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Agriculture and Natural Resources
Forest Stewardship

Forest Stewardship Education Newsletter
May 2024

Coast Redwoods

Greetings from UC ANR

Giants... aliens...prehistoric...fire resilient...top quality wood...my favorite tree... ask anyone about coast redwoods and you will receive a variety of responses, but they all include a sense of awe and respect for this most impressive western North American conifer. Yet for it's status as a stewardship participant favorite, there is a lot we don't know about coast redwoods, especially in terms of post-fire management.

Together with Katie Reidy, Post-fire Forest Resilience Program Coordinator, we decided to shine the spotlight on coast redwoods, highlighting its unique biological features; pre-and post-fire management considerations; and giving a shout out to those that spend their time emersed in the redwood forest. This newsletter is part of a week-long redwoods campaign facilitated by our Communications Specialist Grace Dean, leading up to our special coast redwoods webinar on June 12th (details below). I hope you all enjoy learning about 'my favorite tree'!

Cheers,
Kim Ingram, Forest Stewardship Education Coordinator

Germinating coast redwood cones. Photo by Brian Woodward, UC ANR

Coast redwoods store more carbon per acre than any other forest in the world.

The uniqueness of coast redwoods

Coast redwood *(Sequoia sempervirens)* are the iconic representation of the coastal forests of northern California and southern Oregon. These forests are characterized by mild, rainy winters and dry summers where the coastal influence of fog provides moisture and cooling. According to Lorimer, et al. (2009), coast redwoods are found on a variety of soil types with different textures and pH. They share forest stands with a mix of evergreen conifers such as Douglas-fir, grand fir, western hemlock, and Sitka spruce, and broadleaf species such as tanoak, madrone and California bay Laurel. Coast redwoods are a fire-adapted species with traits such as thick, fibrous bark which reduces impact to living tissue from fire, self-pruning lower branches to reduce ladder fuels, and the ability to survive very hot fires that kill their green needles by sprouting.

So, what makes coast redwoods unique? Lorimer et al (2009) write that coast redwoods:

- Are the tallest living trees on earth, dominating the upper forest canopies in which they live;
- Store more carbon per acre than any other forest in the world;
- Are shade tolerant, but redwood seedlings also grow well in open, disturbed areas;
- Have low seedling germination rates, but most regeneration is from basal sprouts;
- Have frequent ring anomalies which make it difficult to precisely date or recording long fire histories from cores, stumps or cross-sections;
- Have foliage that is highly flammable when dry, compared to other western conifers;
- Can quickly re-sprout after wildfire or other disturbances either from the base or along their trunk from epicormic buds if the disturbance is severe enough; and
- Can establish new roots from stems in response to flooding in well-drained alluvial terraces.

Additionally, coast redwoods:

- Have the greatest genetic diversity in the *Taxodiaceae family.* This family of evergreen or deciduous conifers includes coast redwoods, dawn redwoods, giant sequoias, and bald cypress;
- Can live in excess of 2000 years;
- Have no taproot but a vast network of shallow roots spreading out over large areas;
- Have a high tannin content enabling the trees to be highly resistance to fungus, diseases, and insect infestations; and
- Have wood that is very resistant to water-associated rot.

Coast redwoods are feeling the impacts of climate change via increases in fire activity, but they have mostly been spared other climate-related impacts that have impacted other California forests.

For example, the 2014-2016 drought killed 150 million conifers in the Sierra Nevada, yet coast redwoods were largely resilient. They only showed declines in growth in the very southern end of their range. However, some of the things that make coast redwoods unique could also have negative consequences when considering climate change. According to O'Hara et al (2017), two redwood traits may make them more vulnerable to climate change:

1. The uncommonness of their sexual reproduction; and
2. their long-lived nature.

These characteristics could result in slow adaptation to change. Stands on the edges of the range, such as more southern or eastern populations, are most likely to be impacted first.

Redwood burl on tree. Photo by Brian Woodward, UC ANR

Managing redwoods pre-fire/pre-disturbance

Managing a coast redwood forest, or any forest type, is guided by the landowner's goals and can range from the aesthetic (beauty), to the ecological (wildlife habitat), to the utilitarian (timber production). It is not uncommon to have a combination of these goals in different areas (units) of one's forest. Creating a balance between them and knowing what management activities to engage in and when, requires information, skills, and resources.

