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Cynthia Sandeno, Acting Forest Supervisor
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May 14, 2024

Subject: Comments on the Draft Midnight Restoration Plan

Dear Cynthia Sandeno,

I am a Climate Change Scientist and Wildlife Biologist. I have worked with federal, state, and local partners throughout the U.S. to plan for climate resilience based on the best available science and collaborative cross-sector planning processes. I developed and authored climate adaptation plans for cities such as Louisville, KY, Truckee, CA, and Missoula, MT, as well as Alaskan Tribes, NGOs in many states, and Maui County, to name a few. When planning for climate change adaptation and resilience, we plan for communities within the matrix of federal, state, and private lands that provide water, fire resilience, recreation, and other vital services.

I appreciate the opportunity to review and comment on the Midnight Restoration Plan for the Okanogan-Wenatchee National Forest. I spent many summers working on the Okanogan as an owl biologist in the 1990s. Maintaining this dynamic and diverse region for biodiversity, carbon storage, and recreational values for future generations is of the utmost importance. Thank you for your dedication to our nation's unparalleled public lands.

Warm Regards,

Dr. Marni Koopman
Climate Change Scientist

Over the last 15 years, I have learned many lessons about the risks of **maladaptation.** Maladaptation occurs when: (1) climate change adaptation strategies related to one population or resource exacerbate impacts to other populations and resources, potentially outweighing any positive benefit (Schipper, 2020); (2) climate change adaptation actions actually worsen impacts to the target resource, rather than create resilience; or (3) adaptation or resilience measures greatly increase climate change itself through greenhouse gas emissions (the most egregious form of maladaptation). Some of the greatest impacts of climate change are likely to be humanity's misguided responses to this global threat, which is why the plans I have developed focus so heavily on avoiding it.

In order to prevent maladaptive strategies from being designed and implemented, I helped to develop three major planning frameworks: (1) the Climate-Smart Conservation guide (Stein et al. 2014) for natural resource managers, (2) an interdisciplinary planning framework that was later adopted into the Adaptation Planning Guide in California, and (3) the Adaptation for Conservation Targets framework (Cross et al. 2012). All three frameworks allow experts and stakeholders from throughout different sectors of the community to develop **co-beneficial strategies** that create resilience among numerous sectors and/or species while avoiding maladaptation. I focus heavily on **'No Regrets' strategies** – strategies that are highly likely to have positive outcomes and not exacerbate impacts to others or further in the future. These are designed through collaboration among scientists, local community leaders and stakeholders, non-profit organizations, environmental justice organizations, local utilities, recreation outfitters, and others. 'No regrets' strategies on public lands would reduce ecological stressors, such as roads, erosion, logging, habitat destruction, and continued greenhouse gas emissions, while restoring degraded ecosystems.

In my professional opinion, from more than 15 years of designing and writing climate change adaptation and resilience plans, many of the proposed management actions within the Draft Midnight Restoration Plan (MRP) on the Okanogan-Wenatchee National Forest carry a high risk of becoming "maladaptation." Harvest and thinning in old-growth forests are far from 'No regrets' and building of new roads, even temporary ones, are not co-beneficial to water quality, fish habitat, invasive species management, habitat for protected species including salmon and bull trout, and a variety of other sectors.

These strategies result from misunderstanding the myriad of interconnected climate change impacts and/or seemingly purposeful misrepresentation of the severity of the threat of climate change. Due to climate tipping points, the climate crisis has moved into the "All hands on deck" phase, where every tool to store carbon and reduce emissions needs to be urgently implemented.

As one of the largest contributors to climate change, continued land use practices such as road building, logging mature trees, and disturbing mature and old-growth forests are incompatible with avoiding catastrophic climate change. Doing so in the name of "restoration" is uncomfortably disingenuous. Below, I explain why many assumptions presented in the Purpose and Need of the draft MRP are highly uncertain or even false. My main points include the following:

- Mature and old-growth forests must be protected as carbon stores now, not later;
- Avoiding tipping points is vital for future resilience;
- Old-growth forests are more fire-resistant than managed forests;
- Removing canopy cover in old growth through timber harvest will hasten warming;
- Thinning forests does not make communities safer from climate change-driven wildfire;
- Attempts to hold onto desired conditions and return to historical baselines will fail;
- How a plan is presented often differs from its implementation on the ground.

