

Climate change, drought and wildfire: The application of climate-informed and user-driven responses for postfire reforestation in California

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The USDA California Climate Hub Program



We **develop** and deliver science-based, region-specific **information** and **technologies** to enable climate-informed ***decision-making...***



Jennifer Smith,
Asst. Specialist



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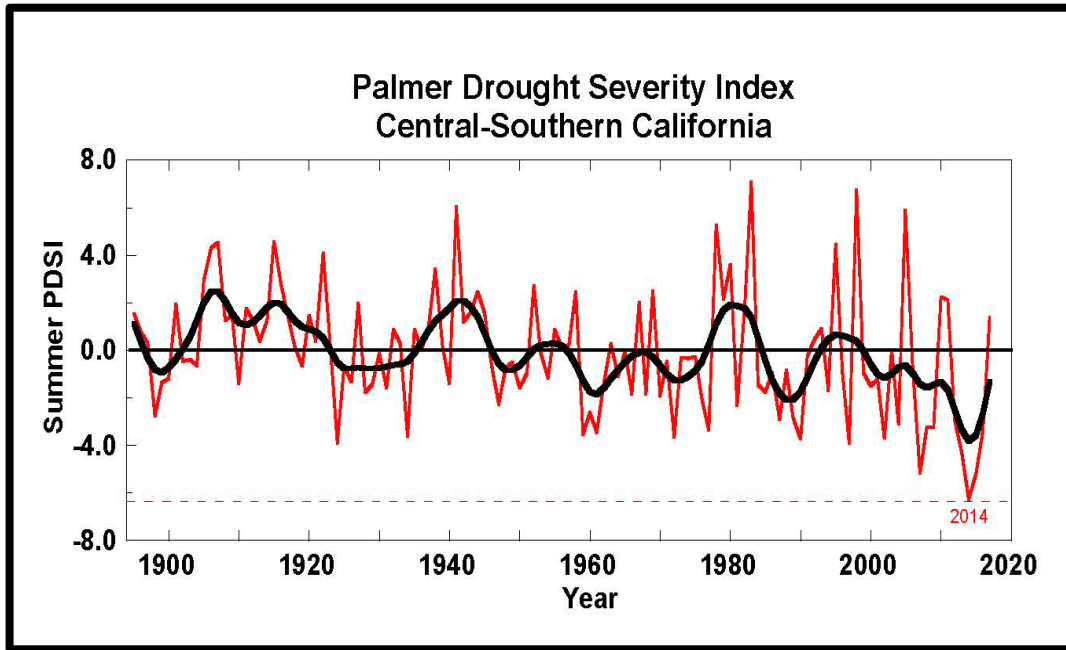
Steven Ostoja, Director

Outline – Climate-informed Reforestation

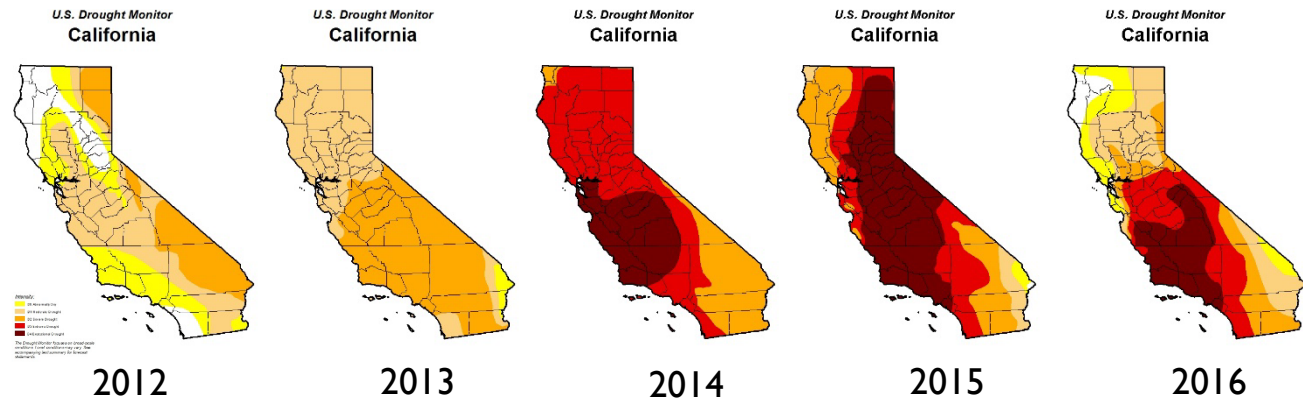
- Backstory and Need
- Working with Managers and Scientists
 - Reforestation Summit
 - Science and Management Dialog
- Responses and Case Studies
 - Reforestation for Resilience
 - Climate-wise Reforestation Toolkit
 - A framework for seed collection
- Next steps and looking ahead
 - Reforestation Dashboard