Many of our workshop participants talk about wanting to re-create a more natural or historic redwood stand. But what does that actually look like and how do we get there? Giusti (2007) points out that old forest stands develop as a function of time and disturbance (storms, fire, landslides, flooding and sediment deposition, etc.) and that may not always be possible or practical to replicate. In studying remanent old-growth coast redwood forests, Giusti identified some key stand characteristics including:

- Relatively low tree density with few, very large individual trees;
- Heterogeneity of tree species (for example, coast redwoods, Douglas-

fir and tanoaks in the same stand);
- A variety of tree diameters, usually tanoaks dominating the smaller size class, Douglas-firs in the moderate size class, and coast redwoods primarily in the larger size class; and
- Low number of snags (coast redwoods with trunk hollows represent some of the habitat characteristics associated with standing snags).

Since ~95% of the coast redwood range has been logged in the past, most landowners are managing young, second and third-growth forests. These stands are generally pretty dense, because redwoods sprout prolifically after harvest – you may have seen trees growing in “fairy rings” around a stump. In addition, some foresters also planted high densities of Douglas-fir in some areas, exacerbating the density problem. In these forests, mechanically thinning out smaller diameter trees can be a way to accelerate the development of some of the old-growth stand characteristics described above. Many studies have shown that reducing tree densities can free up resources so that the remaining trees can get larger, faster. In a study at Redwood National Park, Soland et al (2021), found that thinning can elicit substantial and persistent increases in the growth of the remaining trees over many years. This is due to the reallocation of resources such as water and nutrients to the remaining trees.

Thinning can have understory effects as well by providing light to the forest floor and promoting more herbaceous cover with is beneficial to pollinators, rodents and other wildlife. As the thinned trees grow over time, the canopy will close, shading the forest floor and leading to more shrub species in the understory. In addition to accelerating the development of old-growth characteristics, forthcoming research also suggests that lower density stands were less likely to burn severely in the 2020 wildfires.

When thinning, landowners should also remember that complex, multi-age stands have a mixture of tree clumps, open patches and random placement of trees in the largest age-classes. In addition, most large trees in old-growth forests have complex crowns, where the top has been damaged and regrown many times (called “reiterations”). Sillett et al. (2018) found that topping and pruning can emulate disturbance to the crown and accelerate the development of these old growth characteristics.

Similar to other forests, prescribed fire is beneficial in reducing surface fuels, but often doesn’t thin out the trees enough. Forthcoming research from the old growth stands in Big Basin State Park showed that areas with a history of prescribed fire retained more live canopy cover after the 2020 CZU fire than areas that had no treatment.

Lastly, landowners whose properties support black bears, should be aware that black bears are attracted to the cambium layer of vigorous, young redwoods. For more on this, please see the Forest Stewardship April 2024 Newsletter.

Redwood stump. Photo by Brian Woodard, UC ANR

Healthy Forests: Coastal Redwood	UC ANR: Coast Redwood (Sequoia sempervirens)	Recovering from Wildfire: A guide for CA landowners

Sprouting Redwood Trees Post-Fire

Photo by Katie Reidy, UCANR

Post-Fire Forest Resilience Workshop:
UC ANR's Post-Fire Forest Resilience workshops occur periodically throughout the state, in regions that have been affected by wildfire. Resource professionals and specialists are invited to discuss, share findings, and begin to understand best strategies to manage our forest for the future. After meeting once a week, for 7 weeks on Zoom, the class culminates at an in-person field trip to a field site within a burn footprint.

The information shared below, is compiled from presentations, discussions and research that was shared at the recent 2024 Santa Cruz Post-Fire Resilience workshop.

Understanding how fire impacts Coastal Redwoods:
The term *Fire Regime* refers to an ecosystem's historic response to naturally occurring or intentionally ignited fire.

