To: State Senator Mike McGuire
Governor Gavin Newsom
U.S. Representative Jared Huffman
Secretary Wade Crowfoot
Assemblymember Jim Wood
Polly Girvin, Coyote Valley Band of Pomo
Chad Swimmer, Mendocino Trail Stewards

From: John P. O'Brien, Ph.D.

Re: The effects of timber harvest versus forest protection in JDSF

I have taken the time to write this letter because I feel that I have to. I can no longer sit aside and watch the environment continue to degrade around me, in ways that are completely preventable. The purpose of this letter is to (1) express my position on forest protection in a changing climate and, (2) serve as a document that contains much of the scientific literature necessary to make informed decisions moving forward. I am a climate scientist, and as such I have dedicated my professional life to understanding the earth system and how humans are affecting it. I have a Bachelor of Science in applied physics with minors in geophysics and mathematics, a graduate certificate in applied spatial statistics, and a Ph.D. in climate and atmospheric science. I currently hold dual appointments: at the National Center for Atmospheric Research (NCAR), Climate and Global Dynamics Division, in Boulder, Colorado (website), and at Lawrence Berkeley National Laboratory (LBNL), Climate and Ecosystem Sciences Division, in Berkeley, California (website). Perhaps more importantly, I am a Northern California native, raised in the mountains of Trinity County and graduated from Trinity High School. This land is my home and as a local and a scientist, I am keenly aware of the changes that are taking place here. I am doing my part in working to understand and mitigate the detrimental large- and small-scale environmental change we are forcing upon this planet, however, as a scientist, my ability to enact substantive change is limited. This is why I am reaching out to you in a plea to make an informed decision and protect our forest now, and stop unnecessarily felling Redwood trees for fences and decks when it is scientifically well-established that they are the most important ally in our fight against climate change. What follows is a discussion of four main topics: (1) Wildfire, (2) Climate Change, (3) The Economy, (4) Conservation, and how they relate to Northern California, and more specifically, Jackson Demonstration State Forest (JDSF), which I currently live directly adjacent to. What follows is my position and does not necessarily represent the views of NCAR or LBNL.

Executive Summary

Short of burning fossil fuels, cutting down trees is the single worst thing we can do for climate change. Not only do trees directly remove CO2 from the atmosphere and store it for centuries to millennia, the very act of cutting them down results in immediate carbon releases via felling, hauling, milling, and processing machinery that represents a "double hit" to the climate. Climate change presents a clear, present, and ever increasing danger to nearly every aspect of our lives and the earth system, including our terrestrial forests. The overwhelming body of scientific evidence indicates that forest mortality will drastically increase in the future with conifer species being disproportionately affected (McDowell and Allen, 2015). Agents of change include but are not limited to water and temperature stress, insects and pathogens, wildfire, logging, and urbanization to name a few.

Scientists have estimated that global mean temperatures exceeding 1.5℃ will present dangerous and potentially irreversible changes to the climate system. Globally forests cover only ~9% of the earth's surface yet they absorb approximately 25% of the anthropogenically emitted carbon making their value in the fight against climate change self evident. Our best estimates of our remaining carbon budget suggest that at current emission rates, we will exceed the threshold for staying below 1.5℃ by approximately 2030. Even more concerning, accounting for the uncertainty in the estimate of our remaining carbon budget, there is a 1-in-6 chance that we have already exceeded that budget (Matthews et al., 2021). The current rate of human-caused climate change has only one known historical analog: 66 million years ago when a meteorite impacted the earth and killed nearly all living things. Being flippant about and ignoring climate change is deadly, and given the immediate need to halt emissions, deforestation must stop (Lewis et al., 2019).

Both the U.S. government and California have committed to conserving 30% of our lands and waters by 2030, also known as the 30-by-30 policy. This is a critically important step in the right direction and cannot happen soon enough. In California, one of the difficulties in conserving forest land is that roughly 40% of our 33 million forested acres is privately owned, 35% of which is owned by timber companies. Across the Redwood region, his fraction is even higher. Of the 1.5 million acres of remaining endemic Redwood forest land, 73% (1.1 million acres) is privately owned and considered unprotected, 51% (~560,000 acres) of that being owned by industrial timber companies. Due to the strong property rights in the United States, private forest land will likely never be fully protected without a substantial government-backed financial incentive program.

This is where Jackson Demonstration State Forest (JDSF) stands out as a unique opportunity. JDSF is entirely owned by the State, bought with taxpayer funds in 1947 and therefore belongs to the people of California. More importantly, JDSF is primarily second growth Redwood forest

and has the potential to store far and away more carbon than any forest type in the world and is actually now rarer than old growth due to the absence of environmental protections. Moreover, the biodiversity in JDSF is one of the highest along the entire North Coast containing over 200 native animal species, and over 1,200 native plant species. JDSF's primary use is extractive, managed as "commercial timberland" as stated in the management plan. Therefore, under the 30-by-30 metrics,

this forest has the second lowest protection rating and is given a GAP3 status code indicating high biodiversity and low environmental protections. However, as noted in the guiding 30-by-30 document for policymakers, GAP3 classified lands have particular potential to advance biodiversity and climate protections through simple administrative actions and are considered "low-hanging fruit" toward achieving 30-by-30 (Rosa and Malcom, 2020).

In addition to being a biodiversity and conservation issue, protecting JDSF is also an environmental justice issue. Continued logging in JDSF will exacerbate climate change rather than ameliorating it. It is well-known that climate change and social inequality are characterized by a relationship known as a vicious cycle, whereby initial inequality causes the disproportionate suffering of disadvantaged groups, which in turn is made worse by climate change resulting in greater subsequent inequality. Because JDSF is made up of Redwoods that offer the greatest climate protection of any tree on the planet, cutting them down so wealthy private individuals can build fancy decks and fences at the cost of climate, which disproportionately affects the poor, represents an egregious social injustice enabled by the State on public lands owned by *all* Californians.

Protecting our forests and "demonstration" forest science, as is often thought of as taking place in JDSF, are not mutually exclusive. California *is* in desperate need of a demonstration forest; however, one that demonstrates real science aimed at understanding forest management in a changing climate with overarching goals such as wildfire risk reduction, fuels management, carbon sequestration, forest health, and ecosystem and habitat restoration. Currently, JDSF as stated in its management plan is managed as commercial timberlands. As such, current "demonstration science" is aimed at understanding various timber harvesting techniques, known as silviculture, on forest productivity. Thus, in the context of JDSF's management plan and the agency who manages it, CAL FIRE, the forest is little more than a timber farm, with management goals geared toward maximizing board-feet of timber per acre. This is often referred to as "sustainable forestry", however, from this perspective "sustainable" is defined from an economic perspective rather than an ecosystem perspective at the cost of integrated forest health, ecosystem, and habitat restoration. Having a demonstration forest in California that is managed as commercial timberland makes as much sense as West Virginia having a demonstration coal mine. JDSF's current mandate for resource extraction is not inline with the imperative climate protection needs and policy of the State.

The continued logging in JDSF presents a tremendous lost opportunity to protect biodiversity, mitigate climate change, generate revenue, restore endangered species habitat, reduce wildfire risk, remedy social injustice, and conduct meaningful science aimed at saving our forests and planet. Selected key take-aways from the research conducted herein are summarized below and expanded on in the body of this letter.

1. The largest trees in any forest are also the most fire resilient and their selective removal

weakens the forest's resilience as a whole to wildfire (Douglas et al. 2010).

2. Selectively logging the largest trees opens the forest canopy allowing more solar radiation to reach the forest floor thereby drying out the underbrush and soils creating hotter, drier, and more flammable understory microclimates (Weatherspoon, 1996).

3. Selectively logging the largest trees thins the canopy and stand allowing for greater in-canopy and in-stand wind speeds that fuel higher intensity fires (Banerjee, 2020).

4. Across the entire western U.S., fires burned with less intensity on lands that had the highest protections from logging (Bradley et al., 2016).

5. Weather and climate is the most important predictor of wildfire intensity with logging intensity being the second most important factor (Zald and Dunn, 2018).

6. The largest atmospheric driver of wildfire intensity, Vapor Pressure Deficit, has and will continue to exponentially increase with continued climate warming (Williams et al., 2019).

7. Climate change in California will be characterized by a hydroclimate with a greater probability for drought conditions interspersed with sharper, more intense rainy seasons (Swain et al., 2018).

8. Forest mortality resulting from drought and temperature stress is expected to increase dramatically in the future with disproportionate effects to conifer species (McDowell and Allen, 2015).

9. Climate change disproportionately affects species in regions of high endemic biodiversity like JDSF making them 3-10 times more likely to suffer negative effects (Manes et al., 2021).

10. The economic potential from protecting JDSF through recreation and carbon sequestration far outweighs the monetary value of timber extraction.