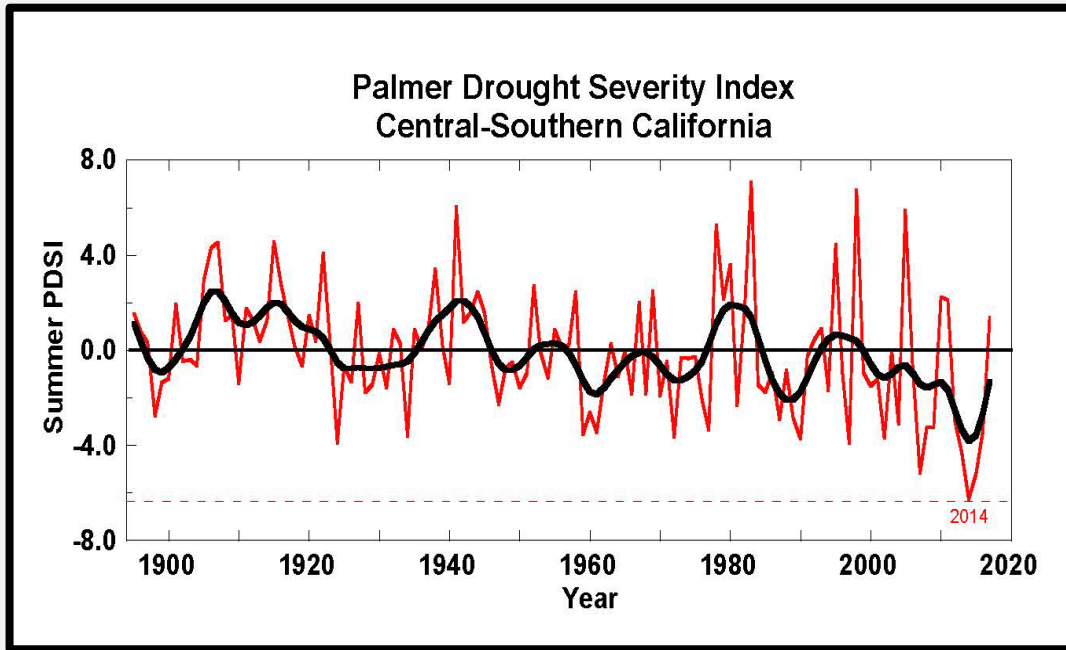
Megadrought



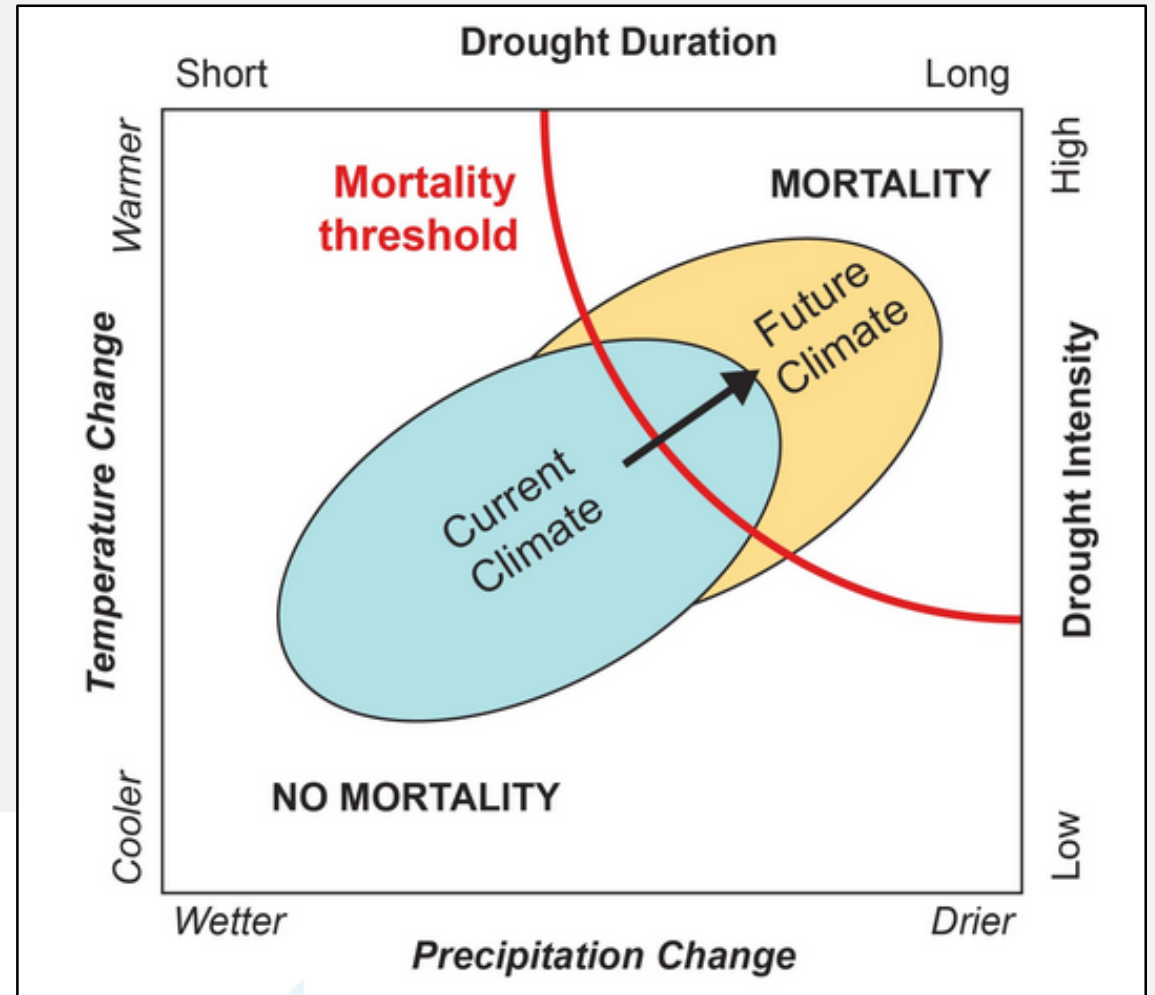
Source: Griffin and Anchukaitis 2014



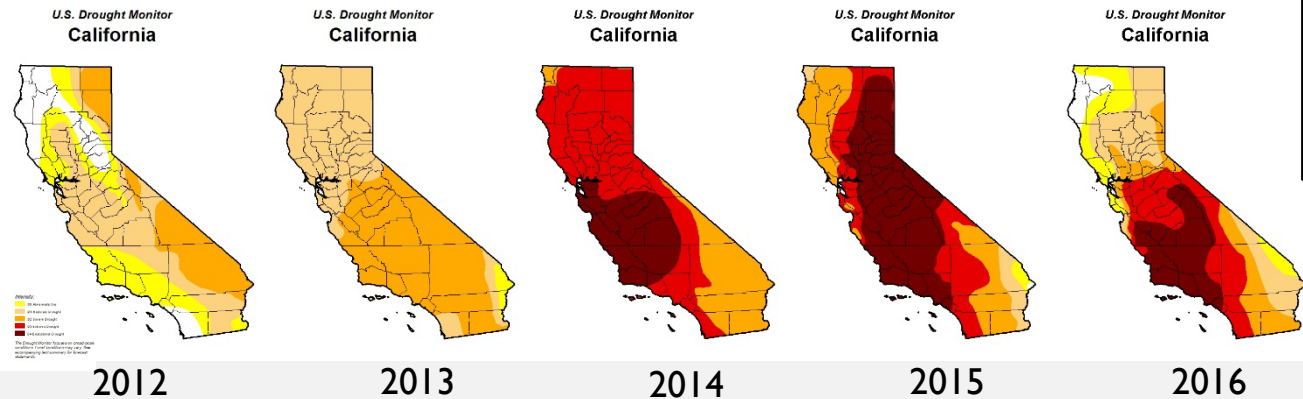
Megadrought



Source: Griffin and Anchukaitis 2014



Allen and others 2010 Forest Ecology and Management

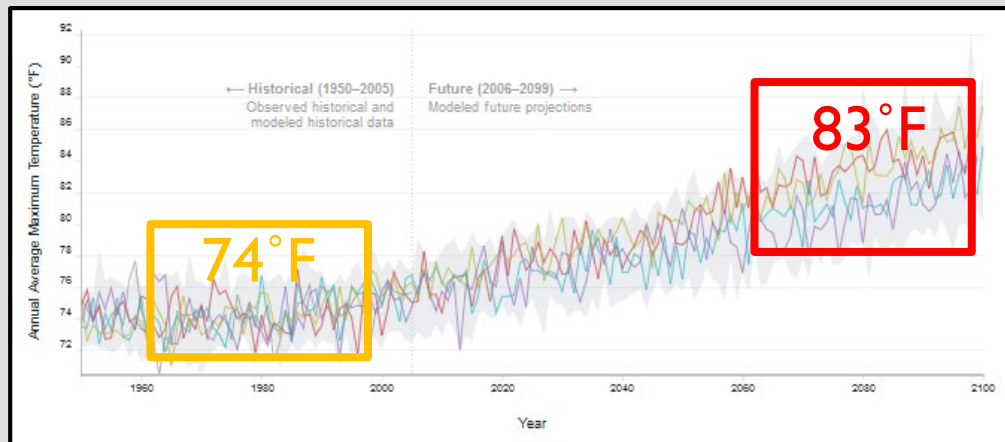


WARMER TEMPS AND DROUGHT = RISK FOR TREES

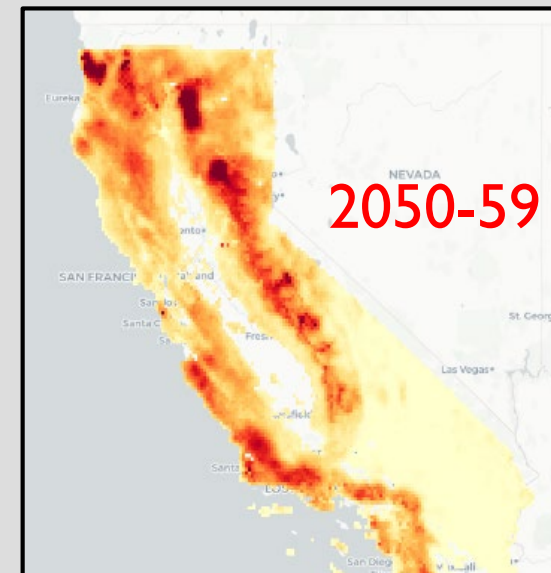
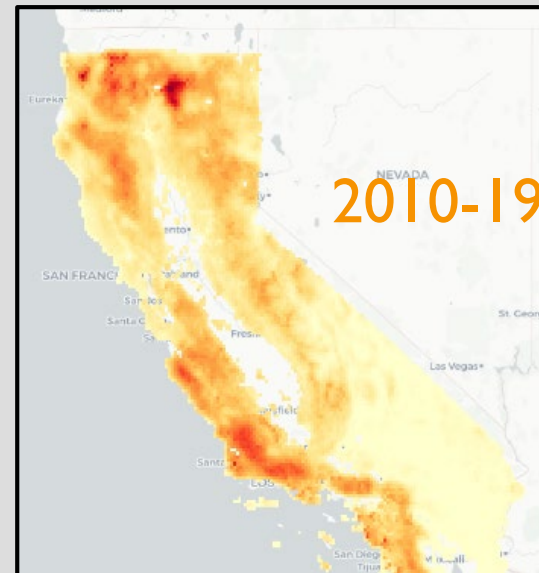