Factors that affect the fire regime include:
- The timeline or frequency of fire
- The area burned or size impacted
- Fire severity on the ecological conditions of the landscape, often associated with mortality or trees lost
- Seasonality
- The way fire moves throughout the landscape

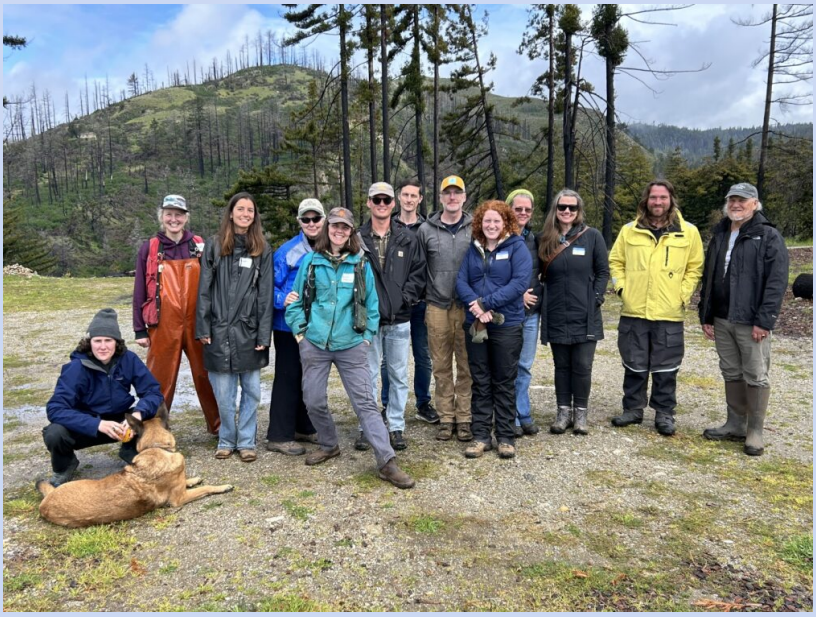
The Coastal Redwoods have a variable fire regime, based on their adaptations which demonstrate both resistance to low and moderate severity fire, and resilience to high severity fire. Despite the high moisture content found in these forests, fire history studies indicate that fire was frequent in these systems (Varner, et al. 2016).

Post-Fire Management Considerations:
Conifer species found in Sierra Nevada ecosystems, such as Douglas-fir or ponderosa pine, rely on a seed source to reproduce. Mike Duffy a Registered Professional Forester for Redwood Empire Sawmills in Santa Cruz County described his experience managing redwoods, after the 2020 CZU fire. "The sprouts are tied to the root system of the trees that were salvaged and cut, the resources of a 50ft tree are now available in a 10ft sprout. They are showing a lot of growth very quickly which are predicted to continue in the next 10-15 years."

The natural regeneration may perpetuate a dense forest structure with**high fuel loads and may influence the severity of wildfire reburns.** After large fires like the 2020 CZU fire, managers are discussing ways to promote old growth stand characteristics for the future, such as thinning when appropriate and introducing prescribed fire in the future.

With freshly burned landscapes, we can restore the pre-colonial ecology of these forests, by encouraging more open spaces with coastal grasslands, as well as Douglas-fir and tan oak forests. Some managers are emphasizing that we should begin to focus on the quality versus the quantity of trees.

Now that our communities have experienced significant fire, as we begin to reforest, the question that should be consistently asked is: What will fire do in this landscape in the future? What are our goals and objectives for the future?



Post-Fire Forest Resilience Workshop Participants Santa Cruz CoHort, March 2024

In our experience with managing second growth redwood, wildfire damage significantly impacts the trees when fire intensity is moderate to high.

Q&A with John Anderson, Director of Forest Policy, Humboldt and Mendocino Redwood Companies

Q. We know that redwoods have an overall strong timber market value. For small forest landowners needing to do some forest management, what are some key points they should consider when considering the harvesting of their redwoods?
A: When harvesting redwoods, or any species for that matter, it is important for timberland owners to communicate their goals for their forest. When commercializing redwoods, the timberland owner needs to hire a Registered Professional Forest to prepare a Timber Harvesting Plan. The goals need to be shared with the RPF. The THP is an expensive document but there may be other permit options that are significantly cheaper. The RPF can explain those options to the timberland owner.

The timberland owner should also have a discussion with their RPF about market conditions that impact, positively or negatively, the value of their timber. Lumber and log prices are cyclical so timing the sale of the timber during favorable pricing conditions will determine how much profit is returned from the timber sale.

