20 July 2022

TO: Susan Piper, Pomeroy District Ranger

ATTN: Allison Arnold

VIA: <https://cara.fs2c.usda.gov/Public//CommentInput?Project=61995>

**Subject: Sunflower Insect & Disease CE — comments**

Please accept the following comments from Oregon Wild concerning the Sunflower Insect & Disease CE, <https://www.fs.usda.gov/project/?project=61995>. Oregon Wild represents 20,000 members and supporters who share our mission to protect and restore Oregon’s wildlands, wildlife, and water as an enduring legacy. Our goal is to protect areas that remain intact while striving to restore areas that have been degraded. This can be accomplished by moving over-represented ecosystem elements (such as logged and roaded areas) toward characteristics that are currently under-represented (such as roadless areas and complex old forest).

In the proposed action thinning would be used to reduce stand density on approximately 2,902 acres. The proposed action includes 1,340 acres of commercial thinning from below and 1,562 acres of non-commercial thinning. White fir trees up to 30” dbh would be cut. Other trees would have a 21” dbh limit. Non-commercial treatments in Riparian Habitat Conservation Areas (RHCAs) would meet Riparian Management Objectives and specific design criteria as outlined in PACFish following the Blue Mountain Project Design Criteria (PDCs). No treatment is proposed within Inventoried Roadless Areas (IRAs).

We urge the Forest Service to use an ecological view of forests (NOT an agricultural view.) From an ecological viewpoint native insects and disease are part of the natural processes that diversify and enrich our forests. They are best viewed as solutions, rather than problems. In particular, the wide variety of mortality processes provide many ecological benefits, and treatment efforts are typically ineffective, and logging in particular has numerous significant ecological trade-offs: soil degradation, habitat loss, carbon emissions that exacerbate the climate crsis, significant long-term loss of snag habitat, etc.. So the NEPA analysis should recognize that insect and disease treatments have many costs and few benefits.

The National Forest Management Act and it’s implementing regulations require the Forest Service to follow the requirements of the LRMP, as amended. The Eastside Screens adopted in 1994 and 1995 are a valid amendments of the LRMP. The Jan 2021 Amendment of the Screens was not adopted pursuant to proper NFMA and NEPA and ESA procedures and so the Forest Service cannot rely on that amendment to authorize the removal of large trees >21” dbh.

In the event the Forest Service may rely on the Trump administration’s last-minute decision to approve the [regional Screens Amendment](https://www.fs.usda.gov/project/?project=58050) allowing removal of large trees, we object. The Trump Screens Amendment is unlawful for a variety of reason, including but not limited to:

1. The Screens Amendment was a public involvement nightmare. The FS failed to provide a scoping period and failed to provide an objection period even though one was promised from the beginning. The FS failed to meaningfully respond to public comment. The decision was approved at the last minute by a corrupt, lame duck administration.
2. The decision to amend the Screens and allow removal of large numbers of large trees across a large region is likely to have significant effects on the environment and therefore requires preparation of an Environmental Impact Statement.
3. The Screens EA violated NEPA in numerous ways, including an inadequate analysis of cumulative effects, failed to take a hard look at effects on carbon and climate, habitat for viable populations of species that depend on large and old trees, dense/unmanaged forest, snags and dead wood, riparian and aquatic habitats, etc.
4. The Screens EA failed to consider reasonable alternatives to meet the purpose and need such as retaining old trees regardless of size, and allowing the large-young trees within the dripline of legacy trees to be converted to snags, using prescribed fire to control encroachment of shade-tolerant tree species, and adopting a quantitative, science-based standard for conservation and restoration of large snags and green recruitment trees to meet population goals for snag-associated species.
5. The Screens Amendment also adopted a standardless approach to managing snags and green replacement trees, calling for the provision of *some* snags and green trees to meet the needs of *some* species, but without any assurances that logging will maintain population viability for the species which are most sensitive to the absence of abundant snags.
6. Approval of the Screens amendment violates the procedural and substantive requirements of the NFMA and its implementing regulations.
7. The FS failed to consult with NMFS and FWS regarding ESA-listed species.

We incorporate by reference our scoping comments and comments on the Large Tree Amendment EA and preserve all legal claims related to the issues raised in our NEPA comments. <https://cara.fs2c.usda.gov/Public//ReadingRoom?Project=58050>

Regardless of which version of the Screens the Forest Service is relying on, trees over 21” dbh may not be removed from *inside* LOS stands.

First, the Screens were interpreted to prohibit large tree removal both inside and outside LOS. A 1995 interpretive memo from the Regional Forester says: “… the intent of the screens is to maintain, in the short-term, all features of late and old structure, whether the stand is actually LOS or not. … For additional clarification, the screen direction under Scenario A of the wildlife standard is intended to maintain all live trees >21 inches regardless of tree species and regardless of whether a stand is LOS or not. The existing wording in Scenario A could be erroneously interpreted to mean that large trees >21 inches "could" be cut in LOS in some instances. We regret the ambiguous wording used in writing Amendment #2. The intent of Scenario A is as stated above.” John Lowe, Nov 14, 1995 implementation memo from the Regional Forester to all eastside forest supervisors following a field trip on the Umatilla NF (emphasis added) <https://drive.google.com/file/d/11krMlEE5UcHJcln5eyjWLyiRaJAFRm_M/view?usp=sharing>.

Second, the Jan. 2021 Trump Screens Amendment explicitly applies only “outside of LOS.” In fact, those three words - *outside of LOS* – are the first words of the amended guideline and clearly condition the entire paragraph regarding management o large trees. (2021 Screens Amendment [DN/FONSI](https://www.fs.usda.gov/nfs/11558/www/nepa/113601_FSPLT3_5575541.pdf) page 4). The Screens Amendment did NOT amend the requirement of the Eastside Screens to protect large trees >21” *within* LOS. The Forest Service does not get to rely on “ambiguous wording” excuse twice. If the Forest Service intended to change the requirement to conserve large trees within LOS and allow cutting of large trees >21” dbh inside LOS, the plan amendment should have made that explicit, rather than starting with the words “Outside of LOS…”

Furthermore, the EA supporting the 2021 Screens Amendment did not clearly and accurately disclose the direct, indirect, and cumulative impacts of removing large trees both inside and outside LOS, and the Finding of No Significant Impact was not properly informed by the full scope of the proposal to remove large trees both inside and outside LOS, and suffered for the lack of documentation of the full environmental effects of that proposal.

The NEPA analysis must disclose how the project will comply with all the requirements of the Eastside Screens.

The Eastside Screens say “2) Outside of LOS, many types of timber sale activities are allowed. The intent is still to maintain and/or enhance LOS components in stands subject to timber harvest … Manipulate vegetative structure that does not meet late and old structural (LOS) conditions, … in a manner that moves it towards these conditions as appropriate to meet HRV. … Manipulate vegetation in a manner to encourage the development and maintenance of large diameter, open canopy structure.” 1995 Regional Forester’s Forest Plan Amendment #2. <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5288660.pdf>

Looking at the old-growth definition from ICBEMP (<http://www.icbemp.gov/pdfs/sdeis/Volume2/Appendix17a.pdf>:

“old growth is typically distinguished from younger growth by several of the following attributes: 1. Large trees for species and site. 2. **Wide variation in tree sizes and spacing**. 3. **Accumulations of large-size dead standing and fallen trees** that are high relative to earlier stages. 4. Decadence in the form of broken or deformed tops or bole and root decay. 5. **Multiple canopy layers**. 6. Canopy gaps and understory patchiness.”