Below, I address the assumptions being made as well as specific information that needs to be considered in developing strategies that truly provide ecological and community resilience.

Assumption from Page 33 of Draft MRP: Thinning in old growth "by harvest and fire is needed to sustain old-growth stands because these activities reduce the potential for stand-replacing fires by promoting conditions that are more likely to experience low-intensity fire, therefore maintaining and enhancing old growth forest vegetation structure and arrangement and increasing old growth ecological sustainability to disturbances, such as insects and disease, wildfire, and climate change."

This assumption was presented to justify amending forest-wide S&Gs prohibiting timber harvest (S&G 5-1) and treatment of natural fuels (S&G 19-8) in mixed conifer old-growth stands, thereby allowing both timber harvest and understory thinning in the vital areas. Yet, this assumption (above) ignores important facts about old-growth forests and climate change. These include the following:

Old-growth forests are vital to the U.S. meeting its GHG emissions targets. They must be protected as carbon stores now, not later. In fact, old-growth forests are the lowest-cost climate mitigation option for addressing climate change in the U.S. (Law et al. 2022), and 92% of our nation's old growth are on Forest Service lands (DellaSala et al. 2022). Older forests store massive amounts of carbon in trees, vegetation, and soils (35-70% more than logged stands; Keith et al. 2014, Mayer et al. 2020). Specifically, federally-owned forests of the Pacific NW have been highlighted for enormous carbon storage potential and high biodiversity value (Law et al. 2021, 2022; Fig.1).

In order to combat climate change and biodiversity loss, an executive order issued by President Biden in 2021 directed federal agencies to develop targets of conserving 30% of all lands and waters by 2030 (White House 2021). If we are to meet the target of 30% preservation by 2030 and 50% by 2050, these forests must be preserved in the GAP 1 or GAP 2 status, which does not allow timber harvest. The MRP's proposal to allow timber harvest and understory thinning will undercut these vital goals.

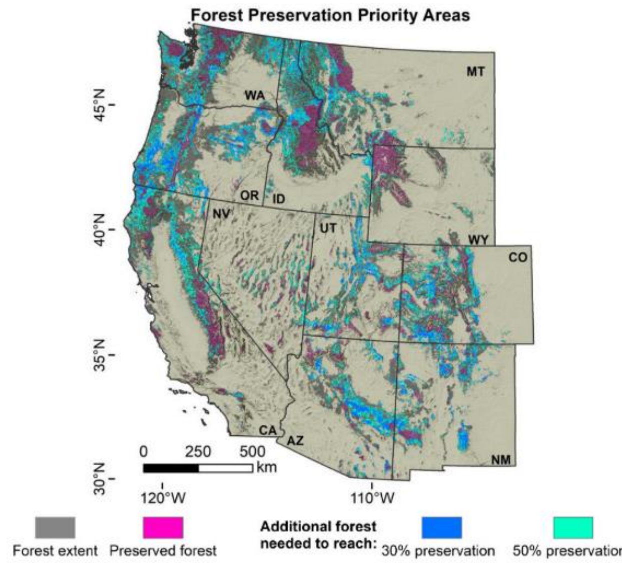

Figure 1. Forestlands that are currently preserved, and additional areas identified as high priority for protection of biodiversity and forest carbon for climate mitigation across the western U.S. (Law et al. 2022).

More specifically, individual large trees within mature and old-growth forest hold significant amounts of carbon. In fact, large-diameter trees (≥21 inches) in Oregon and Washington forests east of the Cascades make up only 3% of stems, but account for 42% of above ground stored carbon (Mildrexler et al. 2020). When these trees are cut, large amounts of carbon are rapidly released into the atmosphere (Hudiberg et al. 2019), and it takes centuries to recapture this carbon (Birdsey et al. 2006). Given the urgency of keeping additional carbon out of the atmosphere, it would be prudent to protect old-growth and mature forests for their carbon stores, habitat values, biodiversity, natural drought/wildfire