Q: Do you think redwoods will continue to hold their value?
A: I do. Relative to the forested regions of this country, redwood grows in a limited area along the northern California coast and north into southern Oregon. Therefore, the redwood lumber market is a niche market but one that produces a product that is highly prized for it qualities.

Redwood contains tannins which make it naturally resistant to rot, decay, and insect infestation. Its reddish color makes it an attractive choice for interior and exterior applications. Redwood forests are sustainably managed under the most stringent forest practice rules in the country. On top of these regulations, a significant portion of the redwood region is certified by third party global certification parties that certify redwood lumber is being sourced from well managed forests.

Q: What differences might there be between harvesting 'green' redwoods vs. those impacted by wildfire?
A: Depending on the severity of the fire, wildfire damage to redwood trees can be minimal or it could be significant with damage to the cambium and heartwood of the redwood tree.

In our experience with managing second growth redwood, wildfire damage significantly impacts the trees when fire intensity is moderate to high. Second growth redwood trees grow in rings around an old growth stump from a harvest many decades ago. The stump is usually in some form of decay and limbs have accumulated around the old growth stump over time. This creates a significant amount of fuel in the center of the redwood rings which many times causes significant damage to the second growth trees.

Harvesting green redwood trees means more value as there is less defect compared to burned redwood trees. Green redwood trees average 8-10% defect whereas burned redwood trees can have 20% or more defect in the logs produced by them.

Q: What are some key points landowners should consider when considering salvage harvesting of their redwoods?
A: I will go back to the goals of the timberland owner. If the goal does not involve commercial timber harvesting, then one option is to leave the redwoods standing. I say this because redwoods are very resilient to wildfire. All needles can be burned off the tree, but it will resprout within a year.

If the goal is to manage the forest for sustainable timber production, an evaluation of the extent of the damage to the redwood trees should be conducted. If the damage is significant, a timberland owner might want to salvage the trees to recover the value of the tree then grow a stand of trees free of defect. This is easy in redwood as the redwood stumps from harvested trees will resprout to form new trees within a few months.

Q: Mendocino Redwoods forestland was impacted by wildfire in 2008. What steps did the company take post-fire to address their impacted forests?
A: Immediately following the fire we created guidelines for our foresters to use when making a decision whether to conduct a salvage harvest or to retain the trees. The cambiums of redwood trees were inspected for burn damage. If damage was found throughout a stand of redwoods then the stand was salvaged. We also salvaged redwoods where the root system had been impacted resulting in stability issues, when all foliage was burned off of the tree, and when bark had been completely burned off of the base of the redwood trees.

The decision regarding salvage of burned Douglas fir was different. The damage was usually more significant as they have thinner bark than redwood trees. But the largest consideration was trying to remove the Douglas fir trees before bark beetles degraded their value even further. It was a race against time as the beetles did show up within a year.

Q: What post-fire lessons can small forest landowners learn from

Mendocino Redwoods and possibly implement on their own properties if impacted by wildfire?
A: As soon as the smoke clears and it is safe to enter the burned area, an assessment needs to be conducted as to the intensity of the fire. With that knowledge, the goals of the timberland owner need to be considered. They may change after an intense wildfire event.

Consultation with an RPF is highly encouraged (and required if a timber harvest is to be conducted). The RPF can inform the timberland owner about permitting options which streamline the review process and about permits that are cheaper to prepare. For instance, an expensive THP is not required to salvage conifers after a wildfire event. An “Emergency Notice” can be prepared in-lieu of a THP. The RPF can also advise on grant funding opportunities for those who have losses due to wildfire for reforestation and other purposes.