Credit: USDA-FS

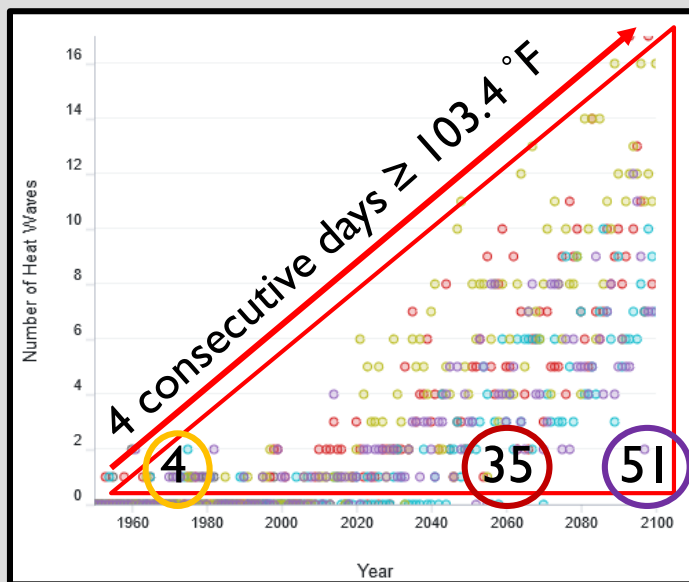
Average Annual Temperature



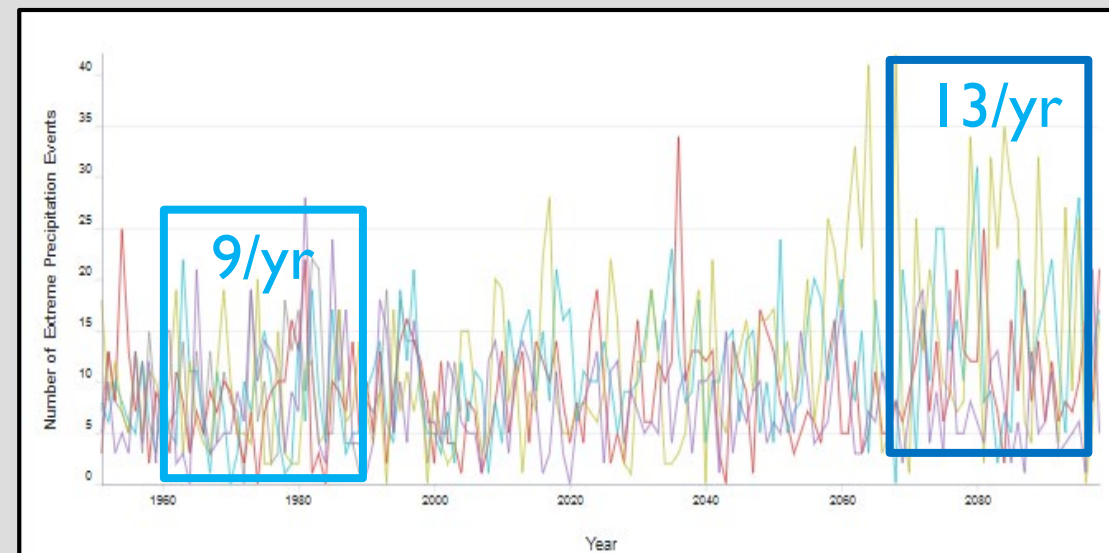
Average Area Burned Wildfire



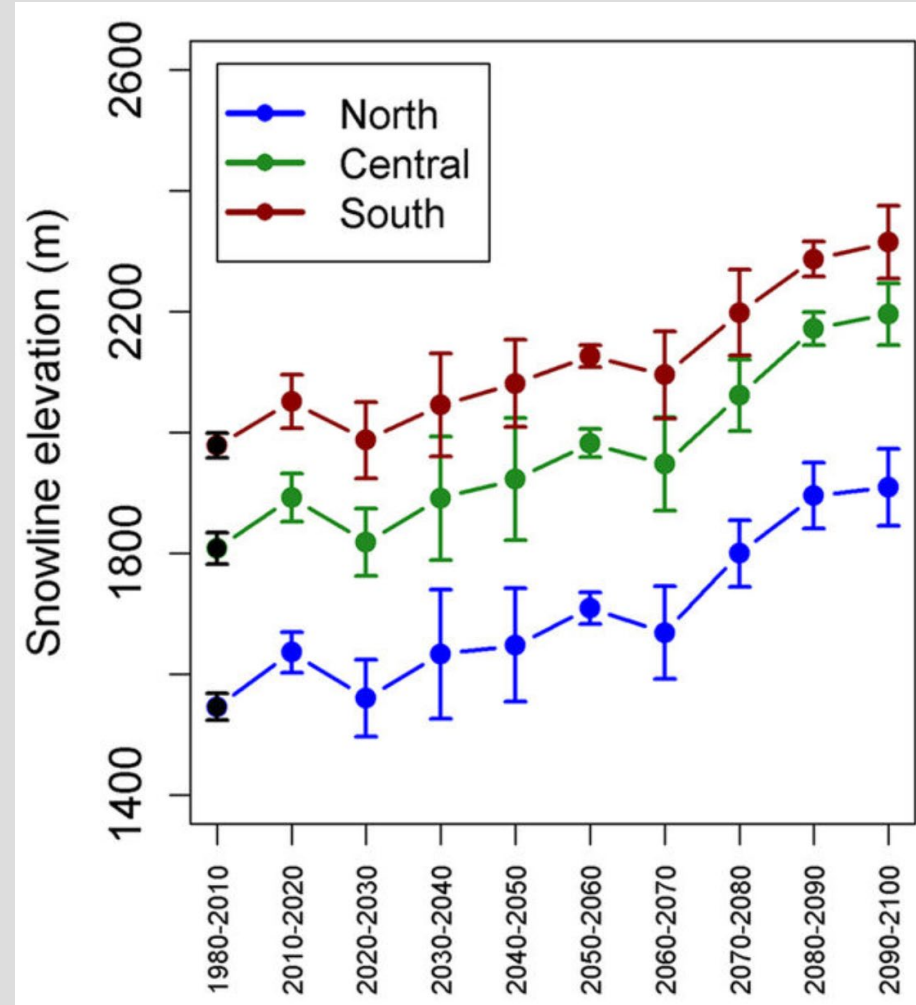
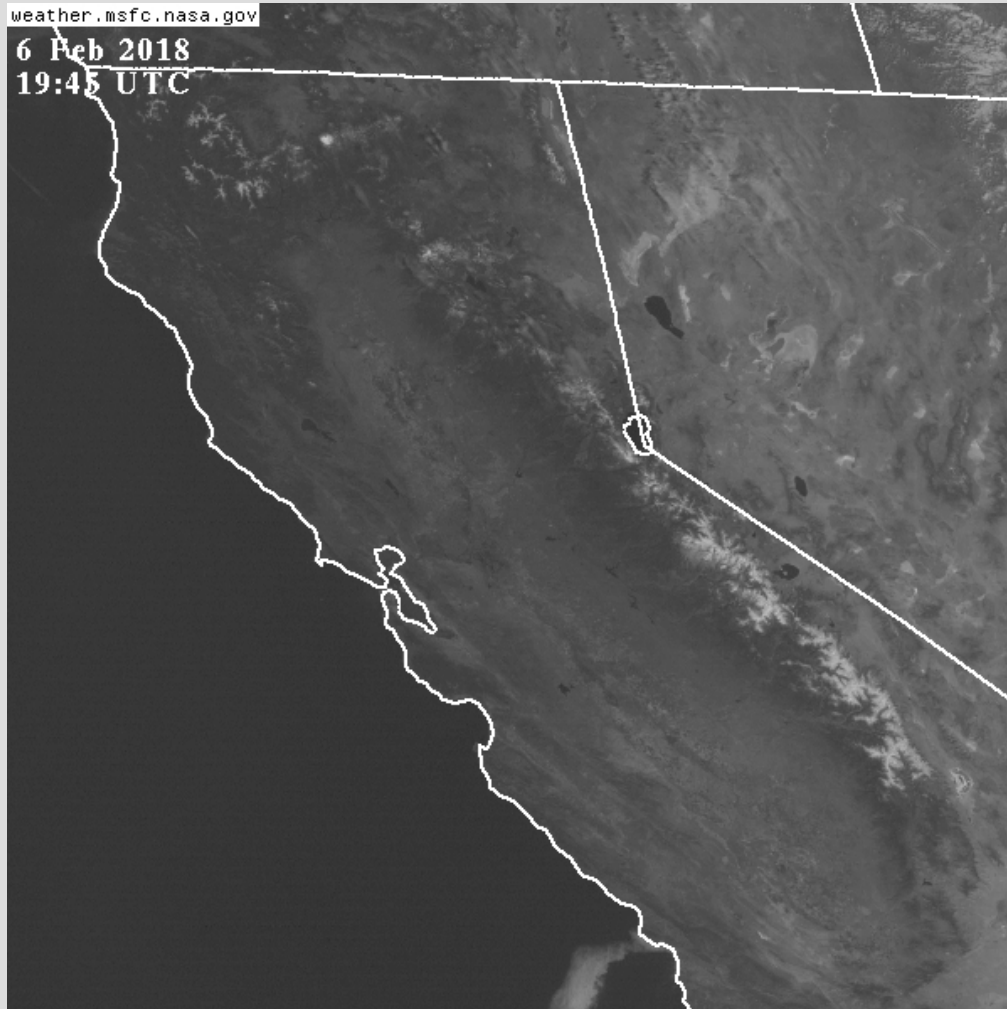
Extreme Heat Events