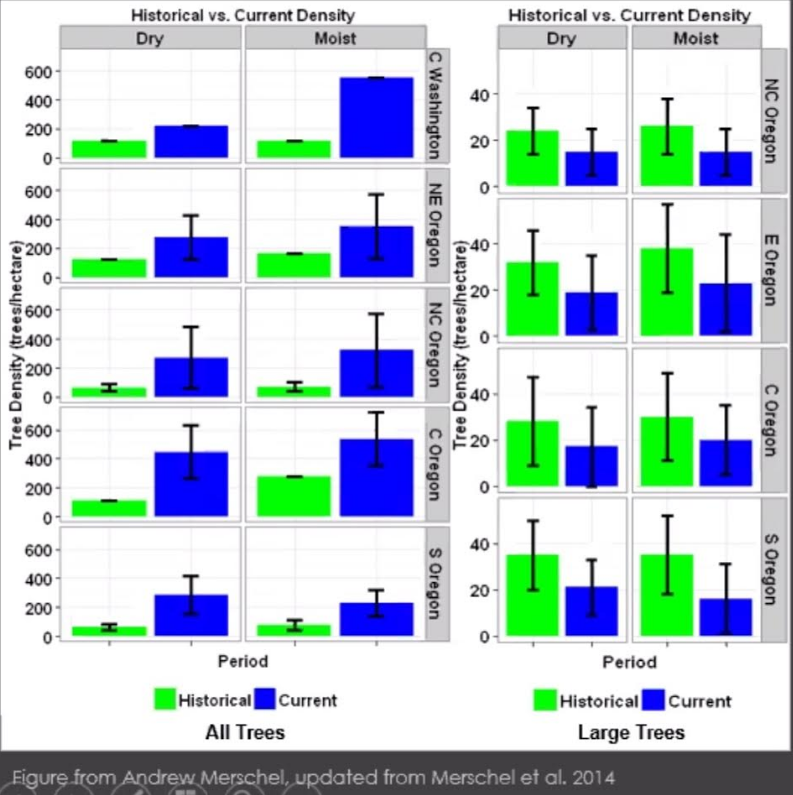
(emphasis added) It is clear that LOS “components” such as abundant snags must be retained and recruited, and many small and medium sized trees are needed grow into large trees. Thinning dense understory trees might help move stands toward LOS, but any action that would remove snags or reduce recruitment of medium trees into large tree classes would not be consistent with the Eastside Screens.

The Eastside Screens also state “To reduce fragmentation of LOS stands, or at least not increase it from current levels, stands that do not currently meet LOS that are located within, or surrounded by, blocks of LOS stands should not be considered for even-aged regeneration, or group selection at this time.” Any action that would build roads or establish young even-aged stands would not meet the Eastside Screens. Heavy thinning for fuel reduction should also be evaluated under this connectivity standard.

Make sure that any treatments in wildlife corridors comply with the expectations of the Eastside Screens, i.e. "medium diameter or larger trees are common, and canopy closures are within the top one-third of site potential. Stand widths should be at least 400 ft. wide at their narrowest point.... some amount of understory (if any occurs) is left in patches or scattered to assist in supporting stand density and cover."

Recognizing the fact that past logging practices have greatly reduced the abundance of large trees and snags, the Eastside Screens also require that projects use the best available science to meet the intent of 100% potential populations of primary cavity excavators. While the potential population methodology has been discredited the Forest Service must still meet the intent by not taking any action that could reduce populations of primary cavity excavators.

If any exceptions to the Eastside Screens will be considered, such as removing white fir larger than 21” dbh, please recognize that compelling ecologic justification for removal of large trees are lacking. There is still a shortage of large trees across the eastside landscape.



Where large trees appear to be abundant, they are helping to compensate for large areas lacking large trees. The agency is not helping when they propose to remove large trees when they exceed the historic average, because large trees populations exhibited a range of conditions often exceeding the average.

Furthermore, where large trees appear to be in competition and at risk of mortality, they are just furthering the natural processes that help tree populations develop adaptive traits such as when less fit individuals die and allow more fit individuals to survive and reproduce, thus increasing population resilience to drought. Mortality also helps recruit valuable large snags and dead wood. It is unavoidable that logging large trees has net negative ecological effects and cannot be justified on ecological grounds. The agency must consider all the trade-offs carefully.

Hessburg et al 2015 recommend: “To improve the longevity of larger early seral trees, restorative activities would include thinning and removing neighboring shade-tolerant trees to reduce competition for water and nutrients, and removing nearby surface and ladder fuels to reduce fire intensities that would threaten their long-term survival.” Paul F. Hessburg . Derek J. Churchill . Andrew J. Larson . Ryan D. Haugo . Carol Miller. Thomas A. Spies . Malcolm P. North . Nicholas A. Povak . R. Travis Belote . Peter H. Singleton. William L. Gaines . Robert E. Keane . Gregory H. Aplet . Scott L. Stephens . Penelope Morgan, Peter A. Bisson . Bruce E. Rieman . R. Brion Salter . Gordon H. Reeves. 2015. Restoring fire-prone Inland Pacific landscapes: seven core principles. Landscape Ecology, May 2015. DOI 10.1007/s10980-015-0218-0 <http://link.springer.com/content/pdf/10.1007%2Fs10980-015-0218-0.pdf>

Shifting species composition has become a popular rationale for removing large trees. The agency needs to recognize that the shift toward shade-tolerant tree species is a natural process. The PNW Region’s Eastside Screens Plan Amendment draft EA (p 23) says:

***3.1.4.2 Forest Succession Assumptions: All Alternatives***

Species composition will continue to shift toward fire intolerant species like grand fir and white fir. Less fire tolerant trees like white fir and grand fir will be the most abundant young trees as they can flourish in shady understories in the absence of periodic fire. Large fires with uncharacteristically large patch sizes will favor species with light windborne seeds that are capable of reseeding areas much farther away from reproducing survivors instead of the fire adapted species with heavy seeds (e.g. ponderosa pine) which do not travel far from the reproducing individual (Kemp et al. 2016, Westerling 2016, Owen et al. 2017, Coop et al. 2019, Downing et al. 2019, Hessburg et al. 2019). The increasing representation of these fire intolerant trees in dry and moist forest landscapes creates a feedback loop that perpetuates conditions more conducive to severe large-scale disturbances with increased risk of a future altered or unique vegetation conditions (Walker et al. 2018, Davis et al. 2019).

USDA 2020. Eastside Screens Plan Amendment draft EA. <https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd779174.pdf>. Retaining large grand fir and white fir that did not grow up under intense competition is better than removing them, especially when the expectation is for lots more small trees and greater challenges growing large trees of any species.

Johnson & Franklin (2013) review several considerations that the agency should make:

**Shift Tree Composition towards More Fire- and Drought-Tolerant Species**  
 Restoring the dominance of fire- and drought-tolerant species in Dry Forests is fundamental to increasing resilience. ….

The desired proportion of fire-tolerant to fire-intolerant species will vary by PAG. On sites historically dominated by ponderosa pine, meeting wildlife, fire and fuels, and resilience objectives may involve leaving almost 100% of a stand’s post-treatment basal area in pines. In the more productive Dry Mixed-Conifer stands, some Douglas-fir or grand/white fir may need to be left to achieve residual basal area objectives.  
 Restoring species composition towards historical levels can often mean removing large but younger (<150 year) grand/white fir and Douglas-fir to favor pines and western larch. Hard diameter limits, such as a 21-inch dbh limit, can make it difficult or impossible to achieve desired composition in many Mixed-Conifer Forests, which would compromise their future resilience. At the same time, large, young fir trees provide important wildlife habitat in their live, standing dead and down states, so some often should be retained (Box 5).

…

**Box 5: Deciding Which Larger Grand/White Fir to Retain or Remove During Restoration**

Deciding how many and which larger grand or white fir to retain and which to remove can be a challenging question for managers, stakeholders, and marking crews, particularly when there are no diameter limits (e.g., trees >21" dbh) or where diameter limits have been suspended. Large grand/white firs are often abundant on sites where they are poorly adapted or unwanted as potential fuel or a continuing source of grand/white fir seed. On the other hand, **larger grand/white firs often make up a large percentage of the basal area and provide important wildlife habitat.** So, what to do? Let’s begin by looking at some attributes of grand/white firs and then examine factors favoring retention or removal. Do remember that all older (e.g., greater than approximately 150 year old) grand/white firs should generally be retained along with older trees of other species.