2008 Lightning Fire – Mendocino Redwood Company. Photo provided by John Anderson.

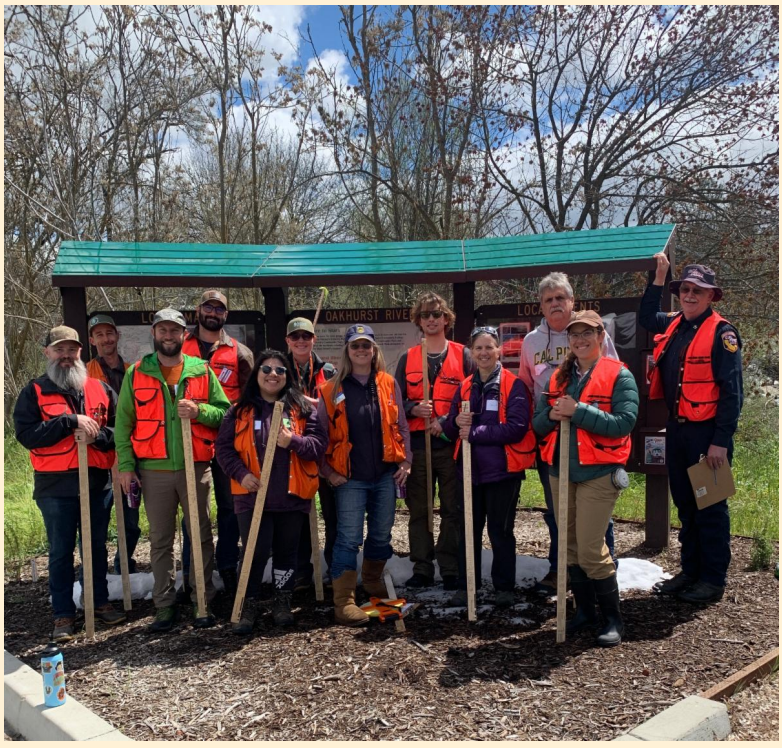
Same location as previous photograph but taken in 2011. Green trees are redwood, dead

ones are Douglas fir. Photo provided by John Anderson.

Jackson State Demonstration Forest	Save the Redwoods League	PBS Outside Beyond the Lens: CA Northcoast Redwoods

Other Stewardship items of note...

- The Forest Stewardship Education Program has extended funding to continue the program through June 30, 2025. This means you still have time for your initial site visit with an RPF, Burn Boss or Certified Range Manager. The new deadline for all site visits is May 1, 2025. No matter which workshop you participated in (even back in 2020!), if you completed the workshop, you are eligible. You DO NOT need to complete your forest management plan before your site visit, just having your management goals thought out is good enough! Need to make up a session in order to qualify for your free site visit, we can arrange that. Contact Kim Ingram at kcingram@ucanr.edu for more details.
- Check out the new stories on ourForest Stewardship Story Map! Read what your fellow forest landowners and workshop participants are up to. Connect with your local natural resource professionals. Interested in having your story added to our map? Please contact our Forest Stewardship Communicaitons Specialist Grace Dean at gndean@ucanr.edu



Fresno-Madera Co-hort participants during the April 26th field day. Photo by Kim Ingram

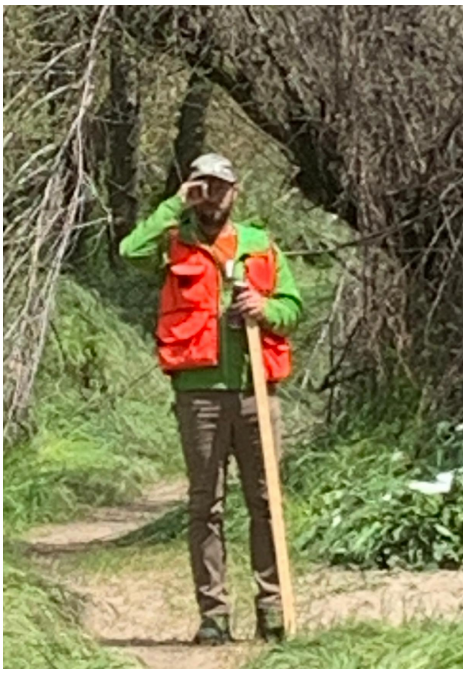
For more information on the workshops, and to share with a friend, please visit:

Stewardship:

Upcoming Forest Stewardship and Post-Fire Forest Resilience Workshops and Field Days:

http://ucanr.edu/forestryworskhopregistration

Post-fire:
http://ucanr.edu/post-fireworkshops



- Forest Stewardship Workshop Series, Lake Tahoe Basin Co-hort beginning May 14th - July 16th (June 8th field day)
- CA Tree School June 1st at the El Dorado Center in Placerville. Register here!
- Coast Redwoods Pre- and Post-fire Management Webinar, June 12th. Register here!
- Post-fire Forest Resilience Workshop, El Dorado beginning July 16th - August 6th (August 3rd field day).