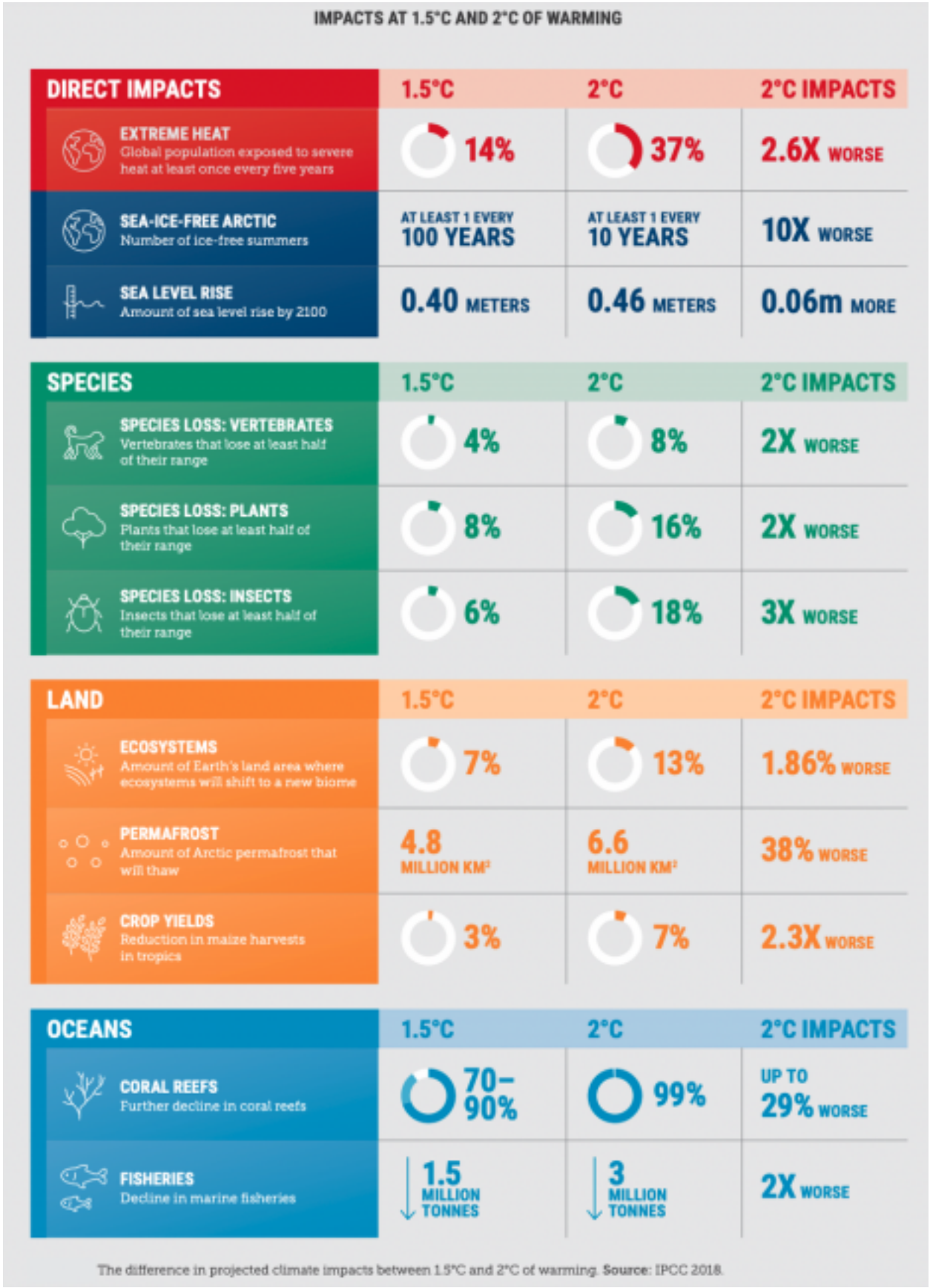
11. Mature second growth Redwoods are now more rare than old growth Redwoods due to the lack of any kind of protections for these trees (Burns et al., 2018).

12. Timber harvesting is the largest emitter of CO2 of any natural or human-caused forest disturbance type (Harris et al., 2016).

13. Limiting timber harvesting and increasing forest protection on public lands is the best approach to increase forest carbon uptake (Law et al., 2018).

14. Increasing forest protection is the lowest cost and the single most effective tool we have in meeting emission reduction targets (Moomaw, et al., 2019).

The time is now for California policy and climate action to heed the science and to reflect the feelings of the people of Mendocino County and the State of California. California is already experiencing and facing a climate change crisis that is far worse than nearly any place in the country, thus protecting JDSF from continued logging should be seen as a form of self-preservation by all Californians that transcends party lines. Given the rapid increasing rate of forest disturbance due to wildfires, urbanization, and logging, we need to protect our forest now, before we potentially end up in a future with very little healthy intact forest to protect. Protecting our forests as soon as possible is a critical step in avoiding reaching 1.5℃ and the associated impacts, which is as little as 10 years away, or far worse, 2℃ as indicated by Figure 1 (following page). As stated by Yvo de Boer, Executive Secretary of the United Nations Framework Convention on Climate Change, "*Protecting forests means fighting for the very survival of humanity*". For California, given JDSF's size, Redwood composition, and biodiversity, protecting JDSF from continued logging under the 30-by-30 guidelines set forth by the State of California and the United States is a no-brainer.



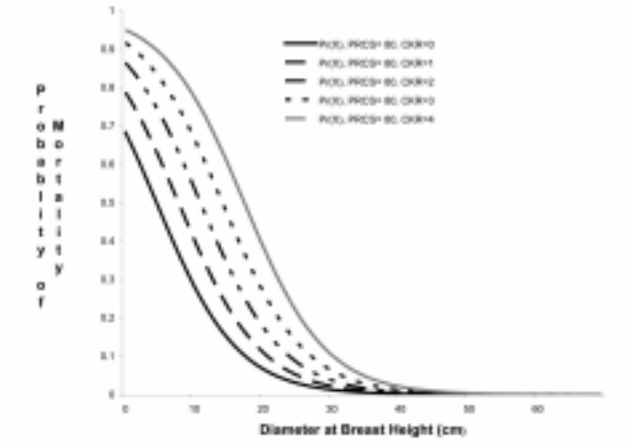
The difference in projected climate impacts between 1.5°C and 2°C of warming. **Source:** IPCC 2018.

Points in Case

1. Wildfire

Here in California, we are no strangers to wildfire, however the last decade, and in particular, the last few years have been truly unsettling. The 2017 Tubbs Fire and the 2018 Camp Fire together destroyed nearly 20,000 homes, incurred over $16 billion and $150 million in damages and suppression costs respectively, and tragically claimed the lives of over 100 people. Most recently, the 2020 fire season by all accounts bordered on apocalyptic, burning over 4 million acres, quadrupling the previous burned-area record, and blanketing the state in unhealthy smoke. This deeply disturbing trend is not without cause; and as we look ahead, especially for those of us living in rural California and in the wildland-urban interface, we wonder with legitimate trepidation, "will it be my home, my town, or my forest next summer?"

Many out there will quickly claim that our forests are overgrown and need to be "thinned" or "raked" to prevent these catastrophic fires in the future. However, this blanket statement is exceedingly coarse and is often driven by economic considerations, as "thinning" is more often than not little more than a commercial timber harvest. As such, the economics of the harvest drive which trees are felled, not the ecological conditions which would make for a forest resilient to wildfire. Indeed, the market value for the largest trees in any stand is greater than for the smallest, and so accordingly, it is the large trees that are preferentially removed. However, it is also those large trees that provide the greatest buffering capacity against wildfire. The large trees have the thickest bark and the highest basal branches, which protect the tree from cambium kill and prevent the fire from climbing up the fuel ladder into the canopy. Douglas et al. 2010, found that in the Mendocino coast Redwood forests, trees greater than 40 cm (~16 in) Diameter at Breast Height (DBH) had a nearly 100% survival rate for fires of *all* intensities. Figure 2 from that study (right) shows the survival curves for Mendocino coast Redwood at five different fire intensities, Cambium Kill Rate (CBR)=0 (lowest intensity fire) and CBR=4 (highest intensity fire). In line with intuition, it shows that wildfire overwhelmingly kills the smallest trees, which like kindling used to start a fire, burn easily and completely. Therefore, in effect, thinning by removing the largest highest market value trees, creates a forest composed of kindling, extremely susceptible to wildfire and high rates of kill.