Extreme Precipitation Events



SNOW IS MOVING UPSLOPE



↓ Snow Cover
by 20–84%

Climate Change

Higher temperatures, more severe and longer droughts

Fire exclusion

Ozone, pollution

Bark beetles, pests

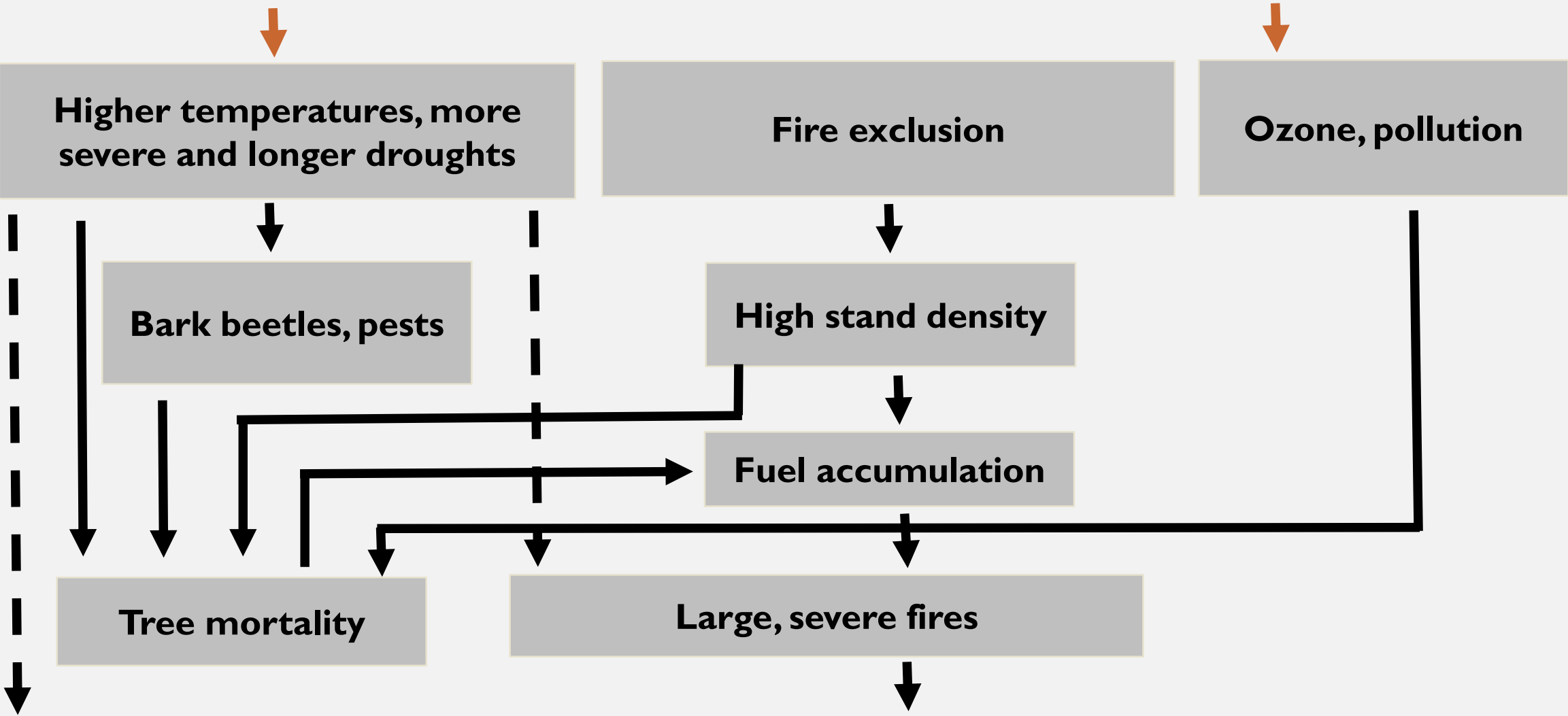
High stand density

Fuel accumulation

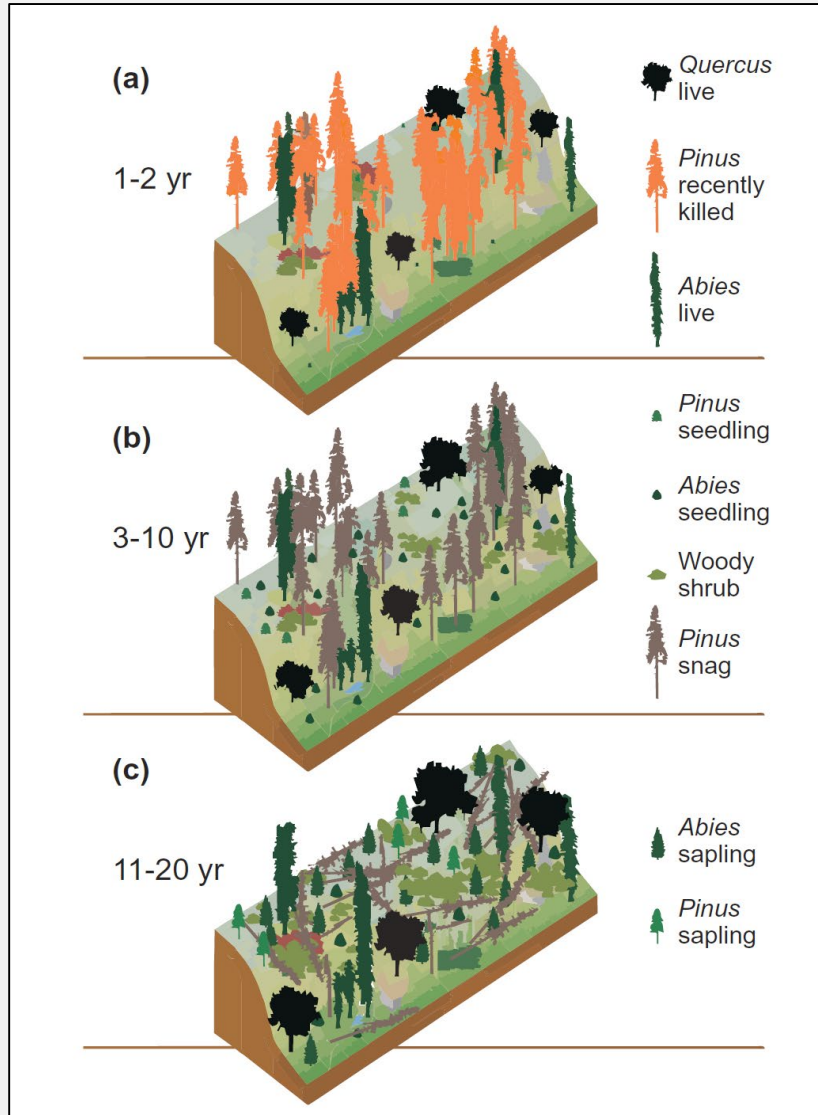
Tree mortality

Large, severe fires

Changes in species composition (incl. non-native species)



MASS FIRES



CAMP FIRE

- 153,336 ac
- Single most destructive and deadly fire in state history
- ~mix of private and federal land



Credit: NPR

CREEK FIRE

- 379,895 ac
- Single *incident* largest fire in state history
- Mainly SNF
- ~Half of burned area at high/extreme fire intensity



SEQUOIA COMPLEX FIRE

- 170,384 ac.
- Also heavy tree mortality area
- High severity burned Giant Sequoias

The Urgency

- Time sensitive
- On top of existing reforestation backlog
- Larger areas with cover loss
- Climate change forcing type change
- Risk of cascading effects







1a. Reforestation Dialogs

DIALOGUES AGENDA Wednesday, November 28th		
9:00 AM – 9:30 AM	Welcome, Introductions, and Dialogue Objectives Chris Fischer, Deputy Director State and Private Forestry, USFS Steven Ostiga, Director, USDA California Climate Hub	Banning (N117)
9:30 AM – 10:30 AM	Session 1: A "Day in the Life" of a Forest Silviculturist (Moderators: Steve Ostiga, Director, USDA California Climate Hub and Ramiro Rojas, Assistant Regional Silviculturist, USFS) Speakers: Teri Banks, Tahoe National Forest (NF), Marty Ryan, Plumas NF, Dana Walsh, El Dorado NF	Banning (N117)
10:30 AM – 11:30 AM	Session 2: Factors that Promote Increased Levels of Regeneration Speaker: Phil van Mantgem, Research Ecologist, USGS	
11:30 AM – 1:00 PM	Lunch	
1:00 PM – 2:00 PM	Session 3: A Decision Support Tool for Increasing Success in Post-Tree Mortality Situations Speakers: Marc Meyer, Ecologist, USFS and Zack Steel, Ecologist, USFS	
2:00 PM – 3:00 PM	Session 4: Patterns of Reforestation Success & Failure in Different Environments Speakers: Andrew Latimer, Professor of Plant Ecology, UC Davis and Young, Postdoctoral Forest Ecologist, UC Davis	
3:00 PM – 3:15 PM	Break	
3:15 PM – 3:30 PM	Frame Next Two Sessions & Break into Groups Facilitator: Chris Fischer, Deputy Director State & Private Forestry, USFS	
3:30 PM – 4:15 PM	Session 5A: Young Stand Management – Fuels & Vegetation Moderators: Dave Bakke, Regional Pesticide Specialist, USFS and Tompkins, Forest Silviculturist, USFS Session 5B: Planting Location Prioritization Moderators: Ramiro Rojas, Assistant Regional Silviculturist, USFS, Warren, Ecologist, USFS Session 5C: Considerations around Plant Material and Seedling Stock Types Moderators: Diana Haase, Western Nursery Specialist, USFS and Research Geneticist, USFS Pacific Southwest Research Station	
4:15 PM – 4:45 PM	Session Summaries/Report Outs	
4:45 PM – 5:00 PM	Wrap Up and Closing Discussion	

**Forest Science and Manager Dialogues:
Developing Reforestation Tools for Silviculturists**

Wednesday, November 28th, 2018

[USFS Wildland Fire Training & Conference Center](#)
Banning Room (N117)

Summary: Scientist-manager dialogues designed to exchange information around the needs, concerns, and time-relevant decisions that silviculturists interface with when prioritizing, planning, and implementing reforestation projects. With a focused understanding of the needs and decisions that forest managers make, scientists can begin to better understand how their investments and outputs can be better designed to meet those interests. This "by invitation" dialogue event will more effectively link the science-manager interface with a focus on investments in reforesting California's forests in the context of climate change, large fires, and tree die-off events.