Grand/white firs have the potential to grow fast and to larger sizes relatively quickly on sites that are environmentally favorable, such as Moist Mixed-Conifer sites. They are aggressive regenerators, producing large seed crops at frequent intervals. Grand/white firs are highly shade tolerant and typically retain lower branches as they grow into saplings and poles, creating potential fuel ladders. While growth during the first century is often rapid, grand/white firs are relatively short-lived species with low resistance to trunk, butt, and root rots, insect defoliators (especially spruce budworm), and bark beetles, among other afflictions (Table 1). Hence, mature (e.g., approximately 100 year old) stands dominated by white or grand fir can be expected to fall apart during their second century because of high levels of tree mortality, although individual trees may survive for 200 years or more. Grand/white firs are decay prone in the dead as well as the live state, so persistence as a snag or down log is short. Grand/white firs are also highly vulnerable to damage or death by wildfire or drought.

**Why would we retain larger young grand/white firs in restoration treatments, given their vulnerability to disease, insects, fire, and drought? One major reason might be the desire to retain some larger diameter trees as part of the residual stand, and a second may be that retaining grand/white fir could help achieve the target residual stand structure (e.g., basal area or tpa) where this species is a major component.** Grand/ white firs may be a good choice for retention where rapid growth in wood volume is a major objective in the restored stand, however wildlife habitat is more likely to be a reason for retaining larger grand/white firs. **Larger grand/white firs often have decadent features, like cavities, decay pockets, and brooms, which are useful to wildlife. Furthermore, many of these trees are important sources of snags and logs, since most will die in the near future (e.g., 50 years). For example, grand/white firs hollowed by Indian paint fungus may be opened up by pileated woodpeckers and later used by Vaux swifts. Finally, grand/white firs produce seed crops that are valuable to some wildlife, including Douglas squirrels.**

Why should many or most of the larger grand/white firs be removed during restoration treatments? First, they compete aggressively with ponderosa pine and other fire- and drought-resistant species and may provide significant fuel ladders. Hence, the location of larger grand/white firs relative to pines and larches or even Douglas-fir may be an important factor in deciding which ones to retain. Grand/white firs are also relatively short-lived and highly susceptible to fires and defoliators; they are not likely to make a long-term contribution to the live basal area of the stand or to contribute to its resilience. There are many examples where larger grand/white firs were retained to maintain the basal area of restored stands but died within the next decade. Of course, this is fine if an objective is to generate short-lived snags and down logs for wildlife. Finally, removal of larger grand/white fir will substantially reduce the amount of grand/white fir seed source present on the site and, potentially, its abundance in regeneration.

**So, what are the most appropriate larger grand/white firs to retain in restoration treatments? First, retain any grand/white fir older than approximately 150 years of age**. Guides for visual identification of these older trees are under development and initial results are reported above. With larger grand/white firs that are less than 150 years of age, **consider retaining individuals that are not threatening older pines or western larches either as fuel ladders or competitors, especially in Moist mixed-Conifer Stands.** Further, where a choice is between trees with significant defects, such as cavities and stem rots, and sound trees of comparable size, retaining defective trees is generally the better choice ecologically and economically. Trees with defects generally will have the greatest wildlife value both in the short- and long-term.

Franklin, J.F., Johnson, K.N., et al 2013. Restoration of Dry Forests in Eastern Oregon – A Field Guide. The Nature Conservancy, Portland, OR. 202 pp. <http://nature.ly/dryforests>.

## Connectivity Requirements of the Eastside Screens

The explicit intent of the Screens which is “to insure that blocks of habitat maintain a high degree of connectivity between them,...” 1995 Eastside Screens, Scenario A, INTENT STATEMENT for connectivity (emphasis added).

The connectivity requirements of the screens are detailed and mandatory. Connectivity corridors:

* Must link all late old structure stands in at least 2 directions;
* Must be at least 400 feet wide at their narrowest spot;
* Must be maintained as dense as possible with medium and large trees, or in the top third of site-potential and at least 50% canopy cover;

The Eastside Screens provide ...

... it is important to insure that blocks of habitat maintain a high degree of connectivity between them, and that blocks of habitat do not become fragmented in the short-term.

a) Maintain or enhance the current level of connectivity between LOS stands and between all Forest Plan designated “old growth/MR” habitats by maintaining stands between them that serve the purpose of connection as described below:

(1) Network pattern – LOS stands and MR/Old Growth habitats need to be connected with each other inside the watershed as well as to like stands in adjacent watersheds in a contiguous network pattern by at least 2 different directions.

(2) Connectivity Corridor Stand Description – Stands in which medium diameter or larger trees are common, and canopy closures are within the top one-third of site potential. Stand widths should be at least 400 ft. wide at their narrowest point. The only exception to stand width is when it is impossible to meet 400 ft with current vegetative structure, AND these “narrower stands” are the only connections available (use them as last resorts). In the case of lodgepole pine, consider medium to large trees as appropriate diameters for this stand type.

If stands meeting this description are not available in order to provide at least 2 different connections for a particular LOS stand or MR/Old Growth habitat, leave the next best stands for connections. Again, each LOS and MR/Old Growth habitat must be connected at least 2 different ways.

(3) Length of Connection Corridors – The length of corridors between LOS stands and MR habitats depends on the distance between such stands. Length of corridors should be as short as possible.

(4) Harvesting within connectivity corridors is permitted if all the criteria in (2) above can be met, and if some amount of understory (if any occurs) is left in patches or scattered to assist in supporting stand density and cover. Some understory removal, stocking control, or salvage may be possible activities, depending on the site.

We would like to emphasize that the screens anticipated the possibility of logging in connectivity areas, but there are minimum requirements for that. The screens provide: “Harvesting within connectivity corridors is permitted if all the criteria in (2) above can be met ...” and some patches of understory are retained.

The 1995 EA for the Eastside Screens identifies the following process for analyzing connectivity:

c) To insure connectivity as described above is maintained, use the following process:

(l) Do suitable network linkages between old and late structural stands and MR-designated habitats occur, according to the previous description? If so, will the proposed project isolate any area or group of areas by reducing any one of the parameters below acceptable levels? If not, the project can continue. If so, the project must be deferred or re-designed to meet connectivity parameters described above.

(2) Do suitable network linkages between old and late structural stands and MR-designated habitats NOT OCCUR under current conditions, as described above? If areas are already isolated, or partially isolated by not meeting the connectivity description above, will the proposed prescription promote linkage sooner than if left alone? If so, the project should continue. If the project is designed in a manner that would further increase isolation, the project must be deferred or re-designed to enhance connectivity parameters.

The NEPA analysis must disclose how much of the project area will maintain >50% canopy closure (or in the top third of site potential) after this project is implemented. The 1995 EA supporting the Eastside Screens says “The intent is to maintain canopy closure as dense as possible.” The Response to Comment asks “where the >50% canopy closure number came from.” The >50% canopy closure number comes from the 1995 EA for the Eastside Screens which included some clarifying text about connectivity on page 17 of Appendix C. Violation of the Eastside Screens, is a violation of NFMA which requires compliance with the LRMP as amended by the Screens.

## Forest insects and diseases enhance biodiversity and help regulate a healthy forest.

The agencies need to stop thinking about forests as an agricultural crop and start thinking about forests as complex, self-organizing systems. When forests become dense, natural mortality processes, like insects, disease, and fire, are not a problem, rather they are part of the solution. Natural mortality increases the diversity and complexity of the forest. Mortality creates opportunities for new organisms, thus enhancing biodiversity. Jonathan Romeo 2016. Beetle-kill zones surprisingly rich in biodiversity. Durango Herald. March 2, 2016. <http://www.durangoherald.com/article/20160302/NEWS06/160309880/0/SEARCH/Beetle-kill-zones-surprisingly-rich-in-biodiversity> (Forests “scarred by the spruce beetle outbreak, can elicit strong emotions in the nature lover. Several logging sales may be on the way, but new research suggests ravaged trees can create an ecologically vital habitat worth saving. … The Forest Service has long maintained such timber sales benefit the health of the ecosystem as it transitions from an old-growth to new-growth forest, but research from the University of Montana, as well as several conservation groups, challenges that idea. … After the beetle moves on, woodpeckers feed on the larvae left behind, which creates nest cavities in dead trees for other species – such as bluebirds, chickadees and even squirrels – who are unable to make the safe havens themselves. Then come the wildflowers, which thrive on the exposed understory of the forest, typically covered in shade. Flies and other insects arrive to feed on the flowers, and in turn bring birds, bats and other small mammals, which attract larger predators. “What you end up with is a very rich and biodiverse ecosystem,” Hanson said. Clark University associate professor Dominik Kulakowski agreed. He said the result, a “snag forest,” is a favorable habitat for many invertebrates and vertebrates because of the creation of canopy gaps and enhanced growth of understory plants. “Outbreaks create snags that may be used by various birds and mammals, including woodpeckers, owls, hawks, wrens, warblers, bats, squirrels, American marten and lynx,” Kulakowski said.” By removing the trees, you remove this process, both Hanson and Kulakowski said.)