In addition, removing the largest trees also removes the canopy overstory, which provides

cooling shade to the understory below. The stand openings created by "thinning" allows the understory to receive more solar radiation, which has two main effects: (1) In the spring while the ground is still wet from the winter rains, the excess sunlight reaching the forest floor encourages the rapid growth of thick brush, which then quickly dries out during the subsequent summer months turning into highly flammable tinder. In combination with the remaining stand composed of smaller trees and leftover slash from the timber harvest, these dry understory fuels provide both horizontal and vertical continuity necessary to turn a surface fire into a crown fire (Weatherspoon, 1996). Overall, the excess solar radiation reaching the forest floor results in reduced fuel moisture, enhanced rates of soil evaporation, and therefore a drier understory microclimate that exacerbates wildfire risk. (2) Removing the largest trees creates canopy and stand gaps that allow for greater wind speeds within the forest (Russell et al., 2018). The artificially enhanced windier environment enhances evaporation rates, further drying out the forest fuels, and, in the event of a fire, allows the fire to spread faster with greater intensity (Weatherspoon, 1996; Cruz et al., 2014). Cruz et al. 2014 also found that thinning in all scenarios increased fireline intensity and in the most likely scenario also increased in-stand wind speeds and the associated crowning potential of the fire. In a retrospective post-fire study of three management types, uncut (no treatment of natural fuels) and partial-cut stands (treated and untreated slash), the uncut forest had the least fire damage while the region's partial-cut stands with the untreated slash suffered the most severe damage (Weatherspoon and Skinner, 1995). The researchers concluded that, "*the partial cuttings created a warmer, drier microclimate compared with that of the uncut stands—an inevitable effect of cuttings, as was explained earlier. [And] the partial cuttings were typical of many past cuttings that removed big trees and left small ones. The more readily scorched small trees thus constituted a higher percentage of the residual stand. Furthermore, the live fuel ladder component of fire hazard in the uncut stand was not reduced in the partial-cut stand.*"

The 1996 Sierra Nevada Ecosystem Project Report (Erman et al., 1997), commissioned by Congress, concluded:

> "***Timber harvest**, through its effects on forest structure, local microclimate, and fuel accumulation, **has increased fire severity more than any other recent human activity.***"

A more recent study, the most comprehensive study of western forest land to date, including over 1500 fires and 9.5 million hectares of land, the authors found that, "*Forests with higher levels of*

protection [less logging] had lower severity values even though they are generally identified as having the highest overall levels of biomass and fuel loading. Our results suggest a need to reconsider current overly simplistic assumptions about the relationship between forest protection and fire severity in fire management and policy" (Bradley et al., 2016). Indeed, many of the recent claims about overcrowded forests are unfounded or lacking context. For example, studies have

found that the notion of historical forests being "open and park-like" rely on sparse plot data, and that a more complete synthesis of the available data suggests that present-day forest density is comparable to historical densities (Baker, 2014; Baker et al., 2018; Williams and Baker, 2012). However, forest structure across California is notably different, containing 50% fewer large trees and a higher proportion of small trees (McIntyre et al., 2015).

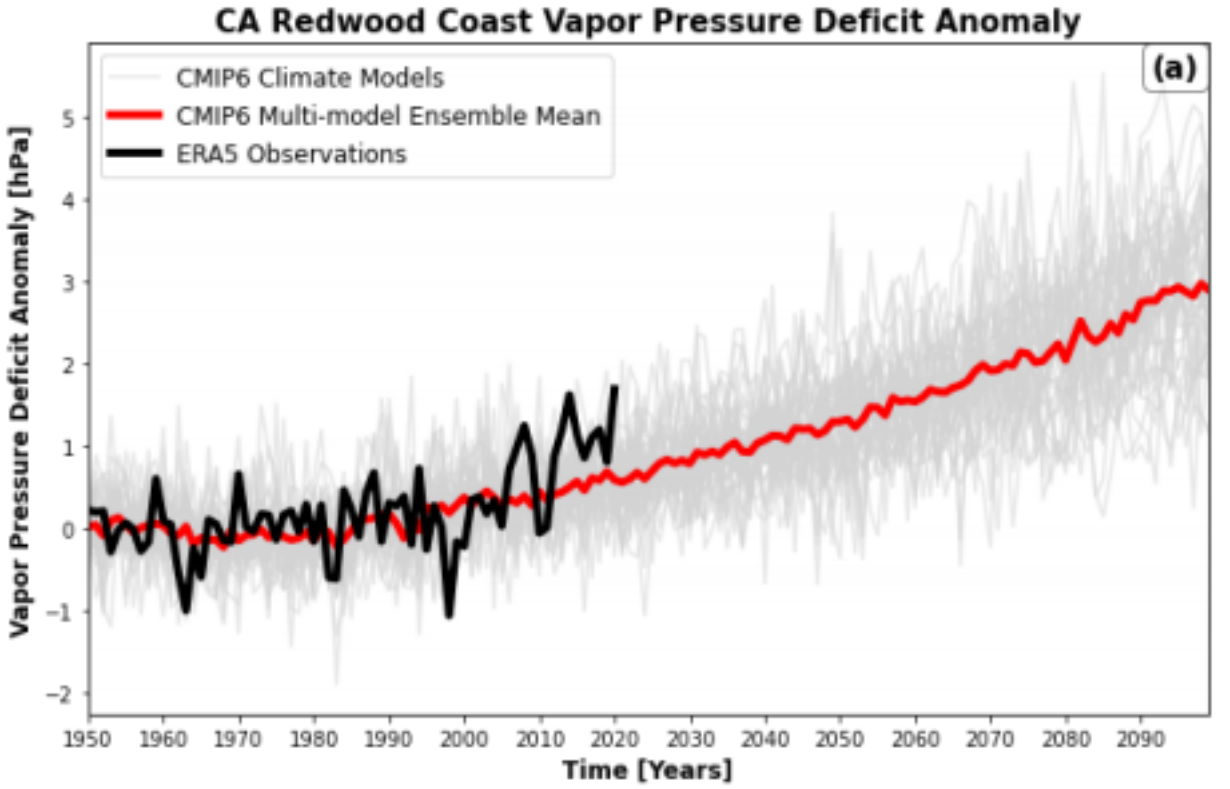
Research shows that, (1) thinning operations have little effect on surface fuel loads or intense fire severity (Weatherspoon, 1996; Rhoades and Baker, 2008; Reinhardt et al., 2008; Knapp et al., 2017; Banerjee, 2020), (2) are typically associated with higher fire intensities (Weatherspoon, 1996; Cruz et al., 2014; Thompson et al., 2007; Banerjee, 2020), and (3) fire weather and climate are better predictors of burn area and intensity than fuel loads or biomass densities (Stephens and Moghaddas, 2005; Abatzoglou and Kolden, 2012; Jolly et al., 2015; Sieg et al., 2017; Zald and Dunn, 2018; Williams et al., 2019; Hart and Preston, 2020). A tragic example of this lies in the 2018 Camp Fire, which burned through previously thinned and burned forest at unprecedented rates, fueled primarily by strong dry winds (John Muir Project, 2018). Post-fire photos show that the more densely forested areas burned with less severity and remained mostly intact despite being next to homes that were burnt to the ground.

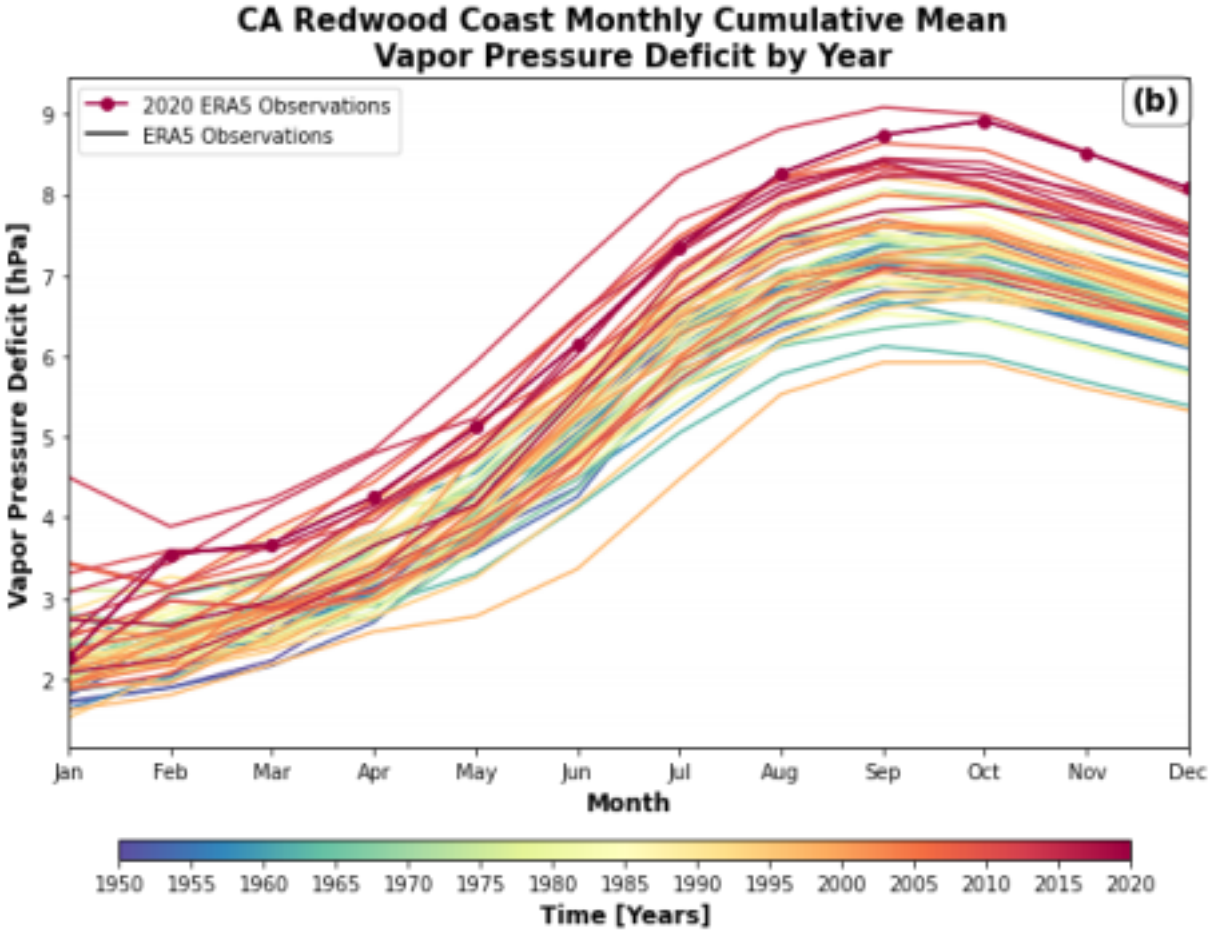
The loss of homes and businesses is one of the costliest types of economic loss associated with wildfire. For example, the capital loss from the Camp Fire is estimated to have cost $3 billion while the total cost of all the 2018 fires is estimated to be approximately $150 billion (Wang et al., 2020). Research shows that vegetation and forest management beyond 100 feet from homes does little to nothing to protect structures (Syphard et al. 2014). Often forest managers will advocate for the creation of "shaded fuel breaks" (the removal of ~70 - 80% of the trees along a path) to slow wildfire spread. However, wildfire modeling shows that shaded fuel breaks do little to slow wildfire spread, due to ember spotting, increased in-stand winds, and rapid overgrowth of highly flammable brush within the break (Van Wagtendonk, 1996; Weatherspoon, 1996; Cruz et al., 2014). Shaded fuel breaks are often tantamount to long linear clear cuts, which in places like JDSF, CAL FIRE makes money from by selling the harvested wood, much of it being high-value Redwood. However, the science is clear, hardening homes and creating 100 feet of defensible space has been shown to be both an economic and effective means of protecting property as it minimizes contact with the fire, radiative heating, ember drop probability, and allows more space for firefighter protection (Cohen, 1999; 2000; Gill and Stephens 2009; Syphard et al. 2014; 2017). Yet, despite evidence for the efficacy of creating