1b. Reforestation Science Summit

Forest Ecology and Management 432 (2019) 209–224

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Tamm Review: Reforestation for resilience in dry western U.S. forests

Malcolm P. North^{a,*}, Jens T. Stevens^{b,c}, David F. Greene^d, Michelle Coppoletta^e, Eric F. Knapp^f, Andrew M. Latimer^g, Christina M. Restaino^h, Ryan E. Tompkinsⁱ, Kevin R. Welch^j, Rob A. York^k, Derek J.N. Young^l, Jodi N. Axelson^m, Tom N. Buckleyⁿ, Becky L. Estes^o, Rachel N. Hager^p, Jonathan W. Long^q, Marc D. Meyer^r, Steven M. Ostojia^s, Hugh D. Safford^{t,u}, Kristen L. Shive^v, Carmen L. Tubbesing^w, Heather Vice^x, Dana Walsh^y, Chhaya M. Werner^z, Peter Wyrsh^{aa}

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^o Department of Environmental Science and Policy, University of California, Davis, CA 95616, United States
^p USDA Forest Service, Humboldt NF, Government, CA 96034, United States

ARTICLE INFO

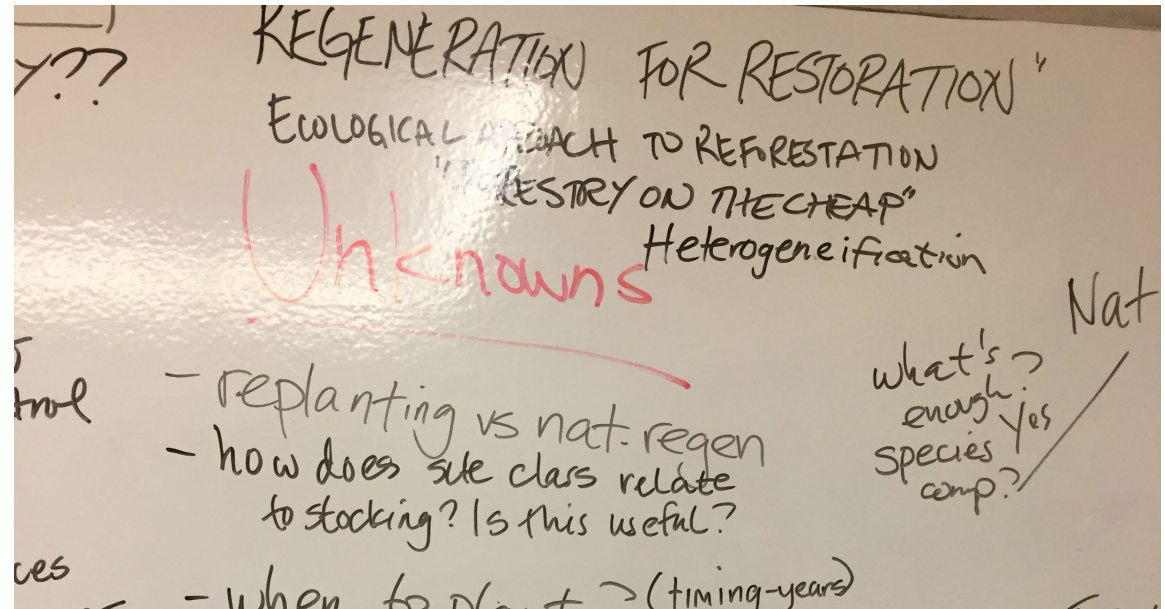
Keywords: Climate change; Drought; Fire; Spatial heterogeneity; Tree mortality; Tree regeneration; Young plantations

ABSTRACT

The increasing frequency and severity of fire and drought events have negatively impacted the capacity and success of reforestation efforts in many dry, western U.S. forests. Challenges to reforestation include the cost and safety concerns of replanting large areas of standing dead trees, and high seedling and sapling mortality rates due to water stress, competing vegetation, and repeat fires that burn young plantations. Standard reforestation practices have emphasized establishing dense conifer cover with gridded planting, sometimes called ‘pines in lines’, followed by slash control and pre-commercial thinning. Resources for such intensive management are increasingly limited, reducing the capacity for young plantations to develop early resilience to fire and drought. This paper summarizes recent research on the conditions under which current standard reforestation practices in the western U.S. may need adjustment, and suggests how these practices might be modified to improve their success. In particular we examine where and when plantations with regular tree spacing elevate the risk of future mortality, and how planting density, spatial arrangement, and species composition might be modified to increase seedling and sapling survival through recurring drought and fire events. Within large areas of contiguous mortality, we suggest a ‘three zone’ approach to reforestation following a major disturbance that includes: (a) working with natural recruitment within a peripheral zone near live tree seed sources; (b) in a second zone, beyond effective seed dispersal range but in accessible areas, planting a combination of clustered and regularly spaced seedlings that varies with microsite water availability and potential fire behavior; and (c) in a final zone defined by remote, steep terrain that in practice limits reforestation efforts to the establishment of founder stands. We also emphasize the early use of prescribed fire to build resilience in developing stands subject to increasingly common wildfires and drought events. Finally, we highlight limits to our current understanding of how young stands may respond and develop under these proposed planting and silvicultural practices, and identify areas where new research could help refine them.

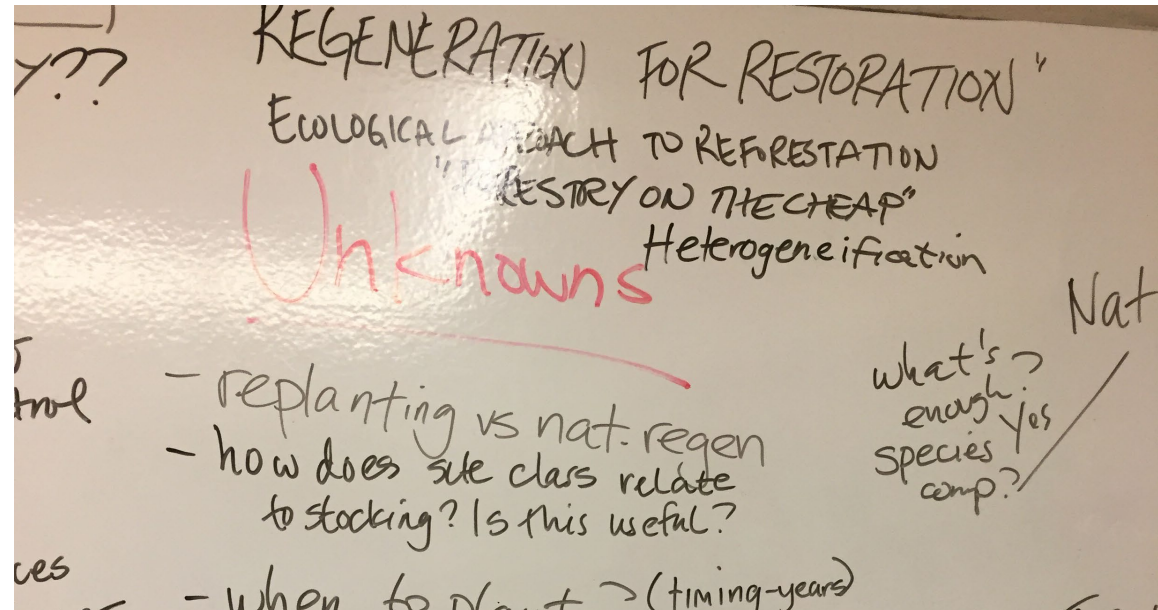
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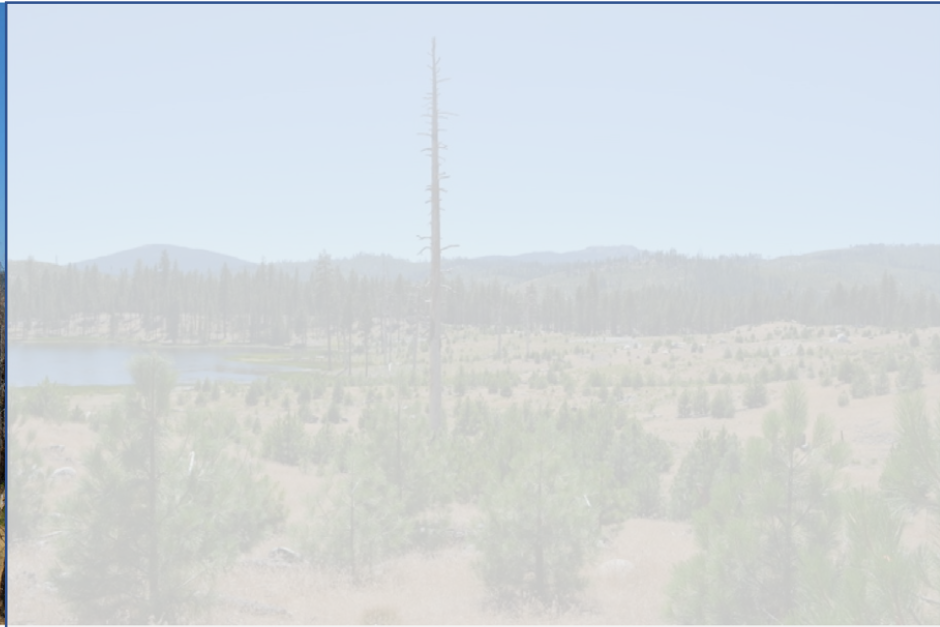
Reforestation Science Summit

