]

68. Many of the dynamics that appear to regulate gypsy moth populations are outside the control of land managers. For example, small mammals appear to be important at regulating low-density gypsy moth populations.[113] Studies indicate that regional weather influences (directly and indirectly) these predators as well as pathogens.[114] For example, the gypsy moth fungal pathogen *Entomophaga maimaiga* appears to "limit the severity, if not the frequency, of outbreaks" during wet weather."[115] The fungus is likely to play an important role in gypsy moth dynamics, given its dependence on moisture-related variables and the relatively wet conditions of this region.[116]

69. It is unpredictable which populations will later reach outbreak levels. It is most likely the interaction of a complex set of abiotic and biotic variables that allow gypsy moth populations to reach outbreak levels.[117]

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[110] *See* A.M. Liebhold et al. at 258 fig. 1 (2000) (showing periods of two decades or more during which gypsy moth activity in New England was very low).
[111] *See* P.C. Tobin et al., The Ecology, Geopolitics, and Economics of Managing *Lymantria dispar* in the United States, 58(3) Int'l. J. of Pest Mgmt. 195, 198 (2012) ("Tobin et al. 2012").
[112] Tobin et al. 2012 at 198.
[113] *See* Elkington & Liebhold 1990 at 574-76; D.M. Johnson et al., Geographical Variation in the Periodicity of Gypsy Moth Outbreaks, 29 Ecography 367, 372 (2006) ("Predation by small mammals is considered the single most important factor affecting low-density gypsy moth populations…"); *and* Muzika & Liebhold 2000 at 102 ("The largest source of mortality affecting low-density gypsy moth populations in North America is predation, mostly caused by small mammal predators").
[114] Liebhold et al. 2000 at 257, 261-263; J.R. Reilly et al., Impact of *Entomophaga maimaiga* (Entomopthorales: Entomopthoraceae) on Outbreak Gypsy Moth Populations (Lepidoptera: Erebidae): The Role of Weather, 43 Environmental Entomology 632 (June 2014) ("Reilly 2014"). *See also* Muzika & Liebhold 2000 at 103-104 (summarizing dearth of scientific evidence that silviculture can increase gypsy moth mortality indirectly by improving habitat for predators); Muzika et al. 1998 at 267 (thinning had no effect on predation of gypsy moth).
[115] C. Asaro & L.A. Chamberlain, Outbreak History (1953-2014) of Spring Defoliators Impacting Oak-Dominated Forests in Virginia, with Emphasis on Gypsy Moth (*Lymantria dispar* L.) and Fall Cankerworm (*Alsophila pometaria* Harris), 61 American Entomologist 174, 181 (2015). *See also* C. Asaro et al., Impacts of oak decline, gypsy moth and native spring defoliators on the oak resource in Virginia, Oak Symposium: Sustaining Oak Forests in the 21st century through Science-based Management, 20 (2019).
[116] *See* Reilly 2014 at 632, 640.
[117] *See* Liebhold et al. 2000 at 263-65. *See also* J.R. Foster *et al.*, Spatial dynamics of a gypsy moth defoliation outbreak and dependence on habitat characteristics, Landscape Ecology, 1-2, 9 (March 2013) ("Spatial propagation of outbreak populations remains poorly understood, in part

70. When considering whether any gypsy moth-related intervention is appropriate, land managers must consider gypsy moth population levels.[118] Two commonly used tools to measure gypsy moth density are pheromone traps and counting overwintering egg masses.[119]

Pheromone traps are useful for detecting and delineating new infestations. [120] Thus, they are "mostly used in isolated populations outside of the generally infested area and in areas along the expanding front of the gypsy moth infestation" as with the Slow the Spread Program.[121] Gypsy moths, however, have been present in the forest surrounding the proposed treatments for over a decade. Thus, "more intensive surveys" are needed to identify "rising populations."[122]

71. Therefore, it is more appropriate to use egg mass counts—a survey method relied upon to make decisions concerning control in "the generally infested area."[123]

72. Although there is considerable variation in the amount of defoliation that occurs in stands where 100 to 1000 egg masses are present, [124] research has shown that oak stands are unlikely to suffer noticeable defoliation when egg mass surveys detect less than 1,000 egg masses per acre.[125] And while a threshold of 250 egg masses per acre has been used for intervention, this threshold would be waste of resources for lad managers trying to reduce susceptibility and vulnerability to gypsy moth for ecological purposes: "[i]f a manager's objective is to prevent noticeable defoliation, growth loss, or mortality, then initiating treatment at 250 egg masses per acre would show little or no return on the expense of treatment."[126] Additionally, intervention at low egg mass densities "… may result in the needless treatment of many stands that would never become defoliated[.]"[127]