**Failure to embrace natural disturbance as part of the solution rather than part of the problem.** Throughout the CFCP, wildfire, insect mortality, and drought mortality are all described as undesirable carbon losses to be mitigated through preemptive thinning when it is generally understood that California forests are in need of more fire not less (Stephens et al., 2007; Marlon et al., 2012; Baker, 2015 ) and that insect mortality, and drought mortality function primarily to thin forests (Harvey et al., 2013; Meigs et al., 2016), much like that proposed through selective harvest.

Campbell, J.L. 2017, Comments on the Jan 2017 draft California Forest Carbon Plan. <http://www.fire.ca.gov/fcat/downloads/FCAT_PublicComment/Campbell_CFCP_Review_Final-2nd.pdf>.

The scourge of forests, the [beetle], is usually described with words like "destructive" and "pest." A recent study based on data collected by citizen scientists suggests that one more adjective might apply, at least from a bird's perspective: "delicious."

USDA Forest Service - Northern Research Station (2013, August 8). Increase in woodpecker populations linked to feasting on emerald ash borer. ScienceDaily. Retrieved August 12, 2013, from <http://www.sciencedaily.com/releases/2013/08/130808124229.htm>

A bird exclusion study in an Oregon forest showed that “on average, insectivorous birds reduced arthropod abundance by 16% and plant damage by 14% …” Harris, S. H., Kormann, U. G., Stokely, T. D., Verschuyl, J., Kroll, A. J., and Betts, M. G.. 2020. Do birds help trees grow? An experimental study of the effects of land‐use intensification on avian trophic cascades. Ecology 101(6):e03018. 10.1002/ecy.3018.

Foresters are trained to control and limit tree mortality, but tree mortality from insects, disease, fire, etc. actually enhances stand heterogeneity and resilience to disturbance.

Resilience to wildfire may arise from feedback between fire behaviour and forest structure in dry forest systems. Frequent fire creates fine‐scale variability in forest structure, which may then interrupt fuel continuity and prevent future fires from killing overstorey trees. Testing the generality and scale of this phenomenon is challenging for vast, long‐lived forest ecosystems. We quantify forest structural variability and fire severity across >30 years and >1000 wildfires in California's Sierra Nevada. We find that greater variability in forest structure increases resilience by reducing rates of fire‐induced tree mortality and that the scale of this effect is local, manifesting at the smallest spatial extent of forest structure tested (90 × 90 m).

Koontz, M.J., North, M.P., Werner, C.M., Fick, S.E. and Latimer, A.M. (2020), Local forest structure variability increases resilience to wildfire in dry western U.S. coniferous forests. Ecol Lett. <https://doi.org/10.1111/ele.13447>

Several recent studies suggest that beetles may in fact help forests adapt to changing climate conditions.

* Peter T. Soul, Paul A. Knapp & Justin T. Maxwell (2013) "Mountain Pine Beetle Selectivity in Old-Growth Ponderosa Pine Forests, Montana, USA" Ecology and Evolution Volume 3 Issue 5 pp.1141-1148. <https://libres.uncg.edu/ir/asu/f/Soule_Peter_2013_Mountain%20Pine%20Beetle_orig.pdf>;
* Millar, C.I. et al. 2007. Response of high-elevation limber pine (Pinus flexilis) to multiyear droughts and 20th-century warming, Sierra Nevada, California, USA. Canadian Journal of Forest Research 37: 2508-2520. <https://www.fs.fed.us/psw/publications/millar/psw_2007_millar031.pdf>;
* Millar, C.I. et al. 2012. Forest mortality in high-elevation whitebark pine (Pinus albicaulis) forests of eastern California, USA; influence of environmental context, bark beetles, climatic water deficit, and warming. Canadian Journal of Forest Research 41: 749-765. <https://www.fs.fed.us/psw/publications/millar/psw_2012_millar001.pdf>;

Beetles also help inoculate trees with diverse fungi which surprisingly reduces the rate that carbon is relased from dead trees.

In two new studies, James Skelton, along with a group of collaborators, investigated how the fungi associated with bark beetles and closely related ambrosia beetles influence how fast wood decays. As a postdoc in Jiri Hulcr’s lab at the University of Florida, Skelton’s work focused on describing the ways in which the beetles and their symbiotic fungi interact. And very soon he began to question a broadly accepted idea – that the fungi the beetles carry into the tree accelerate decay.

“It didn’t make sense given these beetles are really better suited to a fast food lifestyle” Skelton says. “They [fungi] get into the tree and then have to be ready to get back out fast when the beetles leave. They are not in the tree that long.” That means a grab-and-run lifestyle. “If the beetles are your only bus out, why invest in expensive enzymes for decay which is way too slow?”

So, Skelton set off to see what really happens in beetle-infested trees. In two experiments, one set in the messy but natural conditions of the forest and the other in the tightly-controlled environment of the laboratory, he used a combination of high-tech molecular approaches and standard wood product testing methods to challenge the old supposition with actual data. The exposed pieces of trees he left in the forest were soon colonized by hundreds of beetles and with them came a diverse set of fungi – in fact, these logs were 400% higher in fungal diversity than the pieces of trees he protected from beetles. And the kicker – the more species of fungi that were brought in by beetles or introduced in the lab, the lower the rate of decay.

This outcome was not completely surprising to Skelton. “The majority of the fungi the beetles carry do not decay wood.” But it wasn’t just that. The diversity of fungi was key to lowering the rate of decay, irrespective of whether individual species could decay wood or not. This effect had been found in other studies in wood without beetles where researchers found that that as the number of fungal species increased, CO2 release declined. And again, it wasn’t so much who was there but how many.

Early models of CO2 release from beetle-killed forests were mostly tales of gloom and doom predicting a rapid mass release of carbon into the atmosphere. However, field-based studies have since helped define crucial factors affecting carbon release that were missing in the early models.

In living forests it turns out, about half the CO2 taken from the air by the tree for photosynthesis is converted to sugar and excreted into the soil via the roots where it is consumed by soil microbes that use it as energy resulting in its release back to the atmosphere as CO2. When trees die, this process and release stops, offsetting much of the increase in CO2 release that occurs due to decay. Matt Hansen, a scientist with the Forest Sciences Lab in Logan, UT comments “The work I did on the ground began to add the information we needed for more accurate models. It showed beetle-affected forests become carbon neutral and slowly recover” says Matt Hansen. Similarly, a study by David Moore of Northern Arizona University found much lower rates of CO2 release from beetle-kill in forests than expected.

Six, D. 2020. How tiny fungi may be slowing carbon release from bark beetle-killed trees. Blog post. <https://eddycovarianceblog.wpcomstaging.com/2020/06/11/how-tiny-fungi-may-be-slowing-carbon-release-from-bark-beetle-killed-trees/>.

Beetle outbreaks also stimulate flowering plants and benefit pollinators.

The team found that average floral abundance in spruce beetle-affected stands was 67 percent higher than in non-affected stands. The average number of bee species was also 37 percent greater in beetle-affected stands, with more species present in June than later in the growing season. Davis said the relationship between these insects and their surrounding vegetation may be more complex.

“It appears there are different controls over bee abundance and diversity,” Davis said. “Bee abundance was correlated to the floral species, while the diversity is more related to the forest structure, both of which are affected by bark beetles.”

In other words, bark beetles directly changed the forest structure which indirectly improved wild bee populations by providing a more robust food source for the buzzing insects on the ground.