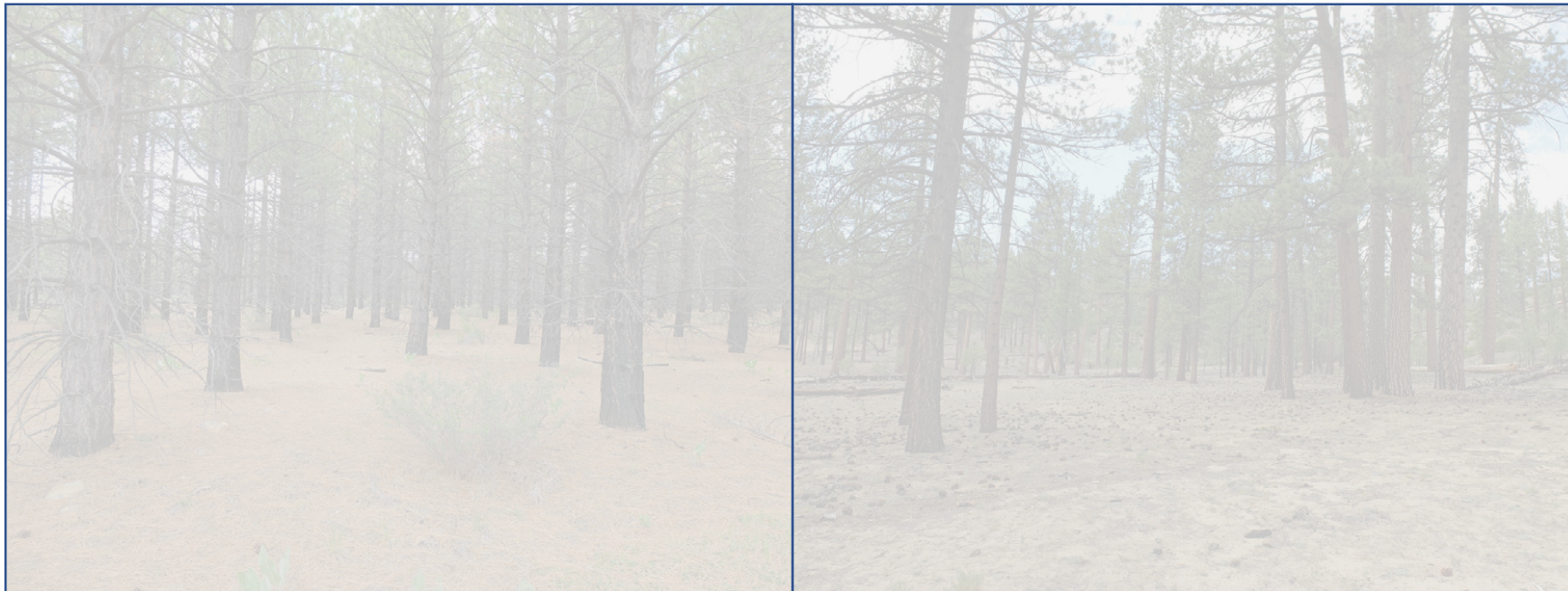
- Seed Zonation
- Density and Arrangement
- Species Composition
- Rx Fire in Young Stands
- Future Site Suitability



A Three Zone Approach









North et al. 2019 Forest Ecology and Management



North et al. 2019 Forest Ecology and Management

2. Climate-wise Reforestation Toolkit

Decision Support toolkit

Reforestation Prioritization Tool

Post-drought Stand Condition Tool

Best Management Practices

Post-Mortality Reforestation Prioritization Tool

Step 1: Select area of interest

Step 2: Select reforestation need threshold:

Mortality Threshold (% loss)

10 50 100

Step 3: Select mechanical constraint scenario:

Moderate constraints

Fewer constraints

Step 4: Select data layer weights:

Drought Risk (CWD)

-1 0

High-severity Fire Core

0 1

Wildland-Urban Interface

0 1

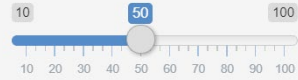
Leaflet | Tiles © Esri — Esri, DeLorme, NAVTEQ, TomTom, Intermap, iPC, USGS, FAO, NPS, NRCAN, GeoBase, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

Source: USDA California Climate Hub Website

Post-Mortality Reforestation Prioritization Tool

Step 2: Select reforestation need threshold:

Mortality Threshold (% loss)

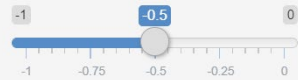


Step 3: Select mechanical constraint scenario:

- Moderate constraints
- Fewer constraints

Step 4: Select data layer weights:

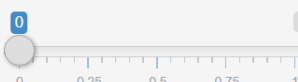
Drought Risk (CWD)