We have a far greater chance of reducing wildfire risk and conserving old growth through reducing greenhouse gas emissions rather than if "managing" and thinning these forests. If we look at the number of "extreme fire danger" days, we see that, on average in Gilbert, WA, there were 11 days per year (historically) in this category (Fig. 2, Left). By 2040-69, global climate models project 18.5 days per year of extreme fire danger if we reduce emissions (RCP4.5) and 23.5 days per year (more than twice the historical rate) if we continue with higher emissions (RCP8.5). These levels do not incorporate tipping points (see below), which would push them much higher. Wildfire is strongly driven by higher temperatures, which are expected to increase by 7°F, on average if we reduce emissions but could increase as much as 13°F if we continue with business-as-usual emissions (Fig. 2, Right).

These forests are also affected by insects and disease, which can increase dramatically when winters become warmer. If emissions continue at business-as-usual rates, by 2040-2069, Gilbert, WA will have 48 fewer nights below freezing, on average, than if we reduce

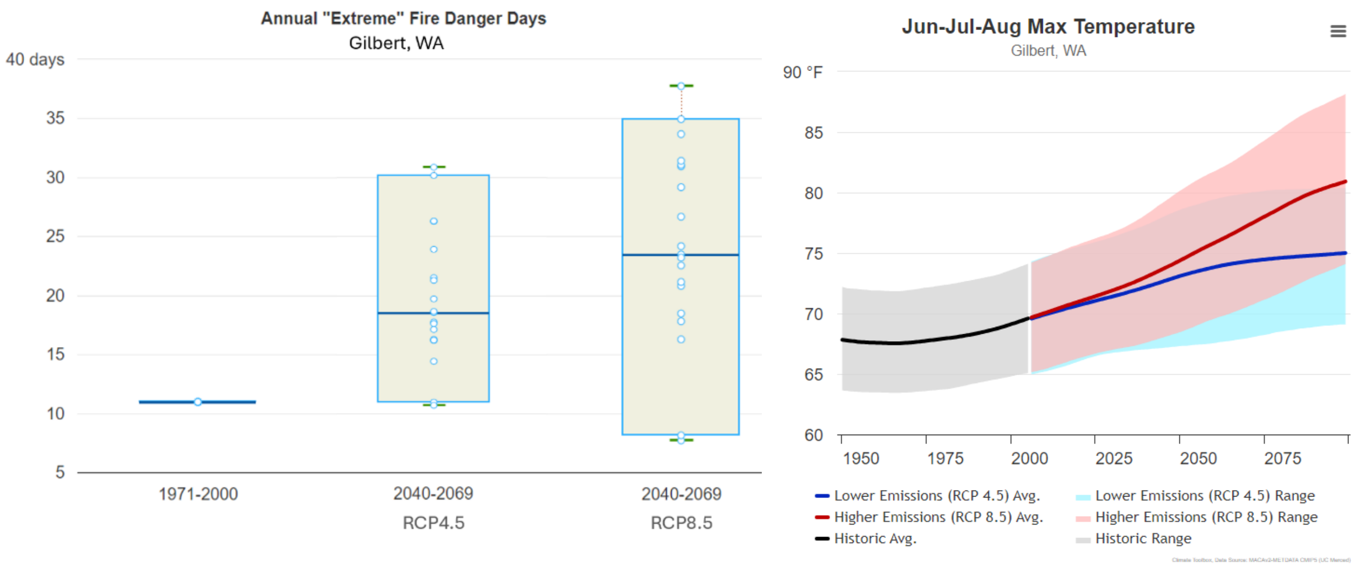

Figure 2. Left – If emissions are reduced (RCP4.5), the number of days/yr. with "extreme fire" conditions in Gilbert, WA could be 8 days longer than the historical period, on average, compared to 13 days with continued higher emissions (RCP8.5). **Right** – Maximum summer temperature could be 7°F warmer, on average, if we reduce emissions (RCP4.5), as compared to 13°F if we continue with higher emissions (RCP8.5). Data from 20 GCM ensemble accessed through Climatetoolbox.com.

emissions. Fewer freezing nights could dramatically increase insect damage to forests. Also, if we reduce emissions, evapotranspiration would increase by 23%, rather than by 39% if we continue with business-as-usual. This is important because carbon uptake by forests is already limited by water availability (Berner et al. 2017). More evapotranspiration translates to less carbon uptake.