Spruce beetle-affected forests offer a few advantages for understory plants and wild bees. Tree mortality typically opens up the forest canopy, allowing more light to reach plants and flowers on the forest floor. Dead trees also remain standing for up to 25 years after this disturbance. This offers more cavities for wild bees that nest in trees and dead wood.

Karina Puikkonen 2020. Bark beetle outbreaks benefit wild bee populations, habitat. CSU News, Published Oct. 14, 2020. <https://web.archive.org/web/20201021055702/https://warnercnr.source.colostate.edu/bark-beetle-outbreaks-benefit-wild-bee-populations-habitat/>

The NEPA document needs to consider the beneficial effects of insects and disease, for example: the value of mistletoe brooms as wildlife structures; the value of root rot in creating pockets of down woody debris, enhancing biodiversity, and creating gaps with complex canopy architecture; the value of bark beetles as food sources for diverse wildlife and as vectors of sapwood decay fungi rendering the tree more suitable for wildlife habitation.

Rather than pests, both the bark beetle and wood-boring beetle species at issue are native species that fill essential roles in native forests. They evolved in these forests over many millennia; in many ways, they're a cornerstone of the biodiversity in forest ecosystems in California and the western U.S.

Periods of drought are natural in the western U.S., and most dead trees result from occasional pulses of drought and fire. These native beetle species require recently dead trees to survive, since their larvae depend upon the unique microhabitat and food conditions found under the bark of recent snags. Woodpeckers depend upon these beetle larvae for their food, and the woodpeckers need snags, which are softer than live trees, so they can excavate nest cavities to raise their chicks.

Every year these native woodpecker species, like the black-backed woodpecker, hairy woodpecker, and white-headed woodpecker, create a new nest cavity, allowing the previous cavities to be used by dozens of species that also require nest cavities but cannot create their own, such as bluebirds, nuthatches, wrens, and even small mammals like flying squirrels and pine martens. Raptors such as the northern goshawk and Cooper's hawk depend upon such birds for their food.

Where pockets of dead trees occur, increased sunlight spurs the growth of native shrubs, which produce flowers and edible berries. These shrubs require high levels of sunlight, and cannot survive under the shade of a dense forest canopy. The flowers attract native flying insects -- bees, wasps, butterflies and moths -- which in turn provide food for flycatching birds and bats. The berries on these shrubs are essential food bears need to eat to fatten up before the long, cold winter, and the leaves on the shrubs provide forage for mule deer. The shrubs also create important nesting habitat for many shrub-nesting birds, many of which have become rare or are declining due to lack of habitat currently. Small mammals create dens in the shrubs and downed logs, providing a core food source for owls.

The entire ecosystem and many of its inhabitants depend upon these native beetle species and an abundance of snags. No snags, no beetles. No beetles, no woodpeckers. No woodpeckers, no bluebirds, nuthatches, or other secondary cavity-nesters. No woodpeckers, bluebirds, etc., no hawks. Without an ample supply of snags, and healthy beetle populations, bears and deer also suffer.

The fact is, an ecologically healthy forest has a lot of dead trees. Current science indicates that we have a deficit, not an overabundance, of dead trees in forests of California, relative to the needs of the dozens of cavity-nesting wildlife species that depend upon these snags for both food and homes.

…

Studies show that cavity-nesting wildlife species generally need at least four to eight snags per acre to have sufficient food and nest-cavity abundance. The rarest and most imperiled cavity-nesting species often require much higher levels.

For example, the California spotted owl depends on dense, old forests with 8 to 12 snags per acre for nesting and roosting habitat, and generally even higher levels for foraging habitat, because snags and downed logs (after the snags fall to the ground) create excellent habitat for the owl's small mammal prey species. The rare black-backed woodpecker depends upon areas with at least several dozen snags per acre in order to have enough food to survive, since the birds feed on the larvae from native beetles found almost exclusively under the bark of dead trees.

So, when you see a forested slope with some pockets of dead trees, don't lament it; rather, celebrate the sight as a positive sign for wildlife populations and the ecological resilience of the forest.

Chad Hanson 2015. COMMENTARY - In Defense of The Bark Beetle. October 14, 2015 <http://www.kcet.org/news/redefine/rewild/commentary/in-defense-of-the-bark-beetle.html>

Unplanned disturbance often enhances forest diversity. Eugene BLM’s Middle McKenzie Landscape Design says “Many times, small natural disturbances are biologically desirable since they increase the variability of the forest. When natural disturbances are small, the planned schedule of activities should not be altered.” <http://www.blm.gov/or/districts/eugene/plans/files/MMLD.pdf>

The massive insect epidemics that have plagued Pacific Northwest forests in recent years are mostly a reflection of poor forest health conditions, overcrowding, overuse of chemicals, fire suppression and introduction of monocultures or non-native species, a new report concludes.

Beyond that, these insect attacks are actually nature's mechanism to help restore forest health on a long-term basis and in many cases should be allowed to run their course, according to Oregon State University scientists in a new study published this week in the journal Conservation Biology In Practice.

Native insects work to thin trees, control crowding, reduce stress and lessen competition for water and nutrients, the researchers found. Some levels of insect herbivory, or plant-eating, may even be good for trees and forests, and in the long run produce as much or more tree growth.

"There is now evidence that in many cases forests are more healthy after an insect outbreak," said Tim Schowalter, an OSU professor of entomology. "The traditional view still is that forest insects are destructive, but we need a revolution in this way of thinking. The fact is we will never resolve our problems with catastrophic fires or insect epidemics until we restore forest health, and in this battle insects may well be our ally, not our enemy."

Historically, Schowalter said, destructive forest insects such as the mountain pine beetle or tussock moth were native to Pacific Northwest forests and served an essential role in keeping them healthy. When trees became too crowded the insects would eliminate weaker trees and reduce competition. But since the beetles' reproductive pheromones only carried effectively about 15-20 feet, naturally open stands of mature pines were protected against widespread outbreaks.

In these same forests today, fire suppression has allowed shade-tolerant, fire-intolerant species to crowd the understory, create an entire forest stressed for water and nutrients, and beetles can skip from one weak tree to another across entire stands. But the solution in cases such as this, Schowalter said, is to address the fundamental issue of overcrowding through forest thinning, controlled fire and insect attack, allowing the pine beetles to actually help in the long-term process of restoring forest health.

It now appears that insects, which are the most abundant and diverse animals on Earth, are anything but destructive pests. Rather, they are major architects of the plant world in both structure and function, and in natural balance help to maintain healthy and productive forest ecosystems.

According to the new report, insects can influence their environment in five key ways:

* Insects aid decomposition, stimulate the breakdown of organic materials, enhance soil fertility and plant growth, burrow in soils and increase its porosity and water-holding capacity.
* Insects are herbivores that eat plants, influencing where they can grow. Sometimes they kill trees and other plants to reduce competition, and many times feed on trees without killing them in ways that actually improve the health and long-term growth of trees and forests.
* Insects are a key food source for vertebrates and other animals, and play a major role in the food chain.
* Insect are dispersal agents to carry seeds, fungal spores, and even other invertebrates from one place to another.
* Insects are pollinators, and in this role also help control the movement of plant species.

Through this multiplicity of roles, forest insects can help to control plant succession, dictate which plants will be allowed to grow or thrive in particular areas, and generally invigorate plant communities, the report said. Studies suggest herbivory levels as high as 40-50 percent make little or no difference to plant growth and survival, and this type of moderate herbivory clearly should not be "fought" with costly controls. Wood production in western U.S. pine forests reached or exceeded pre-attack levels 10-15 years following mountain pine beetle outbreaks, research has shown, and the more an individual Douglas-fir tree is defoliated by the tussock moth, the more it compensates afterwards with increased growth, given sufficient resources. The herbivory may alleviate drought stress by reducing a tree's demand for water, and also encourage more competitive interactions between plant species that ultimately work to the benefit of the tree.

Insects may be so important to soil fertility that they may be a better barometer of forest ecosystem health than the larger trees or animals which live there, researchers say. In natural forest communities there are more than 200 species of arthropods and more than 200,000 individuals in a square meter of soil, and the numbers of these arthropods can tell more than chemical tests about soil concerns such as compaction and nutrient cycling. A study by another OSU researcher showed residual impacts on soil invertebrate populations from a site that had been clearcut and slash burned 40 years earlier.