Again, Ms. Bier's field surveys of all 7 working areas, including 870 plots, resulted in only 3 potentially viable gypsy moth egg masses: 2 in the Dismal area and 1 in the Caseknife area.[128] The very low numbers that were observed indicate that egg mass densities that are far below thresholds for intervention. The clear conclusion of applying this research to the

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because defoliation effects are often ephemeral and difficult to quantify" but "may reveal processes that drive disturbance behavior….Spatial patterns are increasingly used to explain and predict defoliation outbreaks…") (internal citations omitted).

[118] Liebhold et al. 1994 at 1.

[119] *Id.*

[120] *Id.*

[121] *Id.*

[122] A.M. Liebhold et al., Gypsy Moth Egg Sampling for Decision-Making: a Users' Guide, at 1 (USDA Forest Service NA-TP-04-94 1994) (emphasis added) ("Liebhold et al. 1994").

[123] *See* Liebhold et al. 1994 at 1. *See also* A.M. Liebhold, Forecasting Defoliation Caused by the Gypsy Moth from Field Measurements, 22 Environmental Entomology 26, 26-31 (Feb. 1993).

[124] *Id.* at 16 fig. 7.

[125] *Id.* at 19 fig. 8.

[126] *Id.* at 19-20.

[127] *Id.* at 20.

[128] Bier report at 3.

project area is that there is no justification for invoking gypsy moths as justification for silvicultural intervention at this time.

The proposed silvicultural treatments would likely do more ecological harm than good.

73. There is an ever-growing body of literature that supports decisions by land managers not to actively intervene, particularly pre-emptively, in response to the presence of gypsy moth or other pests.[129] As several researchers concluded, [s]ince forest managers and researchers both have had limited success in predicting the occurrence of catastrophic events much before they occur, it is not practical to attempt to preempt the role of natural disturbances by harvesting stands prior to their occurrence."[130]

74. In 2006, forest ecology researchers undertook a study to "evaluate the hypothesis that active management can improve long-term ecosystem function by increasing ecosystem resilience and resistance."[131] They did so by comparing the effects of wind and insect disturbance on forest "ecosystem structure, composition, and function[,]" with the effects of "salvage and preemptive [timber] harvesting."[132] Noting that "[i]nsect and disease outbreaks often lead to increased harvesting of the host species, including preemptive cutting… and post-mortality salvage logging," the authors pointed out that the timber harvest "may generate more profound ecosystem disruption than the pest or pathogen itself."[133]

75. Studying the silvicultural interventions related to infestation by hemlock woolly adelgid ("HWA"), an invasive insect, serve as a good example.[134] Kizlinski et al. compared the direct effects of infestation by HWA" and the indirect effects of HWA infestation, namely intensive logging.[135]

Kizlinski et al. found that HWA and logging impacted vegetation composition similarly but at different temporal and spatial scales.[136] HWA resulted in vegetation changes that were more gradual and more localized than vegetation changes following logging.[137] Post-disturbance "forest floor dynamics" differed in HWA-infested and logged sites because of the latter allowing much more light to reach the forest floor.[138] Whereas logging creates

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[129] Even Gottschalk's Silvicultural Guidelines, timber-focused as they were, recognized that in some conditions, it was better not to log trees in response to gypsy moth. *See* Gottschalk 1993 at 2, Figure A (recommendations to defer cutting).
[130] Aber et al. 2000 at 13.
[131] *See e.g.* Foster & Orwig 2006 at 960.
[132] *Id.* at 960.
[133] *Id.* at 963 (citations omitted).
[134] HWA are a more aggressive invasive than gypsy moths because it disperses in a variety of ways, it reproduces twice per year, and it has no predators native to North America. M.L. Kizlinski et al., Direct and Indirect Ecosystem Consequences of an Invasive Pest on Forests Dominated by Eastern Hemlock, 29 Journal of Biogeography 1489, 1490 (2002) ("Kizlinski et al. 2002").*Id.* at 1490.
[135] *Id.* at 1490.
[136] *Id.* at 1500.
[137] *Id.* at 1496-98.
[138] *Id.* at 1498-99.

large and often uniform openings in a forest canopy, HWA disturbance changed forest structure in a manner that is similar to natural disturbances, which create gaps "… of mixed sizes depending on cause."[139]