defensible space in saving homes from wildfire, in 2018 CAL FIRE inspected just 7% of the rural property in Butte County and just 8% in Mendocino County (KQED, 2019). Their excuse is a lack of resources. Given the preponderance of evidence which shows that thinning operations and timber harvest increase fire danger coupled with CAL FIRE's nearly $3 billion annual budget, there is no excuse for continued mismanagement of our State Responsibility Area (SRA) forests and the continued catastrophic losses of homes every year.

Despite being commonly thought of as a wet "fire-free" region, our Redwood Coast is increasingly threatened by wildfire due to an increasingly dry atmosphere and land surface (Williams et al., 2019; 2020), a later, shorter, and sharper rainy season (Lukovic et al., 2021; Swain 2021), increased probability of hot, dry conditions coinciding with extreme wind events (Nauslar et al., 2018; Wang and Ullrich, 2018; Abatzoglou et al., 2021; Swain 2021), and an increased probability for lighting strikes (Romps et al., 2014). Together, these act as wildfire risk multipliers and that, combined with the risk imparted by continued timber harvest in the Redwood coast region poses direct threats to both the forest, homes, and other infrastructure in this region. A study of coastal Redwood forests in the Santa Cruz mountains found that selection harvest increased fuel loading and led to increases in the rate of spread and fire intensity, which significantly increased fire hazard to the forest and to adjacent home sites (Dicus, 2003). The 2020 Santa Cruz Complex fire is sobering evidence that we here on the Redwood Coast are not immune to wildfire, and thus it is imperative that we minimize risk by all means possible to prevent another catastrophe like the SCZ complex in the future.

The atmospheric variable known as Vapor Pressure Deficit (VPD) is one of the most important variables in understanding wildfire behavior and burned area. Researchers recently found that nearly all of the increase in California summer forest fire area could be explained by increasing VPD and that warming driven fuel drying is the clearest link between climate change and increased California wildfire activity (Williams et al., 2019). With that finding in mind, Figure 3 on the following page shows VPD metrics specifically for the Redwood Coast region, stretching from southern Big Sur to the Oregon border. Panel (a) shows simulations of the VPD anomaly from the most recent state-of-the-science Climate Model Intercomparison Project Phase 6 (CMIP6) models (gray), the multi-model ensemble mean (red) and ERA5 observations (black). Figure 3a shows just how extreme 2020 was in VPD terms, falling nearly outside the range of variability simulated by 41 different climate models totaling 200 independent simulations. Indeed, during the California firestorm of August 2020, VDP reached levels never seen before over the modern observational record. Figure 3a also shows that if we continue on the business as usual pathway, 2020 will represent nothing more than an average year by 2060 and an exceedingly mild below average year by 2100. Figure 3 Panel (b) shows the monthly cumulative mean VPD colored by year, i.e. the first point of each curve represents the January average VPD, the second point the Jan-Feb average, the third Jan-Mar average and so on. Quantifying VPD in


CA Redwood Coast Vapor Pressure Deficit Anomaly
(a)
CMIP6 Climate Models
CMIP6 Multi-model Ensemble Mean
ERA5 Observations
Vapor Pressure Deficit Anomaly [hPa]
Time [Years]


CA Redwood Coast Monthly Cumulative Mean
Vapor Pressure Deficit by Year
(b)
2020 ERA5 Observations
ERA5 Observations
Vapor Pressure Deficit [hPa]
Month
Time [Years]

this way captures the cumulative effects on forest drying due to increasing VPD throughout the year. VPD tends to decrease at the end of the calendar year due to cooling of the northern hemisphere associated with the onset of winter. Each curve is colored by the year in which the data represent, with 2020 specially marked with the line-dot pattern. Figure 3b clearly shows the progressive increase of VPD (forest drying) along the Redwood Coast by year with nearly every year in the 2000's laying at the top of the stack of VPD curves. Note that the only year that exceeds 2020 in the peak of the late summer fire season is 2014, which was the peak of the most recent extreme drought we have had here. This has ominous implications for the upcoming year given the current extreme drought conditions. The combination of extreme atmospheric moisture demand driven by atmospheric warming and the present lack of moisture available for the land and vegetation to give up suggests that surface and atmospheric dryness may shatter records in the upcoming year and would have dire implications for wildfire risk and drought-induced forest mortality (Hartmann et al., 2018).

VPD increases exponentially with climate warming even if relative humidity stays constant. Thus with every incremental increase in the average temperature of the atmosphere, it gets exponentially more dry, which in turn demands more water from vegetation and the land surface. Have you recently felt that you've needed to water your houseplants more often? Or that when you walk through the forest it feels more "crunchy" out, even though it just rained the week before? If so, it's not your mind playing tricks on you, it's because it is getting more dry and this trend will worsen every year with continued climate change, further increasing fire danger to communities along the Redwood Coast and statewide.

Climate Change

We have known since 1896 that carbon dioxide is a heat trapping gas that if added to the atmosphere in sufficient amounts could heat the planet (Arrhenius, 1896). Today, human-induced global climate change is well-founded and *is not* subject to substantial debate among experts (IPCC, 2014). Despite the overwhelming evidence that the climate is changing and that humans are the primary cause, CAL FIRE's Timber Harvest Plans (THPs) openly engage in climate denial language and understate risk. In any of the proposed THPs for Jackson Demonstration State Forest, CAL FIRE states in Section 4 regarding Greenhouse Gases (GHGs):

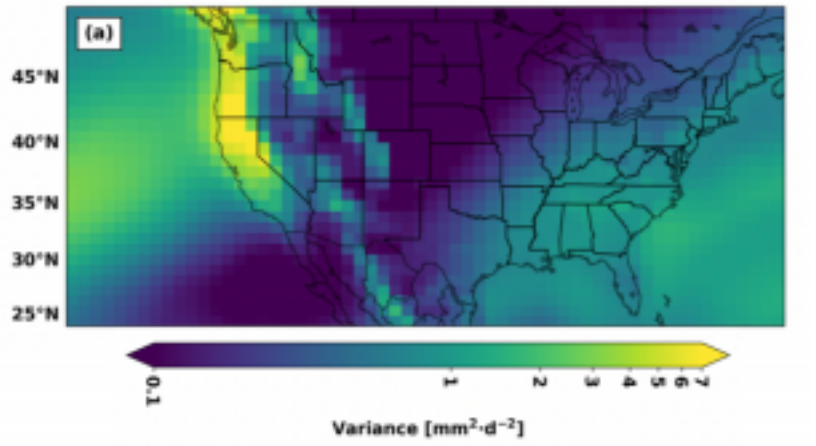
> *Global climate change and the variables that influence this change are subject to intensive scientific investigation and debate. For now, the consensus is that temperature within the earth's atmosphere is increasing, although exactly how and to what extent human activity plays a role in global climate change appears*

to be unknown. (Emphasis added)

The fact is that the climate is changing, it is not subject to intensive debate among experts, it is not going to start magically getting cooler, and the role human activity plays is very well-known (IPCC, 2013). This disconnected position on climate change by the agency tasked with protecting our forests is hardly what we need moving forward.

The effects of climate change resulting from increasing anthropogenic CO2 emissions are not some hypothetical future, they are happening now all around us, in wildfire (Westerling and Bryant, 2006; Westerling et al., 2011; Williams et al., 2019; Goss et al., 2020), droughts (Swain et al., 2014; Angelil et al., 2017; Diffenbaugh et al., 2015), floods (Pall et al., 2017; Risser et al., 2017), extreme heat (Zwiers et al. 2011, Peterson et al., 2013), forest mortality (Anderegg et al., 2013; Allen et al., 2010; Brodribb et al., 2020), sea level rise (Slangen et al., 2016), ocean warming (Nagelkerken and Connell, 2015), changing ocean circulation (Caesar et al., 2021), ocean acidification (Frieler et al., 2013), arctic sea ice melt (Min et al., 2008), and remarkably, even in the weather on any given day (Sippel et al., 2020). Indeed, the effects of climate change are pervasive and inescapable.