In their natural role, insects are usually helpful to the forest and rarely cause large epidemics.

"When you have a highly destructive insect epidemic, what that really should be telling us is not that we have an insect problem, but that we have a forest health problem," Schowalter said. "It's monocultures and fire suppression that cause insects to become nuisances. The pests that plague us are all too often of our own making."

As these systems become more fully understood, Schowalter said, it should be possible to work with insects, rather than against them, to produce new solutions to maximize the yield of forest commodities while achieving conservation goals and healthier ecosystems.

"It's really simple on one level," Schowalter said. "We have to pay more than lip service to the balance of nature."

Oregon State University. "View Of Forest Insects Changing From Pests To Partners." ScienceDaily, 31 October 2001. <http://www.sciencedaily.com/releases/2001/10/011030230203.htm>.

See also:

* Insect Ecology - An Ecosystem Approach Edited by Timothy D. Schowalter Academic Press. 2000. and Schowalter, TD and J. Withgott. 2001.
* Rethinking insects: What would an ecosystem approach look like? Conservation Biology In Practice 2(4): 11-16.
* Waldbruaer, Gilbert. 2003. What Good are Bugs? Insects in the Web of Life. Harvard University Press. Cambridge, MA. 316 pp.
* Maddie Oatman 2015. Bark Beetles Are Decimating Our Forests. That Might Actually Be a Good Thing. They gobble up trees and send politicians into a frenzy. But do the bugs know more about climate change than we do? Mother Jones, May/June 2015 <http://m.motherjones.com/environment/2015/03/bark-pine-beetles-climate-change-diana-six>

Another interesting example, though anecdotal, is from Yellowstone National Park where researchers noted after the 3,400 hectare 1994 Robinson fire that beetle-killed lodgepole pine (self-thinned to lower density) experienced significantly lower fire severity compared to adjacent burned areas. <http://www.fs.fed.us/projects/documents/Omi_pollet_2002_thinning_effects.htm>.

The Forest Service should encourage bark beetles in order to provide the benefits they provide such as forest thinning and food for many different wildlife.

Bark beetle infested habitat\_. Areas of bark beetle (Scolytidae) infestation have received less attention in terms of research on black-backed habitat than post-burns areas. Bull et al. (1986) and Goggans (1988) report nesting of black-backed woodpeckers in areas of bark beetle outbreaks in Oregon. Setterrington et al. (2000) proposed populations of black-backed woodpeckers could be supported by endemic localized populations of bark beetles, as Hughes suggested (2000) in northeastern California.  
  
Mohren (2002: 87) in his study of the black-backed woodpecker in the Black Hills of South Dakota concluded "It is also possible these woodpecker species are not selecting foraging location based on habitat characteristics, but are selecting areas populated with wood-boring beetles." Mohren (2002) criticized management recommendations in the Black Hills Forest plan (1996 Revised Land Resource Management Plan Final Environmental Statement III-450) that call for thinning in that such timber management would reduce habitat suitable for insect outbreaks and, therefore, habitat for the black-backed woodpecker.  
  
Mohren (2000: 86, 87) further suggested a need to create "stands that will become susceptible to wood-boring beetles will provide an abundance of prey for both of these species (black-backed and three-toed woodpeckers) as part of forest management by the Black Hills National Forest. Also, allowing large areas to become infested with wood-boring beetles (such as Baer Mountain area) is suggested to let black-backed and three-toed woodpeckers increase in population size. Current outbreaks should be examined to determine the effects wood-boring beetles have on black-backed and three-toed woodpecker." \*\*  
  
Bonnot (2006) also working in the Black Hills with support from the US Forest Service found black-backed woodpeckers nested in areas of mountain pine beetle and preferred areas with increased snag densities. Bonnot found black-backed woodpecker nest success in bark beetle areas ranged from 75% (n =1 2 in 2004) to 47% (n = 32 in 2005) and used both live and dead aspen trees on an equal bases. He further suggested that black-backed woodpecker demographics in bark beetle habitat were at least equal to that reported in post burn habitat. Bonnot (2006: 2) further suggested that forest managers "will need to consider trade-offs between timber harvest and wildlife species that benefit from mountain pine beetle infestations."

\*Draft\* \*Habitat Guidelines for the Black-backed Woodpecker\* \*Northern Region, USDA Forest Service\*

Perovich & Sibold (2016) looked at vegetation change after a large beetle outbreak in lodgepole forests and found that -

… the outbreak initiated a shift in forest structure from single-cohort lodgepole pine stands to stands with greater diversity in age classes and species composition. This increase in landscape asynchrony may increase resiliency to future disturbances. However, this heterogeneity is a result of more spruce and fir on the landscape, species which are less adapted to projected future climate conditions. Our results indicate that disturbances do not necessarily increase the rate at which vegetation adapts to a changing climate, and that it is essential to consider disturbance type and available seed sources when predicting future forest conditions.

Carlyn Perovich, Jason S. Sibold 2016. Forest composition change after a mountain pine beetle outbreak, Rocky Mountain National Park, CO, USA. Forest Ecology and Management. Volume 366, 15 April 2016, Pages 184–192. doi:10.1016/j.foreco.2016.02.010.

Axelson et al (2009) found that canopy thinning by beetles helps diversify forests homogenized by stand replacing fire.

Our study clarified the relationship between fire and [mountain pine beetle] MPB disturbance and allowed us to describe the role of MPB as a modifier of the simple stand structures, which form after stand replacing fire. Regeneration cohorts that arise in response to canopy thinning by MPB will form the next crop after the present canopy is destroyed by the current outbreak.

In summary we found that in the Logan Lake area:

* In the absence of wildfire for much of the 20th century in our study area, the MPB has played a significant role in directing stand dynamics in lodgepole pine stands.
* Stand-replacing fires initiated even-aged seral lodgepole pine stands; while subsequent multiple MPB disturbances have transformed stands into forests with multi-stories and multiple age cohorts, initiated by repeated canopy thinning.
* In the long term, the impacts of MPB mortality on the overstory will be alleviated by the presence of a sub-canopy, and to a lesser extent, the advance regeneration layers which will form reasonably well stocked forests in the future.

Axelson, J. N., Alfaro, R.I., and B. Hawkes. 2009. “Influence of fire and mountain pine beetle on the dynamics of lodgepole pine stands in British Columbia, Canada.” Forest Ecology and Management 257(9):1874-82. <http://www.fire.ca.gov/treetaskforce/downloads/TMTFMaterials/alexson_alfaro_hawkes_2009.pdf>

Scientists have found that the high levels of biodiversity found in tropical forests is due in large part to agents of mortality that keep dominant trees in check. Taal Levi, Michael Barfield, Shane Barrantes, Christopher Sullivan, Robert D. Holt, and John Terborgh 2018. Tropical forests can maintain hyperdiversity because of enemies. <https://doi.org/10.1073/pnas.1813211116>; <https://www.pnas.org/content/early/2018/12/19/1813211116> (“Abstract: ... We show here that the 48-year-old Janzen−Connell mechanism, in which natural enemies restrict tree recruitment near conspecific adults, is capable of maintaining high levels of diversity indefinitely via a stabilizing mechanism that favors rare species and hinders common ones. Diversity maintenance requires only a small zone around conspecific adults in which saplings fail to recruit.”) The agencies should be viewing insects and disease as likely beneficial forces helping to maintain and increase diversity which is increasingly important in the face of climate change.