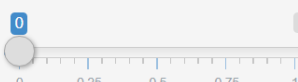
High-severity Fire Core



Wildland-Urban Interface



Recreation Areas

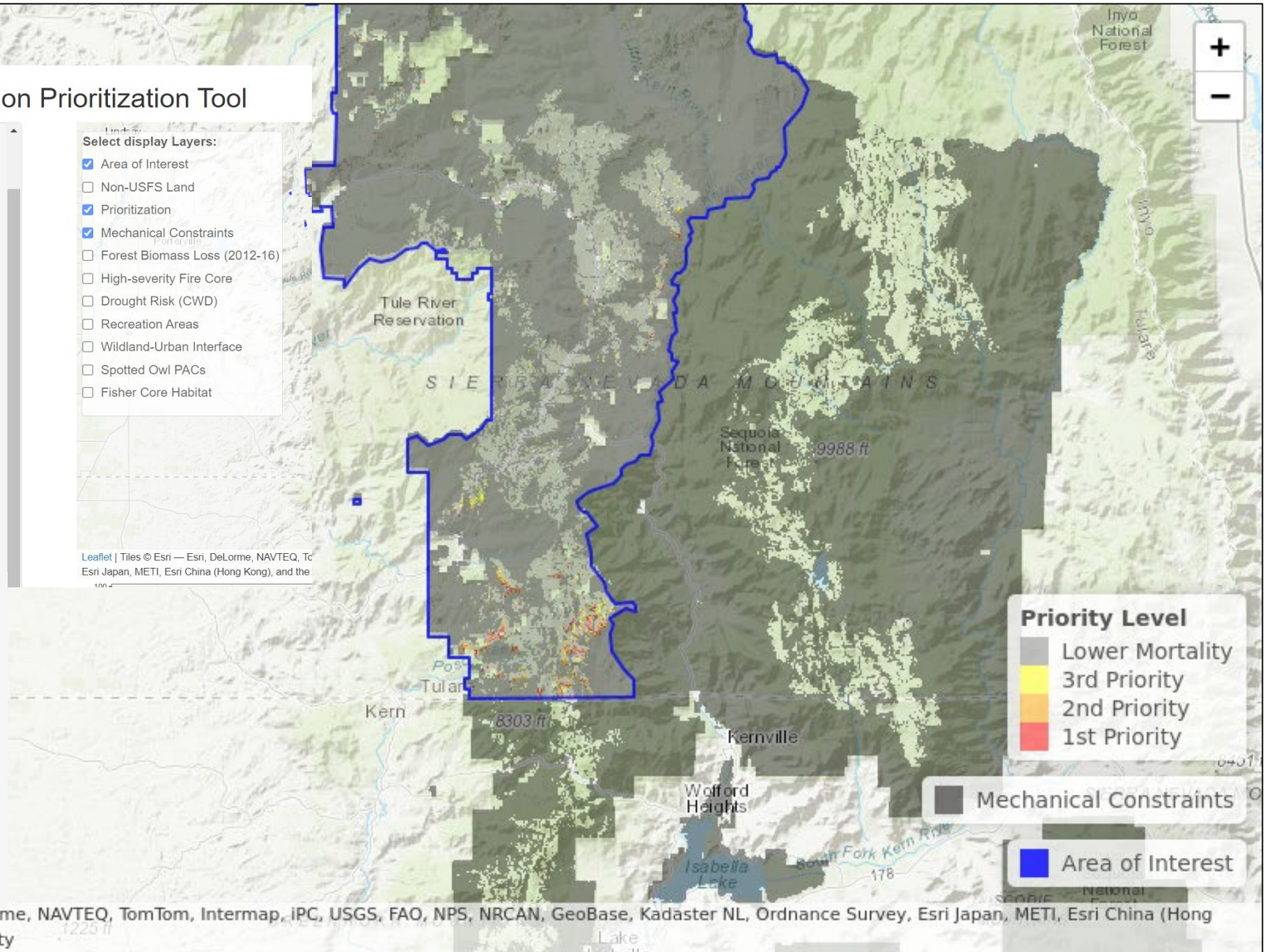


Spotted Owl PACs

Select display Layers:

- Area of Interest
- Non-USFS Land
- Prioritization
- Mechanical Constraints
- Forest Biomass Loss (2012-16)
- High-severity Fire Core
- Drought Risk (CWD)
- Recreation Areas
- Wildland-Urban Interface
- Spotted Owl PACs
- Fisher Core Habitat

Leaflet | Tiles © Esri — Esri, DeLorme, NAVTEQ, TomTom, Intermap, iPC, USGS, FAO, NPS, NRCAN, GeoBase, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community



Climate-wise decision support tool

Reforestation Resources

3. Forest Seed Collection

Forest cover decreases annually

Seed and seedling resources in short and limited supply

Reserves mainly consist of few species

Seed crop years are limited

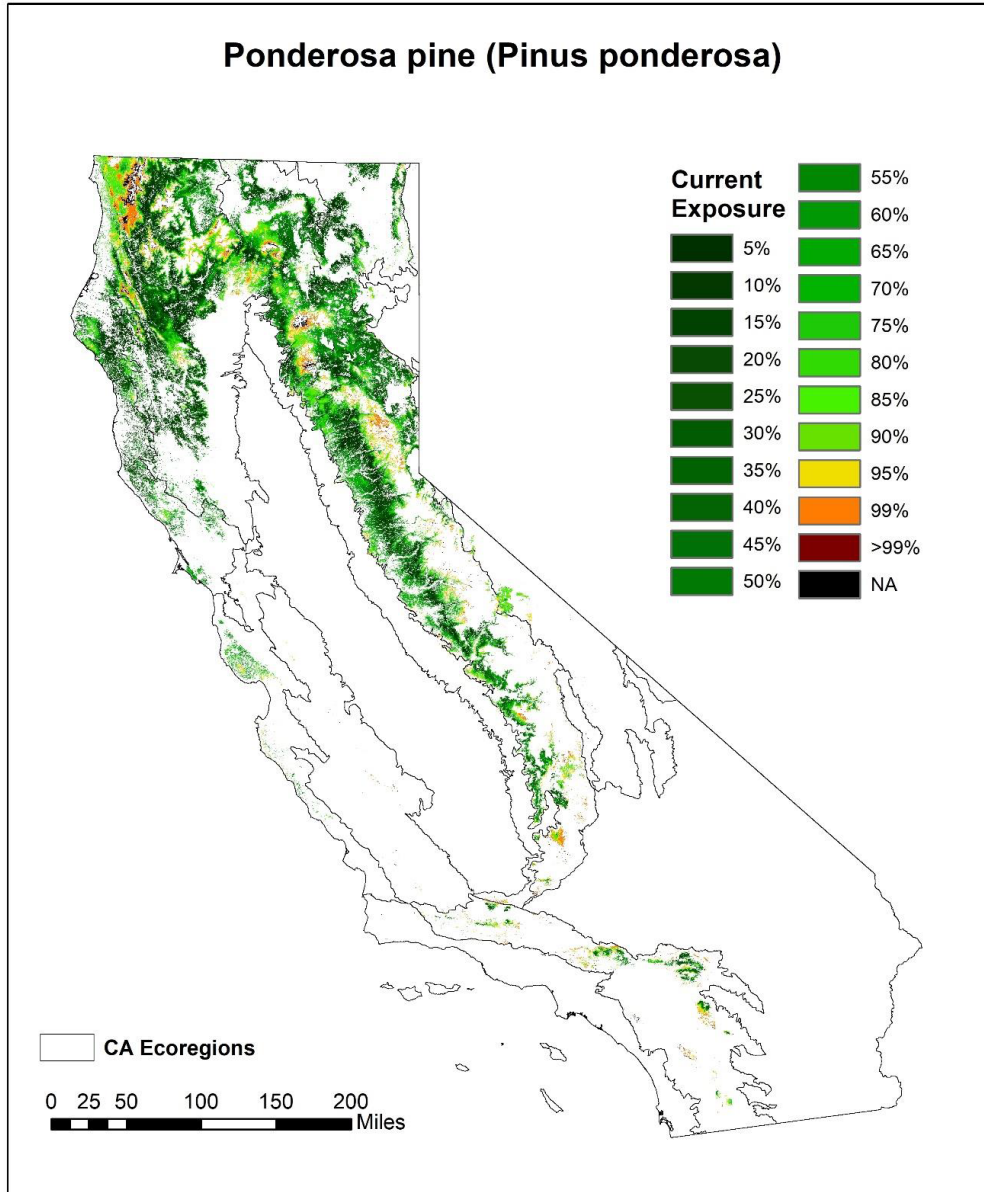
Limited to USFS units in Region 5 CA Only