Managing our nation's mature and old-growth forests for carbon uptake is the most efficient approach to reducing the risk of future wildfires, which are increasingly driven by drought, heat, and high winds.

Avoiding tipping points is vital for future resilience. Given the intensifying urgency and insufficient efforts to tackle climate change, we currently need to prioritize highly certain, near-term carbon storage in old-growth forests and elsewhere (DellaSala et al. 2022, Armstrong McKay et al. 2022, Mildrexler et al. 2023), because once tipping points are surpassed, climate extremes and accelerating change become the self-perpetuating norm. Five major tipping points are already at risk of being crossed (Lenton et al. 2023). Three more are threatened to be crossed in the 2030s as the world exceeds 1.5°C warming. The impacts of crossing these tipping points are expected to exceed the ability of many countries and ecosystems to adapt. Thus, the MRP's plan to build "resilience" in the future does not prevent the unraveling associated with crossing critical thresholds into new states in the very near term. Because we live in an interconnected global system, continued GHG emissions and land cover degradation are significant contributors to such global tipping points, and should be avoided.

Triggering climate tipping points leads to impacts such as collapsing ice sheets, dieback of corals and rainforests, carbon/methane release from permafrost, and collapse of the Atlantic Meridional Overturning Circulation (AMOC), all of which lead to dangerous and largely irreversible positive feedbacks and impacts such as:

- Amazon dieback could put 6 million people at risk of extreme heat stress and cause US$1-3.5 trillion economic damages.
- Antarctic ice sheet instability leading to a potential sea level rise of 2 meters by 2100 would expose 480 million people to annual coastal flooding events.
- Permafrost thawing already damages property and infrastructure; 70% of current infrastructure in permafrost regions is in areas with high potential for thaw by 2050.
- An AMOC collapse would disrupt regional climates worldwide, cooling most of the northern hemisphere and especially Europe by up to 10°C, substantially reducing vegetation and crop productivity across large areas of the world, with profound implications for food security.

Tipping points that were once thought to be high-impact yet low-probability have become high-probability in recent years (Lenton et al. 2023). The positive feedback mechanisms associated with tipping points, unfortunately, will make future incremental progress from emissions reductions largely inconsequential (Fig. 3), which means that immediate action on emissions is needed.

The only way to stop and reverse our march towards catastrophic tipping points is to put systemic positive change in place. In this vein, carbon storage in existing large trees, and prevented emissions, are urgently needed and have high certainty in both their efficacy and their impact. In contrast, there is high uncertainty in whether the actions proposed in the MRP will achieve their assumed results over many decades, and even more danger that timber harvest and road building are maladaptive and will lead to higher emissions and impaired forest function over time.

The claim that road-building and timber harvest in old growth will increase resilience, reduce wildfire incidence, promote carbon storage in future vegetation, and out-weigh the near-term emissions associated with these activities, is highly dubious, highly uncertain, and unlikely to be achieved in the future climate. The emissions associated with road building, removal of large trees, and land-clearing machinery cannot be discounted. Both fossil fuels and land use emissions need to be phased out immediately to address the severity of this threat. Once tipping points are crossed, incremental change is no longer effective.

Climate change is well underway and, at this time, the very best outcomes available to us are achieved through slowing the rate of climate change. Slowing climate change will give us the time we need to ramp up mitigation efforts across numerous sectors, as well as giving people and ecosystems time to adapt. Unfortunately, sudden shocks, abrupt change, and irreversible systemic shifts are becoming more likely as we near certain tipping points. By preserving all existing old growth on federal lands for the next decade, we save 0.532 Gt CO_2 per year, the equivalent to 9.2% of the total annual U.S. emissions (DellaSala et al. 2022).