Our calculations presented ... imply that insectivorous birds exert substantial predation pressure on insects and other arthropods, especially in tropical and temperate/boreal forest ecosystems. This is supported by a large number of experimental studies conducted in a variety of habitats in different parts of the world (see Şekercioğlu 2006a, Mäntylä et al. 2011; Şekercioğlu et al. 2016 for reviews) ... Birds in forests account for 75% of the annual prey consumption of the world’s insectivorous birds (≈ 300 million tons year−1; Table 2). Forests cover a large portion of the global terrestrial surface area (41.6 million km2; Saugier et al. 2001), and in these productive and vegetatively complex habitats, birds usually reach higher diversities (Willson 1974) and numbers ha−1 compared to non-forested areas (Gaston et al. 2003). ... To fulfill these huge energy requirements, the insectivorous birds capture billions of potentially harmful herbivorous insects and other arthropods. Only few other predator groups, such as spiders and entomophagous insects, can keep up with the insectivorous birds in their capacity to suppress herbivorous insect populations in a variety of biomes (Table 3; DeBach and Rosen 1991; Nyffeler and Birkhofer 2017). Other predator groups like bats, primates, shrews, hedgehogs, frogs, salamanders, and lizards apparently are less effective natural enemies of herbivorous insects (Table 3). Although some of these latter predator groups may exert high predation pressure in a particular biome type ...

Nyffeler, M., Şekercioğlu, Ç.H. & Whelan, C.J. Insectivorous birds consume an estimated 400–500 million tons of prey annually. Sci Nat (2018) 105: 47. <https://doi.org/10.1007/s00114-018-1571-z>; <https://link.springer.com/content/pdf/10.1007%2Fs00114-018-1571-z.pdf>

“[T]here is a widespread belief in the policy arena that timber harvesting is an effective and necessary tool to address beetle infestations. … [I]n reality there has been a dearth of monitoring to assess outcomes, and failures are often not reported. Additionally, few studies have focused on how these treatments affect forest structure and function over the long term, …” Six DL, Biber E, Long E. Management for Mountain Pine Beetle Outbreak Suppression: Does Relevant Science Support Current Policy? Forests. 2014; 5(1):103-133. <http://www.mdpi.com/1999-4907/5/1/103> <http://www.mdpi.com/1999-4907/5/1/103/pdf> Logging to prevent beetle-kill often ends up killing more trees than the beetles, and those trees are removed from the forest, resulting in forgone benefits of snag habitat created through natural processes.

**e360**: The U.S. Forest Service has been thinning forests as a response to this. Any evidence that this is helping with the beetle problem?

**Six**: The idea behind thinning is that if you have an over-dense forest where trees are so close together that they are competing for soil nutrients and water, if you thin that forest out, you will relieve that competition, the trees will become healthy, and that will strengthen their defenses against beetles. It was also thought that, if you thin forests, it disrupts the chemical communication of the beetles, which are the pheromones that they use to mass-attack trees. Neither of those ideas totally pans out.

Nobody has shown conclusively that pheromones get disrupted. Also, we know that thinned stands can go down as easily as un-thinned stands. In most of our forests, we have reached a situation where changes in temperature and drought have reached the point where thinning will no longer be effective. Under normal conditions it can help, perhaps. But the fact is we are just not there anymore. I visited one stand that had been thinned many years earlier as a demonstration of how thinning protects trees from bark beetles and enhances growth. Yet when the insects came through, that was the first stand to go down!

**e360**: So by trying to fix the problem, we sometimes only make it worse.

**Six**: As humans, we have this feeling that if something goes awry, we need to fix it, and that somehow we can. I don’t think that we necessarily always know what needs to be done, or that when we do apply management that we are always actually doing the right thing. Sometimes we just need to realize that nature can sort itself out perhaps better than we can.

…

models assume that the forest is genetically homogenous, that everything is the same. And they are not. I suspect that there is a lot more genetic variability out there that will allow for more adaptation and greater persistence than we currently anticipate.

**e360**: You are suggesting that evolution will kick in and help to a degree?

**Six**: If we let it. If we don’t go out and replant with stock that may not be genetically correct, if we don’t thin or cut down trees that may have been selected by beetles or drought to survive. We have to get smart about how we are treating our forest if we’re going to help nature’s process of adaptation to proceed.

Richard Shiffman interview with Diana Six. 04 JAN 2016: INTERVIEW- How Science Can Help to Halt The Western Bark Beetle Plague <http://e360.yale.edu/content/feature.msp?id=2944>

In October 2005, the Xerces Society released an 88-page report that dispels many commonly held misconceptions about native forest insects and the efficacy of logging as a tool to control them. This analysis of over 150 relevant studies shows that industrial logging is not the solution to forest insect outbreaks. Former U.S. Forest Service Chief Mike Dombeck gives report his "highest recommendation" and calls it "the most useful publication on the topic of forests and forest pests that I have seen."

*Logging to Control Insects: The Science and Myths Behind Managing Forest Insect “Pests.” A Synthesis of Independently Reviewed Research* includes a summary of relevant studies on the importance of insects to forest function and the methods used to control forest "pest" insects, and a compilation of summaries of over 150 scientific papers and Forest Service documents. Key findings in the report include:

\* Native forest pests have been part of our forests for millennia and function as nutrient recyclers; agents of disturbance; members of food chains; and regulators of productivity, diversity, and density.

\* Fire suppression and logging have led to simplified forests that may increase the risk of insect outbreaks.

\* Forests with diverse tree species and age classes are less likely to develop large insect outbreaks.

\* There is no evidence that logging can control bark beetles or forest defoliators once an outbreak has started.

\* Although thinning has been touted as a long-term solution to controlling bark beetles, the evidence is mixed as to its effectiveness.

Scott Hoffman Black. 2005. Logging to Control Insects: The Science and Myths Behind Managing Forest Insect “Pests.” A Synthesis of Independently Reviewed Research. Xerces Society for Invertebrate Conservation. <http://www.xerces.org/wp-content/uploads/2008/10/logging_to_control_insects1.pdf>. The author has degrees in ecology, horticultural plant science, and entomology.

The Xerces Society report also outlines general guidelines to follow when considering pest insects and forest management.

• Maintain and restore high-quality late successional and old-growth forest

conditions. Diverse, old forests contain an array of natural predators and pathogens, and are more resilient to forest insect pests.

• Ensure structural and species diversity when logging, including the retention of large trees and snags, downed wood, and canopy closure. These practices can help minimize large outbreaks of insect pests.

• Minimize soil compaction and harm to trees and tree roots when doing any thinning or logging. Soil compaction and tree damage can increase the susceptibility of forest stands to insect attack.

• Utilize prescribed fire to promote more natural forest conditions. Insect pests are

less of a problem under diverse natural conditions. [Note: Fire should be used

carefully, as there is some evidence that fires that damage tree cambium can

potentially exacerbate insect problems.]

• Reduce current road densities, particularly in ecologically significant areas. Roads can serve as corridors for dispersal for nonnative invasive insect species.

Since logging is likely to have lots of adverse impacts on soil water and wildlife habitat, and since is not likely to have much beneficial effects on insect pests, we urge the agency to reconsider logging to control insects.

In 2010, the National Center for Conservation Science and Policy released a literature review about the effects of beetles and logging on forests with several significant findings:

* FINDING 1: Insect outbreaks and fires have been part of the ecology of these forests for millennia.
* FINDING 2: Ongoing outbreaks of insects are probably caused primarily by climate.
* FINDING 3: Insect outbreaks in roadless areas are not likely to heighten fire risk in adjacent communities.
* FINDING 4: Tree-cutting is not likely to control ongoing bark beetle outbreaks or other insect species common to Colorado.
* FINDING 5: Thinning in roadless areas is not likely to alleviate future large-scale epidemics of bark beetle.
* FINDING 6: Tree-cutting in roadless areas will not keep communities safe from wildfire.
* FINDING 7: Building the roads necessary to enter roadless areas affects their ecological values.
* FINDING 8: Green and familiar forests will eventually return following insect outbreaks in most locations.
* FINDING 9: The 2001 Roadless Area Conservation Rule allows sufficient flexibility to manage Colorado’s roadless areas.

...

Generally speaking, outbreaks of beetles can facilitate the development of a forest that is structurally, genetically and compositionally more diverse (Axelson et al., 2009) and therefore perhaps less prone to subsequent beetle attack (Amman, 1977). Thus, despite causing mortality of many individual trees, outbreaks can also play a critical role in ecosystem processes (Berryman, 1982).