We all know that California is a special place, and much of what makes it special is its unique climate. California spans a climatological transition zone with large-scale descending air in the southern portion of the state, which is responsible for its warm Mediterranean-like climate. The northern part of the state represents the southern edge of the climatological position of the North Pacific storm track, thus winters are dominated by large-scale ascending air. As such, wintertime precipitation variability is maximized in Northern California, shown in Figure 4 (right), which depicts mean wintertime precipitation variance simulated by a large ensemble of atmospheric model simulations. The practical meaning of this is that during the boreal winter this region gets both ample rainfall and ample sunshine such that both sun and rain are each approximately equally represented. In the Pacific Northwest, rain is the predominant state at the expense of sun, and in the Pacific Southwest, sun is the predominant state at the expense of rain. With this optimal combination of both rain and sun, in concert with the fertile soils from California's rich geologic



history, there is little wonder why the tallest trees on earth have evolved to grow here. This geographic blessing that has led to one of the highest concentrations of endemic biodiversity on

the planet is also its curse in this era defined by rapid climate change. Because the flora and fauna that have evolved here rely on this delicate balance between rain and shine they are highly sensitive to changes in either direction. Thus, this delicate balance that makes California unique also makes us more likely to feel the effects of climate change, subtle or otherwise. In fact, due to California's unique climate and high proportion of endemic species, climate change increases the risks of negative impacts to California's endemic species 3-10 times and over other species and increases extinction risks by 34% (Manes et al., 2021).

Presently, and in a future warmer California climate, anthropogenic emissions have increased drought risk and droughts are expected to become more frequent and intense in the future (Diffenbaugh et al., 2015; Williams et al., 2015; Seager et al., 2015; Swain, 2015; Mann and Gleick, 2015; Berg et al., 2015; Angelil et al., 2017; Dai, 2013; Ullrich et al., 2018). This is inherently related to a robust increase in projected precipitation variability despite uncertain changes in average precipitation (Swain et al., 2018; Pendergrass et al., 2017; Seager et al. 2012; Wang et al., 2017; O'Brien et al., 2019; Persad et al., 2020; Yoon et al., 2015). What this practically means is that the future California climate will likely be characterized by longer, more frequent, and intense droughts that will be punctuated by episodic periods of extreme rainfall that manifest on both the intra- and inter-annual timescales during a compressed wet season and extended summers (Swain et al., 2018; Wang et al. 2021). In other words, both floods and droughts (extreme weather) are projected to increase such that interannual mean precipitation stays about the same. We experienced an example of this type of climate regime recently in the 2012-2016 drought, which was estimated to be the worst experienced in at least the last 1200 years (Griffin and Anchukaitis, 2014), followed by the winter of 2017, which broke historical precipitation records all over the state and nearly resulted in the failure of the tallest dam in the United States (Vano et al., 2018; CDWR, 2017). This type of climate variability, rather than being an aberration, is projected to become exceedingly "normal" under a business as usual scenario (Swain et al., 2018; Persad et al., 2020).

The theoretical and practical implications of a more variable and volatile climate cannot be understated and are much more ecologically and socially stressing than secular changes in the mean (IPCC, 2012). After consecutive years of drought, soils can develop hydrophobic (water repelling) tendencies such that when the rains do come, more water is shed as runoff rather than being absorbed by the soil where it can be made available to the parched plant life (Goebel et al., 2011). Soil moisture deficits are made even worse when the rains come as torrential downpours, as those conditions favor rapid runoff, erosion, flooding, and landslides (Gariano and Guzzetti, 2016). The changing hydroclimate expected for California and the greater U.S. is expected to have severe implications for forest health (Ramsfield et al., 2016). The 2012-2016 drought is

estimated to have killed 102 million trees in California with 62 million of those dying toward the end of the drought in 2016 alone (USFS, 2016). Droughts such as the 2012-2016 event are expected to become 3-15 times more likely by the end of the 21st century (McEvoy et al., 2020), and with

more severe consequences in terms of record levels of forest mortality than an equivalent drought could produce today (Ullrich et al. 2018).

In addition to the increased temperatures and exacerbated drought conditions that our forests will face in the coming years, the atmospheric demand for water, known as the Vapor Pressure Deficit (VPD), is expected to have dire consequences for forest health (Novick et al., 2016) and thus fire risk. Even if in a future warmed climate the relative humidity remains constant, VPD will continue to increase exponentially, drying out the land surface, plants, and forests resulting in explosively flammable terrestrial ecosystems (Williams et al. 2019). During the 2020 firestorm, VPD reached record levels, which haven't been seen in at least the last 40 years, perhaps maybe ever (reliable VPD data does not exist prior to 1979). This applies to the coastal regions, and plays a role in the observed and predicted decline of coastal fog (Johnstone and Dawson, 2010; O'Brien et al., 2012), from which the coast Redwoods can derive up to 30% of their water (Burgess and Dawson, 2004). Fog drip is also a critical component in keeping the understory plants hydrated, the litter moist, and streams running the summer months as fog drip is capable of supplying over 15 inches of water per month in high drip locations (Sawaske and Freyberg, 2014). The predicted future decline in coastal fog will have significant implications for wildfire risk in the Redwood Coast region. In the coming years forest mortality is expected to reach levels never seen before, resulting from temperature/drought induced mortality (Battles et al., 2008; Allen et al., 2010; Choat et al., 2012; Anderegg et al., 2013; McDowell and Allen, 2015; Batllori et al., 2020; Brodribb et al. 2020), VPD induced mortality (Williams et al., 2013; Novick et al., 2016; Hartmann et al., 2018; McEvoy et al., 2020), insect induced mortality (Kolb et al., 2016; Kharuk et al., 2020), mortality from invasive species (Ramsfield et al., 2016), wildfire mortality (Westerling et al., 2011; Goss et al., 2020), and logging (Williams et al., 2016; Berner et al., 2017).

There is little doubt about it, our forests are in for an increasingly disturbed future (Mantgem et al. 2009; Millar and Stephenson, 2015; Seidl et al., 2017; Serra-Diaz et al., 2018), and recent studies show that western forest mortality rates have been increasing rapidly and that models may underestimate predictions of future forest mortality (van Mantgem et al., 2009; Yang and Mountrakis, 2017; McDowell et al., 2016). Additionally, stress induced mortality has been shown to persist for several years after a drought, and in a warmed future with a greater frequency of longer hotter droughts, trees may not grow back at all (Schuldt et al., 2020; Stevens-Rumann et al., 2018). Alternatively, in years following drought, accelerated forest mortality and the effects of pathogens can lead to major ecosystem reorganization with forest previously associated with wetter biomes shifting to plant communities characterized by drier

biomes (Gonzalez et al., 2010; Batllori et al., 2020). In a recent comprehensive review of forest mortality in a changing climate, the authors concluded that the preponderance of evidence suggested increased future forest mortality due to high-confidence factors such as, "*(1) droughts eventually occur everywhere; (2) warming produces hotter droughts; (3) atmospheric moisture demand increases nonlinearly with temperature during drought; (4) mortality can occur faster in*

hotter drought, consistent with fundamental physiology; (5) shorter droughts occur more frequently than longer droughts and can become lethal under warming, increasing the frequency of lethal drought nonlinearly; and (6) mortality happens rapidly relative to growth intervals needed for forest recovery" (Allen et al., 2015).

Our beloved coast Redwoods are not by any means immune to these changes, in fact they are at a greater risk than nearly all other tree types due to their large size and inability to reduce leaf area to conserve water making them more susceptible to drought related stress (Lutz et al., 2009; McDowell and Allen, 2015; Groat et al., 2016). It's often thought that coastal regions need not be concerned about wildfire, however, the 2020 Santa Cruz Complex, which burned through the coast Redwoods there, tells us otherwise. Historically, Redwoods are a fire tolerant species, however, recent research shows that the presence of the sudden oak death pathogen makes Redwoods up to four times more likely to die in a fire (Metz et al., 2013). The sudden oak death pathogen is pervasive in Mendocino County and is spread by timber harvesting, which also increases wildfire risk, and that risk is further compounded by climate change. As such, our coast Redwoods are now more threatened by fire, drought, insects, and pathogens than they ever have been. In our changing climate of ever increasing wildfire risk, the firestorms of 2020 that destroyed so many Redwoods in the Santa Cruz mountains should be a wake-up call that the same thing could happen on the Mendocino coast any year now as Santa Cruz and Fort Bragg share an exceedingly similar climate. And once our beloved Redwoods are gone, it is quite possible that we may ever get them back (Gonzalez et al., 2010; Stevens-Rumann and Morgan, 2019; Batllori et al., 2020, Coop et al., 2020).