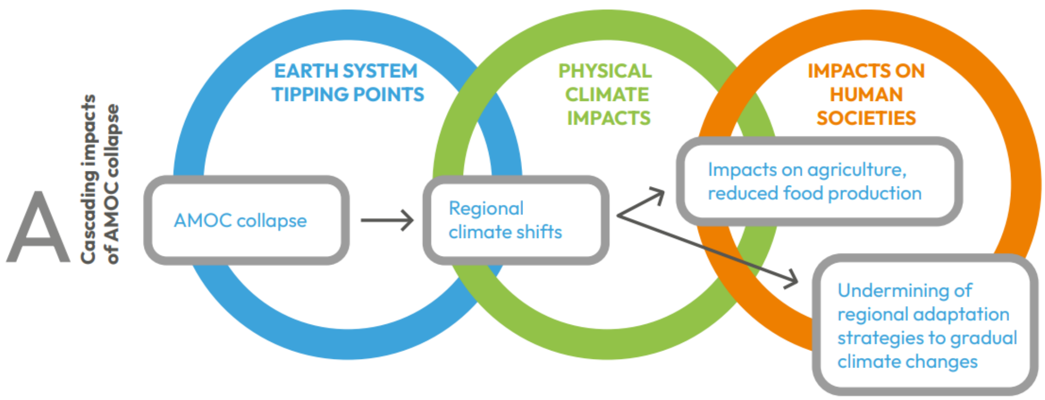

Figure 3. Cascading impacts of the AMOC collapse, just one of many dangerous tipping points that the earth system is moving towards at an alarming rate (Lenton et al. 2023), can lead to failure of adaptation strategies that are ill-equipped to address sudden shocks and abrupt change.

Old-growth forests are more fire resistant than managed forests. It is a widely held assumption that "managing" forests reduces fire severity and risk. And yet, this assumption has rarely been tested, especially in mature and old-growth forests. Mature trees have thick impenetrable bark, and drop their lower branches, making it harder for fire to climb to the canopy. Older forests experience mixed intensity fires based on topography, which creates important habitat mosaics. This is especially the case in the project area, which is a hybrid of the wetter forests characteristic of west of the Cascade Mountain crest and drier eastside forests. When old-growth forests are managed through road-building, mechanical thinning, and logging, canopy cover is reduced, microclimates become warmer and drier, wind speed is increased, and human-caused fire ignitions may also increase with more access. All of these factors are highly likely to exacerbate wildfire on the Methow.

Once an area is mechanically thinned, accelerated plant growth in the understory can lead to an increase in fuels over time. The likelihood that a fire overlaps the thinned area during the window (15-20 years) in which it has lower fuels is actually only 2%, making this an expensive effort (in dollars, carbon emissions, and environmental costs) with highly uncertain benefits, if any, over time. This goes directly against the tenets of 'No regrets' strategies. Plus, the need to revisit and re-thin areas means that "temporary" roads are likely to become permanent rather than decommissioned, or fire risk becomes even higher than it was originally. An expensive cycle, funded by taxpayers, will need to be repeated not just on the MRP, but over millions of acres of federal lands, if we are to continue removing fuels.

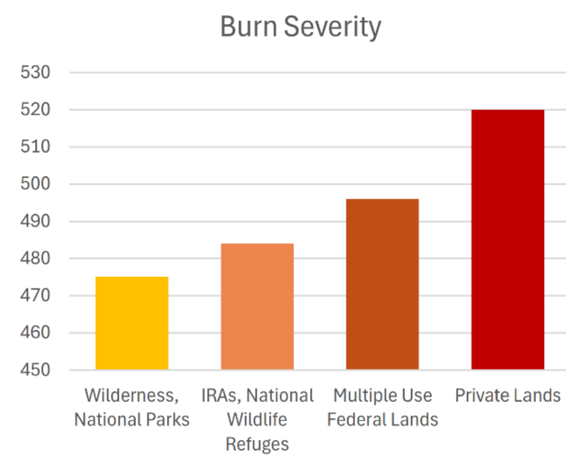

Figure 4. Burn severity in relation to land use designations for 11 western states 1984-2014. Results represent 1500 fires examined on >23 million forested acres affected by high severity fire (adapted from Bradley et al. 2016).