Black, S. H., D. Kulakowski, B.R. Noon, and D. DellaSala. 2010. Insects and Roadless Forests: A Scientific Review of Causes, Consequences and Management Alternatives. National Center for Conservation Science & Policy, Ashland OR. <http://www.geosinstitute.org/images/stories/pdfs/Publications/RoadlessAreas/FireandBugReport.pdf>.

<http://www.xerces.org/wp-content/uploads/2010/03/insects-and-roadless-forests1.pdf>.

Another relevant study compared beetle activity in thinned and unthinned stands found that thinning had the effect of increasing the number of pine engravers while decreasing the relative abundance of their predators (the predators being more abundant in unthinned stands).

The largest effect of stand thinning was the 7-fold increase in the abundance of pine engravers relative to unthinned stands. We speculate, but did not show, that this increase in pine engraver abundance in thinned stands is due to the increased availability of habitat, decreased stand complexity and potential decline in predation pressure. Traits associated with host quality did not improve after thinning as we had expected and as other studies in the boreal forest have shown (Valinger 1992, 1993, Yang 1998). Pine engravers tended to settle on logs from thinned stands earlier and at higher densities than on logs from unthinned stands, yet ultimately experienced similar reproductive success in both log types. Thus, the costs of declining phloem quality after thinning appear to be offset by the direct effects of earlier settlement and of a more simplified stand structure, and the indirect effects of increased host availability or decreased predation pressure.

These results contrast with previous work that indicates thinning is a good management strategy for preventing outbreaks of mountain pine beetle (see above). Thinning is thought to deter attack by mountain pine beetle because of enhanced stand temperature, interrupted pheromone signals and/or improved host defensive response (Waring and Pitman 1985, Amman et al. 1988, Bartos and Amman 1989, Schmid et al. 1991, 1992). We did not detect deleterious impact of increased temperature on pine engraver abundance. Furthermore, we found no difference in pheromone detection ability between thinned and unthinned stands. However, an improvement in host defensive capability may account for the pine engraver’s poor performance in trees from thinned stands, though we were unable to address this specifically.

The response of pine engravers seven years after thinning further contrasts with another species of secondary bark beetle, the striped ambrosia beetle, which was more abundant in unthinned stands. Previous work (Hindmarch and Reid 2001, Park 2002) found the striped ambrosia beetle to be more abundant in thinned stands up to two and three years after harvest. Logging slash and stumps may be better habitat than windfalls for striped ambrosia beetles, unlike pine engravers.

Colleen Simpson and Mary Reid. Consequences of stand thinning for bark beetles: direct and indirect effects. University of Calgary. January 2004

<http://web.archive.org/web/20050816034648/http://sfm-1.biology.ualberta.ca/english/pubs/PDF/PR_200304reidmcons6.pdf>.

Increasing tree vigor through thinning also has complex effects. On the one hand it may help the tree “pitch out” the invading beetles, but on the other hand a vigorous trees can support higher rates of beetle reproduction.

Thinning may also enhance reproductive success of pine engraver bark beetles as

a result of increased tree vigour in the residual stand. Pine engraver reproductive success was significantly greater in trees that had been growing vigorously at the time of death: females laid more eggs and a higher proportion of their eggs developed resulting in more offspring produced per female than in less vigorous hosts. Consequently, trees that fall in thinned stands are superior hosts when compared to trees that fall in unthinned stands, and may lead to larger populations in thinned stands.

…

Reproductive success of pine engravers was examined as a function of tree vigour

using freshly felled jack pine (Pinus banksiana Lamb.) from a 77 year old stand (Reid and Robb 1999). The number of eggs laid, egg gallery length, proportion of eggs that successfully developed, and number of emerged offspring per female were higher on trees that had been growing most vigorously before death.

Commercial thinning had a significant effect on bark beetles. Although diversity

did not change after thinning, the number of beetles in thinned stands was higher than in unthinned stands. Furthermore, beetles in thinned stands chose the biggest logs possible for breeding, and had higher reproductive success in the most vigorous hosts. Beetles could also fly on more days and do so more easily in thinned stands than in unthinned stands.

Trevor D. Hindmarch and Mary L. Reid. Effects of Commercial Thinning on Bark Beetle Diversity and Abundance. May 1999.

<http://web.archive.org/web/20040710190343/http://sfm-1.biology.ualberta.ca/english/pubs/PDF/PR_1999-13.pdf>.

The agency cannot brush these concerns aside. They must address them head on in the NEPA document.

If the agency is concerned about tree mortality, they must recognize that logging kills trees and in fact likely causes greater mortality than it prevents. If the agency insists on intervening, only “hotspots” should be treated. Sims, Aadland, et al 2014. "Complementarity in the provision of ecosystem services reduces the cost of mitigating amplified natural disturbance events." PNAS 2014 ; published ahead of print November 10, 2014, DOI: 10.1073/pnas.1407381111 <http://www.uwyo.edu/aadland/research/compb.pdf>

The main effect of logging is to increase the vigor of the remaining trees (after a substantial delay caused by the shock and damage of logging ). The agency must fully analyze the logical consequences of the fact that tree vigor is delayed several years after treatment, so there is a high likelihood that the beetle outbreak will be either already epidemic or already waning by the time the trees actually significantly increase in vigor.

Science shows that beetle damage sometimes decreases after logging for unknown reasons which appear to be independent of increased tree vigor, so the agency cannot explain why thinning is still necessary. Many factors are at work that are independent of the effects of thinning. Many natural controls are at play, so the beetles might decline on their own.

Thinning activities attracting beetles to the area through the release of terpenes from fresh wood chips, slash, or wounded green trees. Commercial logging can actually facilitate the spread of beetles that reproduced in piles of dead material when they were left for more than a season. If insect attack is a concern, the agency must consider and disclose the factors that tend to attract insects and determine whether thinning will make things better or worse.

Results of the fire surrogates study “indicate that the probability of mortality of large-diameter ponderosa pine from bark beetles and wood borers was directly related to surface fire severity and bole charring, which in turn depended on fire intensity, which was greater in units where thinning increased large woody fuels.” Andrew Youngblood, James B. Grace, And James D. Mciver. 2009. Delayed conifer mortality after fuel reduction treatments: interactive effects of fuel, fire intensity, and bark beetles. Ecological Applications, 19(2), 2009, pp. 321–337 <http://www.esajournals.org/doi/pdf/10.1890/07-1751.1>.

A recent study showed that thinning can increase mortality from bark beetles and increase fuel loading and crown fire behavior.

We simulated management scenarios with and without thinning over 60 years, coupled with a mountain pine beetle outbreak (at 30 years) to examine how thinning might affect bark beetle impacts, potential fire behavior, and their interactions on a 16 000-ha landscape in northeastern Oregon. We employed the Forest Vegetation Simulator, along with submodels including the Parallel Processing Extension, Fire and Fuels Extension, and Westwide Pine Beetle Model. We also compared responses to treatment scenarios of two bark beetle-caused tree mortality susceptibility rating systems. … **[C]ontrary to expectations, the Westwide Pine Beetle Model predicted higher beetle outbreak-caused mortality in thinned versus unthinned scenarios. Likewise, susceptibility ratings were also higher for thinned stands.** Thinning treatments favored retention of early seral species such as ponderosa pine, leading to increases in proportion and average diameter of host trees. **Increased surface fuel loadings and incidence of potential crown fire behavior were predicted postoutbreak**;…

Ager, A.A.; McMahan, A.; Hayes, J.L.; Smith, E.L. 2007. [Modeling the effects of thinning on bark beetle impacts and wildfire potential in the Blue Mountains of eastern Oregon](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V91-4MK0HHB-1&_user=10&_coverDate=04/30/2007&_rdoc=11&_fmt=summary&_orig=browse&_srch=doc-info(#toc%235885%232007%23999199996%23649396%23FLA%23display%23Volume)&_cdi=5885&_sort=d&_docanchor=). Landscape and Urban Planning. 80: 301–311.

Each substantive issue discussed in these comments should be (i) incorporated into the purpose and need for the project, (ii) used to develop NEPA alternatives that balance tradeoffs in different ways, (iii) carefully analyzed and documented as part of the effects analysis, and (iv) considered for mitigation.

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Sincerely,



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