The Economy

When it comes to "industry" decisions and what direction we, as a community, a society, a species, want to head, economic factors always play an important role. Historically, logging constituted a large fraction of the jobs in Northern California, regrettable as that may be, since as a result, our forests have been reduced to a fraction of what they once were, with concomitant impacts to biodiversity, watersheds, salmonids, and endangered species. However, times have changed and the logging industry is tantamount to the coal industry in the eastern U.S., it is archaic and has outlived its purpose. By industry, in Mendocino County in 2018 just 1.5% (349

people) of those employed were in the forestry and logging sectors (CBP Forestry, 2018), compared to 19% in retail, 18% in service accommodations and food service (CBP by Industry, 2018). Indeed, of all jobs in Mendocino County, those in the logging sector year-after-year consistently rank at the bottom of all sectors in California (EDD 2021).

The Mendocino Trail Stewards are advocating for a 20,000 acre reserve to be created on the western portion of JDSF, which is the most utilized portion of the forest by recreationalists due to its abundance of trails, ease of access, and close proximity to the coastal population centers. The

coastal communities with their charm and abundance of outdoor recreational opportunities including JDSF also draw tens of thousands of tourists every year and account for an economic impact distributed across sectors over four times that of the logging industry (Gurewitz et al., 2018). This reserve area only constitutes 2.3% of the 866,206 acres that are zoned timber production (TPZ) in Mendocino County, an exceedingly small fraction, especially in light of the also exceedingly small fraction of people employed in the logging sector. Additionally, the economics of timber harvest are not evenly distributed across the population, as the majority of logging in Mendocino is carried out by private timber companies, which give little back to the County in terms of taxation or otherwise (Gaffney, 2000). For example, of the ~16,247 THPs totalling 385,798 acres carried out in Mendocino County between 1997 and 2019, Mendocino Redwood Company accounts for 6,053 (149,737 acres), Hawthorne Company 3453 (66,146 acres), Lyme Redwoods 1155 (27,919 acres), and CAL FIRE 593 (23,756 acres) (ArcGIS CAL FIRE THPs). Assuming the proposed reserve area was created back in 1997, then that would roughly halve the acres harvested by CAL FIRE over that time. Taking an average of $3,400 per acre gross revenue from each THP (based on data from the recent Caspar500 THP) implies a ~$1.8 million in annual lost revenue for CAL FIRE, which constitutes an infinitesimal 0.07% of their ~$3 billion annual budget.

The loss of benefit to the public and environment in terms of recreation, water quality, carbon sequestration, ecosystem services, habitat loss, and ecosystem degradation, for a paltry $3,400 per acre cannot be overstated. For example, there are hundreds of miles of trails in western JDSF that are used by locals and tourists every day (Strava, 2021). Most of these trails are not sanctioned, nor are they promoted by Fort Bragg and Mendocino County to draw visitors from far and wide to hike through lush forests, bike epic trails, and to breathe in the serenity of the forest (Shinrin-yoku, Park, 2010). In Jackson Hole, Wyoming it was estimated that in 2010 their mountain bike trail system generated over $18 million in economic activity (Kaliszewski, 2011). In Wisconsin in 2019, the trail network in Bayfield and Sawyer counties was estimated to have generated an economic impact of $7.8 million (Hadley and Trechter, 2020). Closer to home, three biking events in Oregon were estimated to generate over $5 million in spending, income, and jobs (McNamee et al. 2013). In British Columbia, where mountain biking is heavily promoted, it was found that mountain biking resulted in over $46 million in visitor spending

(Canadian Sport Tourism Alliance, 2017). Alone, the Sky-to-Sea trail system in Squamish and Whistler BC generated over $10 million in spending from riders coming from outside the area (MTBA Canada, 2007). In Canada, these figures represent economic benefit from mountain biking just over their short four-month summer, whereas here in Mendocino, because of our temperate and favorable climate, mountain biking could support increased economic activity year-round. Not even logging can do that since most logging operations are shut down during the winter months because of the danger of severe erosion and watercourse sedimentation due to haul roads and tractor yarding methods (Rice and Datzman, 1981; McCashion and Rice, 1983; Zemke, 2016). Indeed, there are over 130 studies that document the economic and health benefits that result from trail

systems that support mountain biking, hiking, horseback riding, and walking. Because of the proven potential to increase revenue generation through adventure tourism from promoting mountain biking, Santa Cruz is moving in this direction as well (MBoSC, 2007). In fact, Santa Cruz already has a Skyline-to-Sea trail, but that is used strictly for backpacking. Sadly, this trail was destroyed by the 2020 firestorm. Prior to its closure, reservations for backpacking the Skyline-to-Sea trail were booked months in advance and generated $38 per group in fees. With its east-west orientation, JDSF has all the potential and more to create a Skyline-to-Sea trail system that could be used for backpackers and mountain bikers alike. In the rural mountain town of Quincy, California, the Sierra Butes Trail Stewardship has initiated the "Connected Communities" campaign, which seeks to connect the mountain towns of the northern Sierra through a multi-use trail system and a "passport system - trail for everyone" to generate tourism and stimulate the local economy. This environmentally friendly model could easily be adopted and applied to Fort Bragg, Mendocino, Willits, and Ukiah and further integrated in the Rails-to-Trails project to foster increased eco-tourism in the area.

Aside from the physical, mental, and spiritual benefits those who frequent nature receive, another critical ecosystem service that is provided by our forests is that of carbon sequestration. Not only is carbon sequestration critically important for mitigating climate change, but it also has attractive economics in today's carbon markets. For example, The Nature Conservancy's 5500 acre Burnt Mountain project is expected to generate ~$2 million over 10 years for long term carbon storage (The Nature Conservancy, 2021). Closer to home in Humboldt County, between 2005 and 2009, the 2200 acre Van Eck forest registered 185,000 MTCO2 credits which sold for $2 million (Van Eck Fact Sheet). Since 2008, the Conservation Fund has sold over $36 million in carbon credits, some of which originated here in Mendocino County. Recently completed, the Usal Redwood forest, which is comparable to JDSF in size, registered over 3.9 million carbon credits with the state of California. Using both the Van Eck forest and the Usal forest as benchmarks, they generate anywhere between 10-15 carbon credits per year per acre, which at an average price of $10 per carbon credit (one metric ton of sequestered carbon) would translate into revenues of $5-8 million annually for JDSF. The economic potential of JDSF from

ecotourism, carbon sequestration, and other ecosystem services, without extraction of forest resources (timber), would far surpass the economic gain as it is managed today, primarily through felling of the trees; and, it would have the positive externalities of mitigating climate change, improving human health and lives, improving forest, ecosystem and watershed health, and providing critical sanctuary habitat for the endangered species of the region.

Conservation

Forests are critically important in our fight against rising CO2 levels and concomitant climate

change. Despite only covering ~9% of the earth's surface, forests are responsible for sequestering ~25% of anthropogenic carbon emissions, which is approximately equal to the carbon sequestered by the global oceans (Pan et al., 2011), which cover ~70% of the earth's surface and are rapidly acidifying as a result (Orr et al., 2005). Our forests face an ever uncertain future, as do we as a species, and it is imperative that our forests be conserved and not managed under an incentive structure by which those tasked with overseeing them also see financial gain from their destruction. Our Redwood forests of the North Coast sequester more carbon than any other forest type in the world (Hudiburg et al., 2011; Sillett et al., 2020) making their value toward carbon sequestration and climate change mitigation self-evident (Jones and O'Hara, 2012). Thus, Redwood Forests are powerful carbon storehouses and their protection prevents emissions from deforestation, shields that carbon, and enables ongoing carbon sequestration. Research has found that, "Over time old-growth forests store approximately twice as much carbon as forests managed on a 100-year rotation, and forests managed on a 50-year rotation store about 38% as much as old growth" (Harmon et al., 1990). Studies show that trees continue to grow and absorb carbon throughout their lives (Luyssaert et al., 2007; Stephenson et al., 2014, Lutz et al., 2018; Mildrexler et al., 2020), therefore premature mortality through harvesting is associated with immediate carbon releases and decreased sequestration potential over time (Battles et al., 2014). Indeed the dominant cause of carbon loss from our forests is timber harvest (Harris et al., 2016; Berner et al., 2017), and thus protecting forests from logging maximizes carbon storage and removal of CO_2 from the atmosphere (Campbell et al., 2012; Law et al., 2018). It is often argued that cutting down trees and converting them to wood products sequesters carbon as well, however, this is a red herring. The carbon emissions associated with the timber harvest and processing (emissions resulting from cutting, yarding, slash burning, transport, milling, manufacturing, and distribution to the marketplace) are immediately returned to the atmosphere (Harmon et al., 1996). The wood products that make it into homes and other structures typically end up burned or in a landfill within the typical lifetime of the home, which on average is 70-100 years (O'Connor, 2004). That time frame is a fraction of the sequestration potential of

old-growth forests, particularly Redwoods that if left growing can live, store, and sequester carbon for millennia (Harmon et al., 1990; Iberle et al 2020; Sillett et al., 2020). Recently, both President Biden and Governor Newsom have signed on to conserve 30% of our lands by 2030, known as the 30x30 initiative. The 30x30 initiative is a science-backed vision and plan to combat climate change and to ensure environmental protection in an age of rampant environmental destruction (Dinerstein et al., 2019). In the 30x30 summary for policy-makers, lands are broken into categories based on their Gap Analysis Project (GAP) status code. The study found that GAP3 status lands held the most promise for rapidly achieving 30x30 as GAP3 lands can be protected through simple administrative actions (Rosa and Malcom, 2020). GAP3 lands are particularly important to achieving 30x30 because they already possess some protections and are state-owned, meaning less regulatory red tape in increasing protection to full conservation status.