Efforts underway to expand to all state forested lands

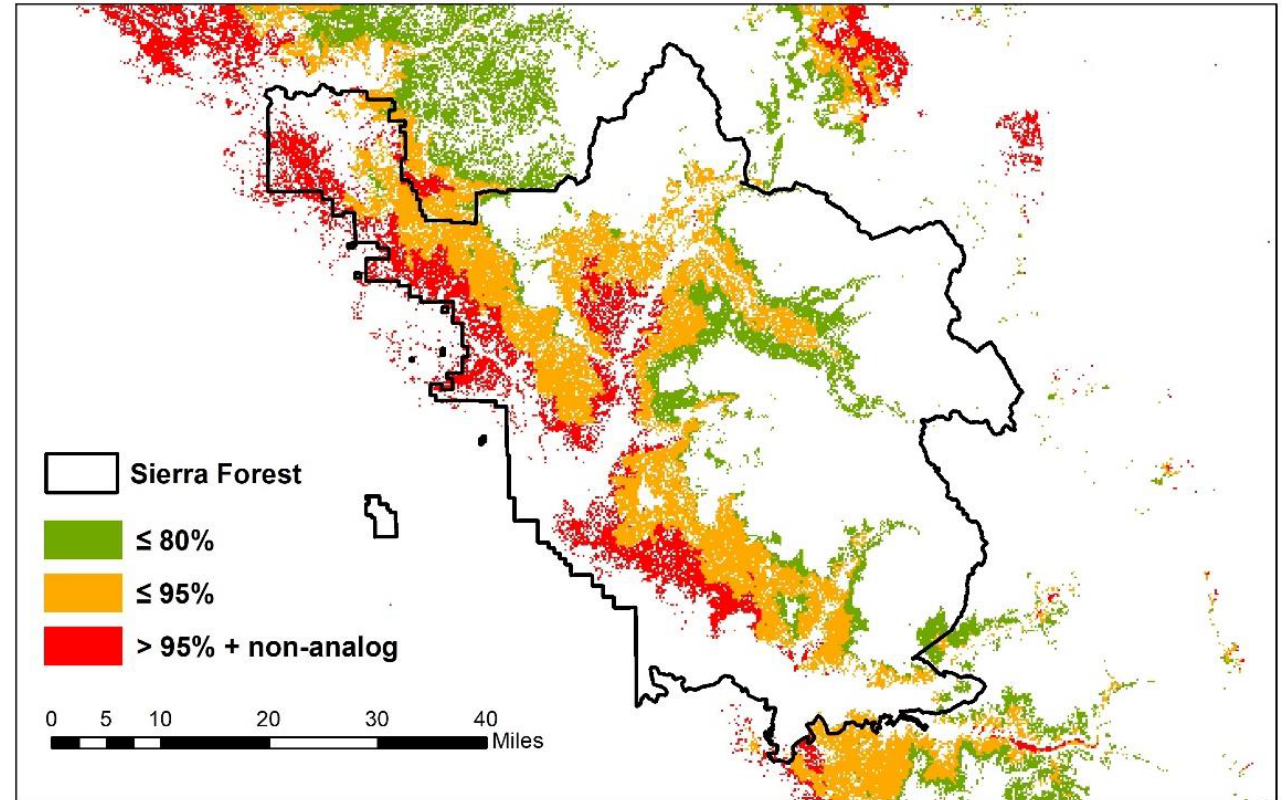


John Battles

1. Map species distribution and 2. Assess climate exposure

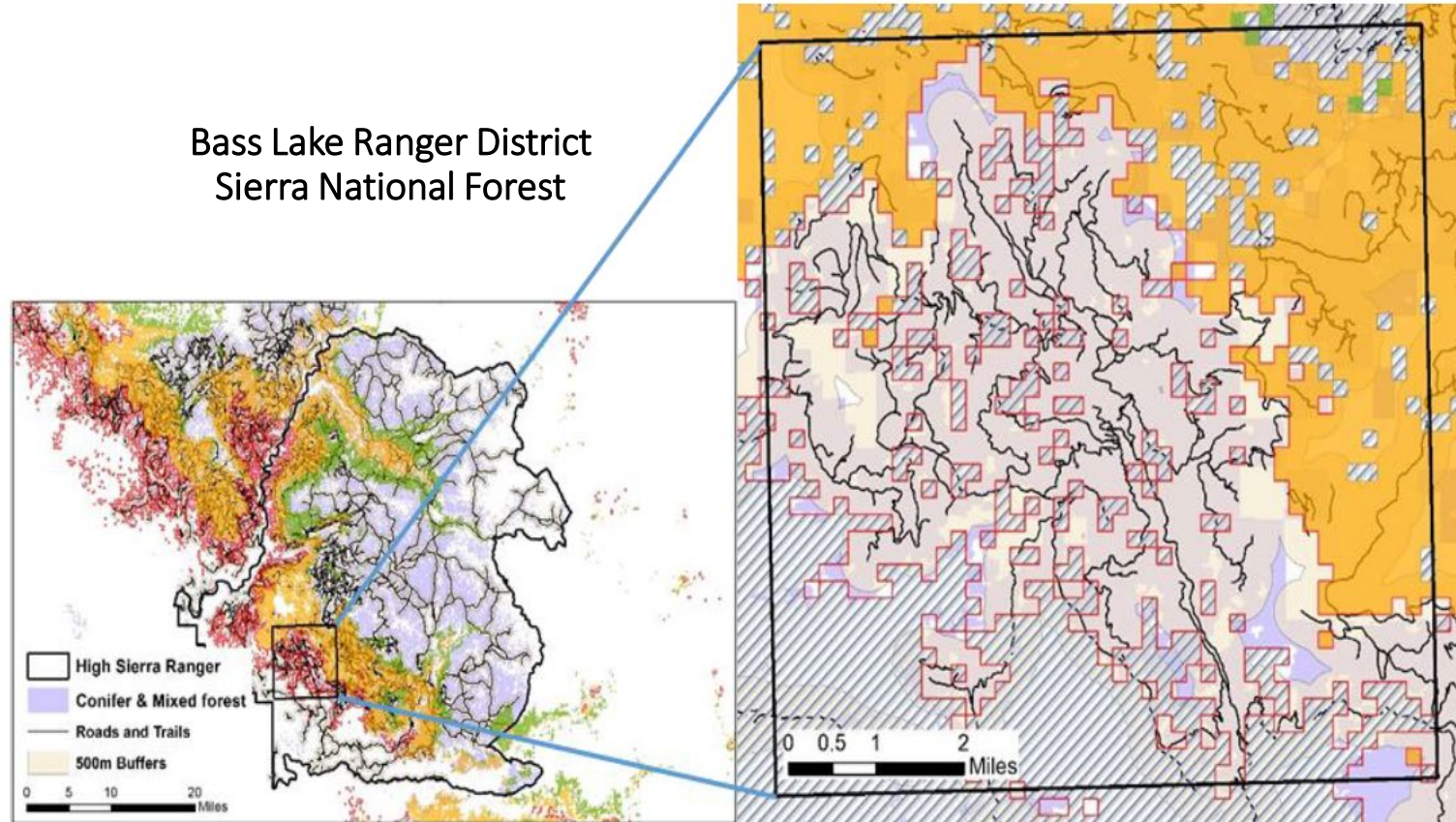


Bass Lake Ranger District Sierra National Forest



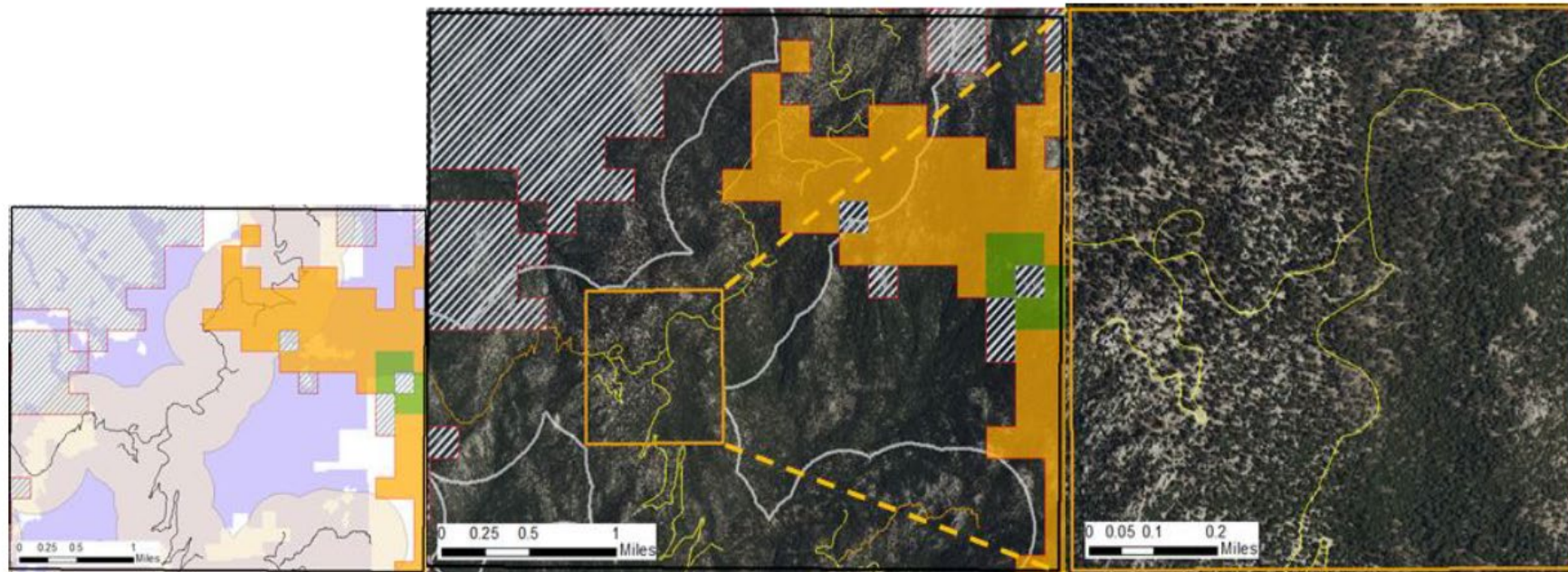
Projected climate exposure in 2040-2069 for Ponderosa pine under MIROC ESM RCP8.5. This is a hotter and drier projected future climate.

3. Clip for access and accessibility



Climate-risky areas of Ponderosa pine within 500m-buffers of transportation lines under MIROC ESM RCP8.5.

4. Check with high-resolution imagery



Estimated climate-risky tree areas within 500m-buffers of roads can be compared with high-resolution imagery

Conclusion – Looking Ahead



Future Task Force meetings:

- Aug. 12, 2021 – Sacramento, 3:30–5 p.m.
- Nov. 18, 2021 – Southern California, 1–4 p.m.
- Feb. 17, 2022 – Sacramento, 3:30–5 p.m.
- May 19, 2022 – North Coast, 1–4 p.m.
- Aug. 11, 2022 – Sacramento, 3:30–5 p.m.
- Nov. 17, 2022 – Sierra Nevada, 1–4 p.m.

Thank you & Stay in Touch

www.climatehubs.usda.gov