Unlike HWA, logging "dramatically altered nitrogen cycling" compared to HWA-infested plots and undamaged plots.[140] In addition to causing "rapid nutrient losses from the disturbed area," the authors stated that post-logging nitrification could have long-term effects on "site fertility."[141]

These results bring to mind a cautionary statement made by another team of researchers that included Kurt Gottschalk: "A key objective in management decisions after insect outbreaks should be to reduce susceptibility to future insect attack, so care must be taken to promote rather than to compromise the inherent resilience of temperate and boreal forests."[142]

Indeed, in 2015 a team of researchers, again including Kurt Gottschalk, stated "… that any decision to undertake active management must be explicitly weighed against the option of doing nothing—of letting ecosystem recovery proceed unaided…for which a solid understanding of forest stand dynamics is required."[143] Burton et al. described an "intervention continuum" that included options ranging from intensive management to doing nothing.[144]

They further explained "[t]here is typically no need or incentive for active forest rehabilitation after an insect outbreak if overstory mortality is low, or if the understory is already well stocked with vigorous seedlings and saplings or is soon expected to be so."[145] The authors concluded that, '[p]rocesses of natural ecosystem recovery typically are more desirable, less intrusive, and less costly than active intervention."[146] The researchers concluded "[a]ll evidence suggests that harvesting exerts greater impacts on ecosystem processes than leaving disturbed or stressed forests intact."[147]

76. Here, the conditions do not weigh on favor of the Forest Service's proposed regeneration logging. As explained above, there is no evidence that that the ecological integrity of the area has been reduced because gypsy moth is in the general area or units. The best available scientific information does not support silvicultural activities as an effective way to reduce

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[139] J. Aber et al., Applying Ecological Principles to Management of the U.S. National Forests, 6 Issues in Ecology 7 (2000) ("Aber et al. 2000").
[140] *Id.* at 1500.
[141] *Id.*
[142] Burton et al. 2015 at 510.
[143] *Id.* at 507.
[144] *Id.* at 507-10.
[145] *Id.* at 507; *see also id.* at 508 tbl 24.1 (identifying considerations that support no active intervention in response to an insect outbreak including "[n]o personal or community safety concerns" and "[s]atisfactory levels of overstory survival ….").
[146] *Id.* at 508.
[147] Foster & Orwig 2006 at 966.

susceptibility or vulnerability to gypsy moth.[148] Moreover, the proposed clearcut with reserves treatments would likely to do more ecological harm than good for this the area.

F. Gottschalk's Guidelines improperly prioritize timber production over ecological integrity.

77. In addition to the above, Gottschalk's Silvicultural Guidelines are not suited to this situation.

78. Gottschalk's report is "primarily a guidebook for foresters whose goal is timber production, it does not balance timber production with the various (and sometimes competing) land uses that the Forest Service must provide. [149] Nor does it grapple with how to protect the resources aside from timber that the Forest Service must.

79. The purpose and focus of the Farm Bill Insect and Disease CE, however, is not timber production. Rather, the CE applies only to activities that restore or maintain ecological integrity—which may or may not involve timber production at all. But because prioritization of timber production is "baked into" the Guidelines, the Guidelines do not guide the land manager to consider non-silvicultural options that may better serve ecological integrity.

80. If any silvicultural intervention is appropriate, the Forest Service should consider other guidance or frameworks that prioritize ecological integrity above all (including timber production). While ecological restoration and timber harvest activities are not mutually exclusive, nor are they equivalent. As a result, the Forest Service cannot assume that the recommendations in the Silvicultural Guidelines would constitute ecological restoration or maintenance activities. Indeed, the best available science does not support that the proposed regeneration logging in these units would constitute ecological restoration.

81. In 2015, Gottschalk *et al.* recommend using a "scorecard" approach to identify the urgency and intensity of appropriate forest rehabilitation actions after insect outbreaks.[150] This approach would be more appropriate for the Forest Service than application of the 1993 Silvicultural Guidelines, because it does not assume timber production is the priority. Rather, it is a flexible tool that allows decisionmakers to emphasize ecological integrity as the priority, while also considering other values for land use, as well as the severity of the outbreak, ecological degradation, and environmental impacts. *See* attached.

G. Relevant Research

82. Relevant research is attached for consideration.

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[148] *See, e.g.,* Muzika et al. 1998 261; *and* Muzika & Liebhold 2000 at 193-94.
[149] Gottschalk 1993 at 1.
[150] Burton et al. 2015 at 509.

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