JDSF is classified as a GAP3 tract of land and therefore has the highest potential of all California lands in achieving the state 30x30 goal. The only thing that prevents JDSF from being a protected landscape and thus contributing to 30x30 is its use for extractive purposes, namely logging. As such, in the race to achieve 30x30, JDSF is "low hanging fruit", and at nearly 50,000 acres increasing its protection level would represent a significant step toward achieving 30x30. Moreover, given the devastating historical impact of logging in Mendocino County, both inside and outside of Jackson, increasing the protection of our Redwood forests would be a step in the right direction. Indeed, historically, our Redwoods have been ravaged by the logging industry such that it is estimated that there are only 5-7% of the original old-growth still standing, and what's even more shocking, is that at present, there are only ~2% of original second-growth still standing (Burns et al., 2018). This is because unlike the remaining old-growth, which are now protected, second-growth Redwoods have no protections and thus represent the largest, highest market-value trees standing, and therefore are preferentially targeted for felling. And despite what CAL FIRE says regarding the recruitment of late seral growth forest, their THPs say otherwise. In the recently approved Caspar500 THP, they have numerous second growth Redwoods marked to cut, some exceeding 6 feet in diameter. Thus, we have a public agency, tasked with the protection of our state forests cutting down some of the rarest Redwoods in existence.

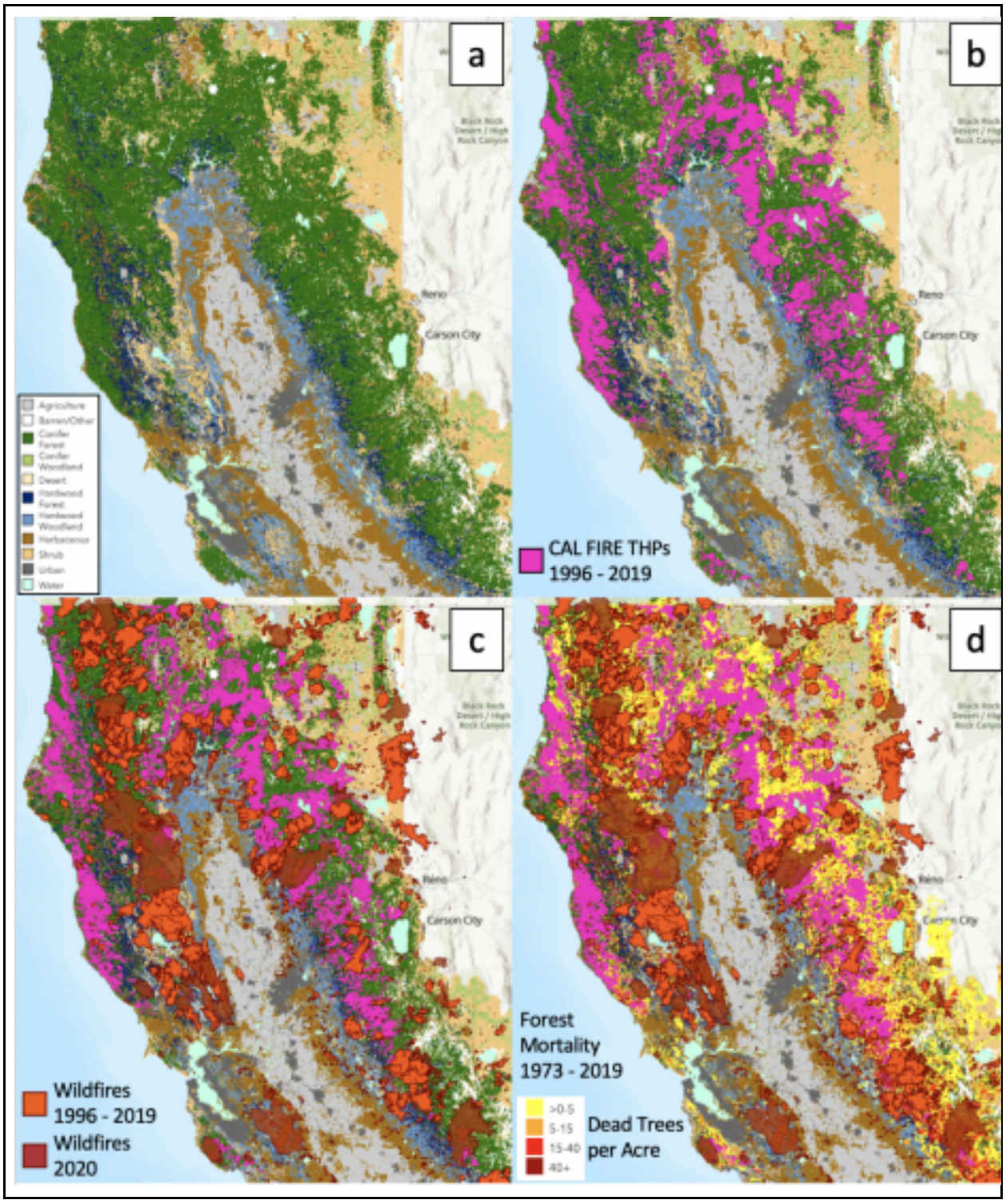
Despite JDSF being a publicly owned forest with the research and demonstration mandate, CAL FIRE manages it as little more than a private source for agency funding through timber harvest. This is a gross violation of Public Trust, especially since selectively taking the largest trees and leaving the smallest creates a wildfire risk, reduces the carbon sequestration potential of the forest, and removes critical habitat for wildlife and endangered species (Weatherspoon, 1996; Iberle et al,. 2020; Thornburgh et al., 2000). These trees have far more environmental and societal value alive and standing rather than cut, milled, and sold as building material, which can't even be used for structural projects such as homebuilding as all-but first-growth Redwood

is generally too soft and therefore not used for structural applications. At present, Redwood is only used for "vanity" projects such as decks, fencing, siding, and the like, which have a much shorter lifespan than a typical home. In this day and age of advanced stains and wood treatment products, there is absolutely no reason to be felling Redwoods such that one person at the end of the supply chain benefits, while the public at large loses all the critical ecosystem services provided by living trees.

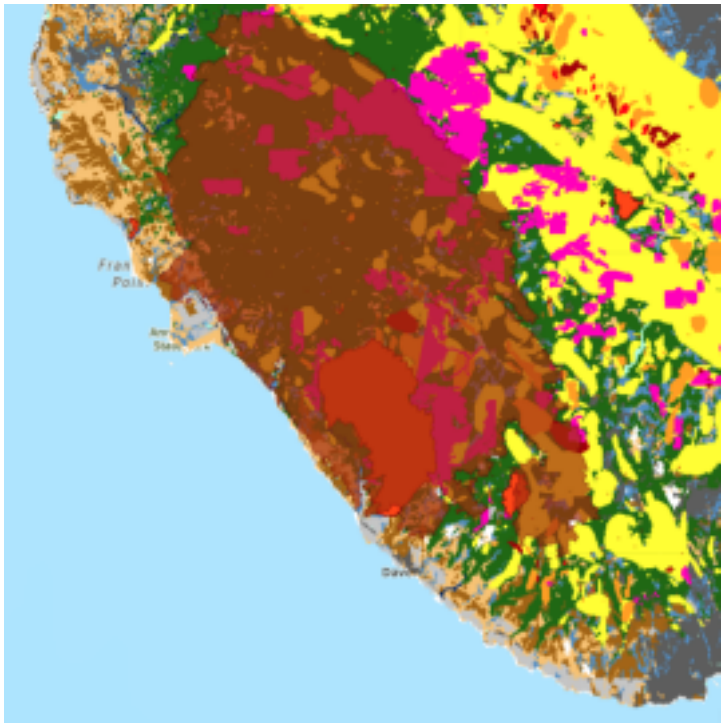
Conserving our forests is critical in this age defined by rapid environmental destruction and climate change. It is often said that as CO2 rises, forests will grow faster due to the additional CO2 in the atmosphere, the so-called "greening of the earth" (Zhu et al. 2016), however, this is not generally true, and in fact, forest growth has been observed to be slowing over the last 20 years (Wang et al., 2020). Photosynthesis is a chemical reaction and the reaction rate, whereby $CO_2$is absorbed from the atmosphere, is constrained by the limiting reactant, which most often is the

availability of nutrients from the soil (Oren et al., 2001; Luo et al., 2004). Due to fire suppression and logging (the removal of biomass from the forests, that in an unaltered setting, would have been transferred back to the earth to support future forest growth), there is a dearth of carbon and nutrients in our forests (McIntyre et al., 2015). Natural decomposition and fire are natural mechanisms for returning carbon and nutrients back to the earth to stimulate and support future forest growth (Neary et al., 2005). Humans have interrupted and suppressed these natural processes in our fire-dependent Redwood forests creating nutrient-depleted forests. That, combined with the stresses of climate change, increasing VPD, present and future moisture deficits due to droughts, decreasing fog, insects, pathogens, and timber harvests puts our forests in dire straits. Without bold steps taken to conserve and protect our forests, we run the very real risk of them turning into a net carbon source rather than a sink due to widespread degradation. We need to act now to conserve and keep standing what trees we do have and put ecological sustainability ahead of economic sustainability once and for all, however these two do not have to be mutually exclusive, as described earlier.