A large-scale study across fire-prone forests of the U.S. showed that fire severity actually decreases steadily from GAP1 (least protection, highest severity) to GAP4 (most protection, lowest severity) protection status (Bradley et al. 2016; Fig. 4). In fact, both temperature and protection status were highly linked with burn severity, making (1) climate change and (2) management (or the lack, thereof) two of the most influential variables in wildfire severity. In the case of the MRP, weakening forest protections such as those provided in S&G 5-1 and 19-8 will likely achieve the opposite of their intended outcome – a classic case of maladaptation.

Old-growth forests in the Pacific Northwest can act as fire refugia in large wildfire complexes (Lesmeister et al. 2021), especially given the mixed forest types of the project area. The larger trees are naturally more fire-resistant and drought-tolerant than smaller ones (Mildrexler et al. 2022), and the microclimate can reduce flammability. Among old-growth forests, almost all of which are on federal lands, only 24% are protected. 100% protection of the nation's remaining old-growth forests is recommended based on their superior climate, water, and biodiversity values (DellaSala et al. 2022).

Removing canopy cover through timber harvest will hasten warming. Old-growth forests play an important role in buffering against climate change and extreme conditions. Old growth stands experience a self-perpetuated localized climate, or microclimate, which is strongly affected by forest management. The forests of the Methow are a hybrid of wetter forests characteristic of west of the Cascade Mountain crest and drier eastside forests. These different microclimates result in different fire risk.

A comparison of old-growth and managed forests in Oregon revealed much higher microclimate buffering ability of old-growth stands, due to higher biomass, taller canopies, and diverse vertical structure compared to mature managed stands (Frey et al. 2016).

Temperate forests themselves may exhibit “tipping behavior.” The recent large-scale forest damages and losses in the temperate zone (Lloret and Batllori 2021) could mark the beginning of self-amplifying and potentially self-sustaining feedbacks. Self-amplifying feedbacks result when forest cover is reduced and moisture is lost. Increasing sensible heat amplifies drying and warming in the affected area, thereby creating a positive feedback of warming and loss of forest cover. The average net cooling effect of temperate forests compared to grassland was found to be 1-2°C, with maxima of up to 5°C (Zhang et al. 2020).

Thinning forests does not make people safe. Many thinning and logging projects are hyped as keeping communities safe from severe forest fires. In turn, the local community (as I have heard in my workshops in Montana, Oregon, and California) develops high tolerance for logging trucks, road building, forest disruption, and degradation of water quality, views and recreational opportunities. Unfortunately, all of this activity can give local residents a false sense of safety when in fact, climate change is causing more extreme fire conditions linked to dry conditions, high temperatures, and high winds, regardless of thinning.

In the case of one of the most tragic wildfires in Paradise, CA (Camp Fire), where 14,000 homes were lost, buildings burned while surrounding managed woodlands often survived. In S. Oregon (Almeda Fire), 6,000 homes were lost as extremely hot winds drove fire through neighborhoods and riparian areas. Years of forest thinning and investment did not even cross paths with this climate change driven wildfire. Fire hardening homes and property are far more important for human safety than thinning expansive forested landscapes, and especially old-growth forests, which can buffer the effects of fire. Reconsidering where we build homes is another prudent risk-reduction measure. By keeping people out of the Wildland-Urban Interface (WUI), we also reduce human-caused ignition of wildfires, which represent up to half of all fire starts.

Attempts to return to historical baselines and maintain desired conditions will fail. Forest systems, especially the fire-dependent forest systems of the Western U.S., are dynamic and ever changing. Major climate systems such as the PDO have shaped precipitation, temperature trends, and fire patterns over time (Littel et al. 2009). From the early 1900s to mid-1940s, western forests experienced a warmer cycle with very little fire suppression. The area burned was similar to that of today (Fig. 5). When the PDO shifted into a cooler and wetter cycle from the mid-1940s until almost 1980, wildfire activity was substantially reduced. Since this time, we have shifted back into a warmer PDO, with reduced spring snowpack and longer fire seasons, and wildfire has again rebounded. Thus, the recent uptick in wildfire likely has a natural and highly dynamic driver.

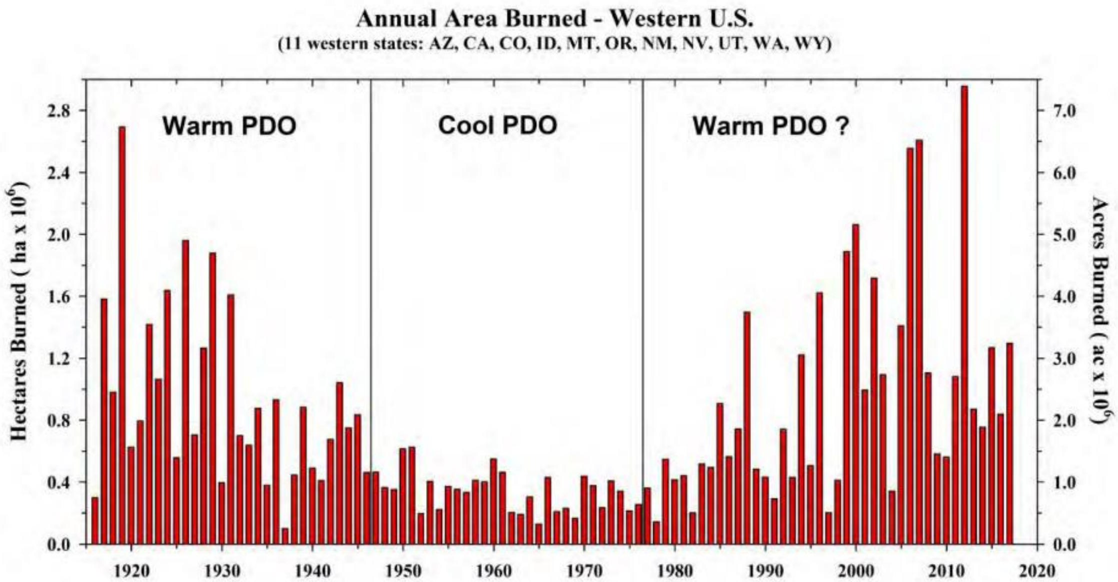

Figure 5. Area burned in 11 western states on federal land from 1916-2018, updated from Littell et al. 2009.

Human-caused climate change means that we may never return to the cooler PDO cycle that we experienced in the middle of the 20th century. If we attempt to return forests to historical baselines from this time, or to create static and unchanging forest composition, we will undoubtably fail. A useful tool that I use in my workshops is the University of Maryland's climate analog mapping tool (https://fitzlab.shinyapps.io/cityapp/). This tool showed the city of Lewiston, ID as the closest match for the 2080 climate of Wenatchee, WA (the city east of the Cascades and closest to the MRP). Lewiston has a climate that is 10°F degrees warmer and 47% drier than Wenatchee. Dominant vegetation differs substantially. We cannot force Lewiston to look like Wenatchee.

As compared to the historical period, average temperature in Gilbert, WA is expected to increase by 6-11°F. and as high as 15°F higher by the end of the century (data from climatetoolbox.com). Maintaining forest structure and wildfire patterns from the historical period is unlikely to succeed while wasting limited resources.

Evidence shows that heat extremes, heavy rainfall events, and agricultural and ecological droughts are already increasing across every continent (IPCC 2021). As the ocean and atmosphere continue to warm, the baseline and also the range of natural variability around the baseline is shifting upwards, making formerly extreme events more common and formerly impossible events possible. Rather than planning for the conditions of the past, as we have for many decades, we need to be planning for the conditions of the future and especially for extremes.

How a plan looks on paper, and how it looks on the ground, differ substantially. During ground truthing after a recent project in Oregon, old growth trees larger than 50”dbh and clearly marked for retention were felled, in direct opposition to prohibition of felling trees over 36” in diameter. Newly built logging roads traversed the area, and more than a foot of logging debris littered the now wide open, sunny slopes, that had previously been late-successional forest. This project will surely increase wildfire risk, erosion, carbon emissions, and habitat and biodiversity loss in the region. These systems can no longer function as old-growth ecosystems. This project, carefully reviewed and commented on by numerous scientists, experts, and conservation organizations, is part of the problem, rather than the solution, to climate change. We expect better from the MRP.

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