Figure 5 on the following page shows Northern California forest disturbance from various sources. Panel (a) shows the native distribution of vegetation, which is dominated by the Sierra and North Coast conifer forests. Panel (b) shows the THPs approved by CAL FIRE from 1996-2019. THPs conducted prior to 1996 do not have digital files that delineate their bounds and therefore cannot be mapped in this context. It is disturbing to see the extent of the timber harvests approved by CAL FIRE in just the past 25 years, which cover more than half of California's conifer forests. The extent and intensity of timber harvest shown in Mendocino County in Figure 3b is also reflected in the JDSF/Mendocino THP map and shows that more than anything, the forests of Mendocino County have been historically treated as little more than a commodity for economic gain to the detriment of environmental and ecological well-being. Indeed, there is hardly a place left along the Mendocino Redwood Coast that hasn't been affected



by logging in the last 25 years. Also note, that the THPs shown in Panel (b) do not include harvests conducted on federal lands such as National Forest or BLM lands and therefore the extent of forest disturbance from logging is actually far greater than is shown. Panel (c) shows the combined effects on California forests from wildfire (1996-2020) and timber harvests. The



wildfires that occurred during 2020 are marked in transparent maroon red to distinguish them from previous years. Note that nearly all of the fires in 2020 burned over lands that had been previously burned and/or harvested for timber. This is also true for the Santa Cruz complex (right, with the same legend as in Figure 5), which burned across all environments present: previous timber harvests, previous fires (both wild and prescribed), wildland-urban interface, and virgin old growth forests. This "all inclusive" fire behavior indicates/implicates a larger driver at work, namely that of weather and climate (Zald and Dunn, 2018; Williams et al., 2019; Mueller et al., 2020; Higuera and Abatzoglou, 2021). Panel (d) adds the backdrop of forest mortality from 1973-2019 resulting primarily from droughts, bark beetles, and climate change. It is estimated that from 2010-2019, 129 million trees died in California. Set upon the trend of rising forest mortality due to environmental factors, the devastating impacts from timber harvests and wildfires make it clear that our forests are under assault from both humans and a changing climate. To mitigate the inevitable changes to the climate we will see over the next 10-50 years and beyond, we desperately need to increase forest protections as soon as humanly possible.

Closing

What California desperately needs right now is not a Redwood forest that demonstrates how to fell trees, but a forest that demonstrates how to save trees, how to manage them in a changing climate such that the health of the forest is prioritized, and consequently, ecosystem, human, and wildlife health benefit as well while simultaneously sequestering carbon and mitigating climate change.

CAL FIRE has the mixed mandate of both forest protection and revenue generation from forest harvesting, while at the same time being the sole agency for reviewing THP's, including their own, which is an egregious conflict of interest. In addition the agency is tasked with fire

protection for all state responsibility lands, which in 2020, pushed the agency beyond its limits,

and this is only expected to get worse in the future (Abatzoglou et al., 2020). With climate change worsening every year, CAL FIRE is not currently equipped to handle either responsibility, forest management or fire protection. In fact, the former director of CAL FIRE, Richard Wilson, has been one of the most vocal critics of the agency, calling for a "CAL FIRE Divorce", that is, a separation of the forestry and fire protection branches due to "their abject failure" in forest management.

A paper published just last month by a few of my colleagues at Berkeley Lab found that both of the State's GHG reduction scenarios fell drastically short of achieving their GHG reduction targets set forth by California Senate Bill 32 and Executive Order 2-3-05 (Simmonds et al., 2021). Relatedly, they found that the State's fuel-reduction plans (understory treatment, prescribed burning, thinning) actually produced 29.1 and 25.5 times more carbon emissions than they prevented for Scenario's A and B, respectively. They found that the activity that had the greatest benefit in reducing carbon emissions was forest protection and the associated enhanced ecosystem carbon uptake. Therefore it's imperative that we move more aggressively in the direction of ecosystem protection as, until we implement a viable replacement for fossil fuels, our forests are our greatest ally in mitigating climate change (Grassi et al., 2017). These forests are already here, already doing the work of sequestering ~25% of anthropogenic emissions, and can do even more with increased protections (Erb et al., 2018). We set lofty goals and targets, but then fail to implement policies that will actually achieve these goals, tantamount to believing that these targets will somehow achieve themselves. In reality though, we are just unwilling to make the hard decisions to step away from the path we are currently on, and the truth of the matter is, the consequences of non-action will be far more painful than those associated with changing the way we manage our forests now.

This is a conversation that needs to be initiated immediately and starting the conversation with JDSF is an excellent place to begin. JDSF is a place of high biological diversity and low environmental protections with deteriorating forest health due to climate change and continued timber harvest. With our forests increasingly susceptible to climate change, wildfire, timber harvest, pests, and pathogens and their cumulative/combined synergistic effects we are at a crucial crossroads between a future of increased forest protection or business as usual. The Mendocino Trail Stewards have called for a moratorium on logging in JDSF in order to have a good-faith discussion about how the future of JDSF is managed. I fully support this and also think it is critical to have this time for experts to review the state-of-the-science regarding climate change, forest health, and best practices. As such, I wholeheartedly endorse and support the creation of the 20,000 acre forest reserve proposed by the Mendociono Trail Stewards, as western Jackson is one of the few remaining places in Mendocino County that has been minimally affected by logging over the last quarter century. That said, I believe we need to go

even further than just protecting only the western one-third of Jackson State Forest and aim to protect all JDSF under the California 30x30 executive order. Again, Jackson as GAP3 lands represents low hanging fruit in the State's effort to conserve and protect 30% of California lands

by 2030 and further, as a State-owned forest is a public resource and should therefore be protected for public enjoyment and not logged for the benefit of a single agency. Using the metrics provided by Battles et al., 2014, appendix III, it is estimated that the impending CAL FIRE THPs slated for western JDSF covering ~3471 acres (~5.4 sq mi) of pristine second growth Redwood forest will result in approximately 1.7 Mt CO2e net emissions to the atmosphere. This includes CO2 stored in durable wood products and excludes direct CO2 emissions from tractors, skidders, logging trucks, and mill emissions and thus is conservatively equivalent to burning ~187 million pounds of coal. Indeed, timber harvest is one of the largest emitters of GHGs (Williams et al., 2016; Harris et al., 2016; Berner et al., 2017; Erb et al., 2018; Law et al., 2018) while simultaneously increasing wildfire risk (Dicus, 2003; Weatherspoon, 1996; Cruz et al., 2014; Thompson et al., 2007; Bradley et al., 2016; Zald and Dunn, 2018; Banerjee, 2020). Wildfires are not only detrimental to human health, both directly and indirectly (Burke et al., 2021), but they can also be detrimental to wildlife health as well, as the smoke from the 2020 wildfires in the western US has now been linked to a large die-off of multiple avian species (Yang et al., 2021). It's past time for California policy to fall in line with the state-of-the-science: our forests need to be protected to effectively mitigate climate change (Harmon et al., 1990; Keith et al., 2009; Pan et al., 2011; Stephenson et al., 2014; Williams et al., 2016; Harris et al., 2016; Grassi et al., 2017; Law et al., 2018; Lutz et al., 2018; Erb et al., 2018; Moomaw et al, 2019; Lewis et al., 2019; Dinerstein et al., 2019; Dinerstein et al., 2020; Simmonds et al., 2021), and to reflect and fall in line with public opinion (Mendocino, County, 2021; California, 2021).

This is a call to action, to stand up for our environment while we can still turn the ship, before it's too late; because once our terrestrial forests begin to collapse, just as our marine forests have, recovering them will be little more than a fantasy. At that point, if our forests collapse, and there are already signs that they are headed that direction, they will become a net carbon source rather than a sink, and that combined with our unabated fossil fuel emissions will be the beginning of the end of this planet as we have come to know it. It may seem like a far fetched statement, but just take a minute to think about and consider these things: 1 million species are threatened with extinction in the near future out of an estimated 7–10 million eukaryotic species on the planet (Mora et al., 2011); >75% of rivers >1,000 km long no longer flow freely along their entire course (Grill et al., 2019); live coral cover on reefs has halved in <200 years and approximately 100% of coral reefs will face long term degradation by 2050 (Frieler et al., 2013); at present, 20% of all species are in danger of extinction over the next few decades, and we are conservatively experiencing >15 times the natural background rate of species extinctions per year (Ceballos et al., 2015); by 2050, it is expected that the world

population will likely grow to over 9 billion, where it will likely continue to grow into the next century (Bradshaw and Brook, 2014); simultaneous with population growth, humanity's consumption as a fraction of Earth's regenerative capacity has grown from ~73% in 1960 to 170% in 2016 (Lin et al., 2018). There is no escaping it, as individuals, as a State, as a Country, or as a

species, we need to step up and rapidly change our course to avoid a Ghastly Future (Bradshaw et al., 2021). We can't change or control what is happening in the Amazon or in China, but we can affect change here. We can choose to be a leader and make the decisions to enact a paradigm shift toward greater environmental protection, stewardship and advocacy. It's time we offer up our forests some real protections, because very literally, our lives and our children's lives depend on it.

Respectfully,

John P. O'Brien, Ph.D.

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