PREDICTING THE SPATIAL PATTERNS OF POSTFIRE CONIFER REGENERATION

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Study system – Sierra Nevada mixed conifer

- Fire suppression and climate change

  = altered fire regimes

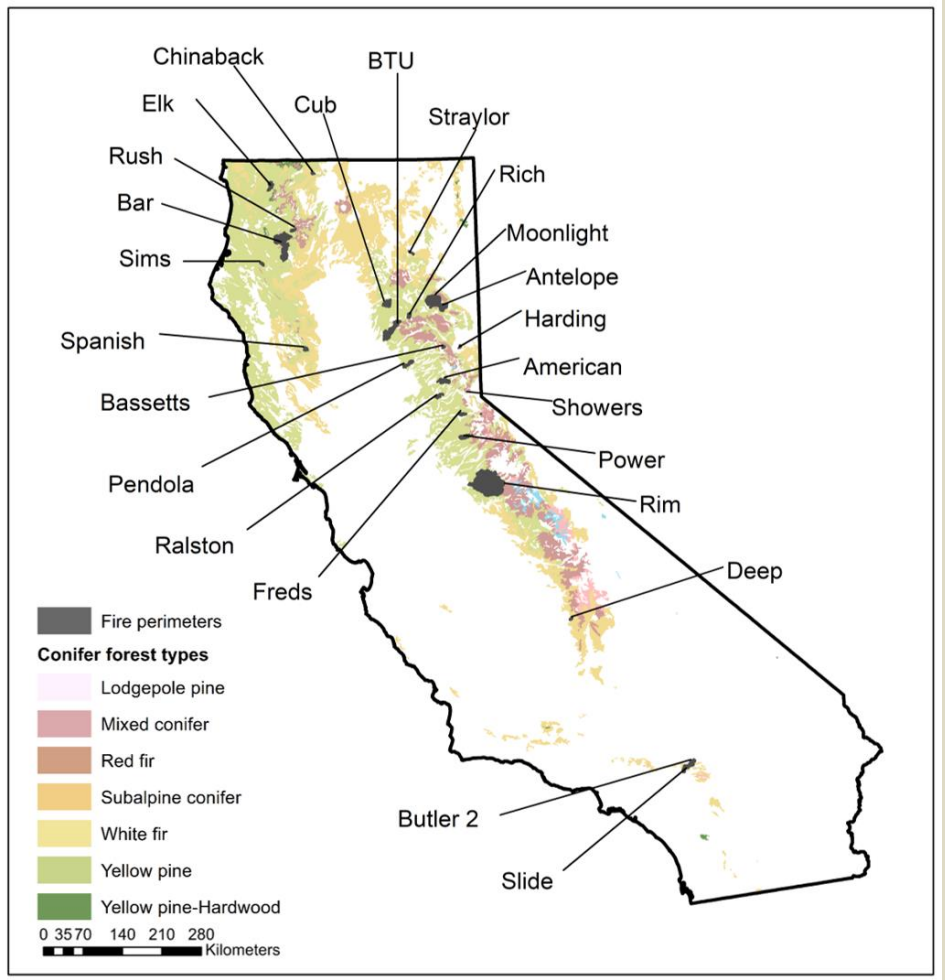
- Increased incidence and patch size of high severity
  - ↑ *distance to conifer seed sources*
  - = ↑ *potential for type conversion?*

GOAL:

Create a tool to predict the spatial patterns of conifer regeneration in yellow pine/mixed conifer forests across an entire fire event

Building the Tool

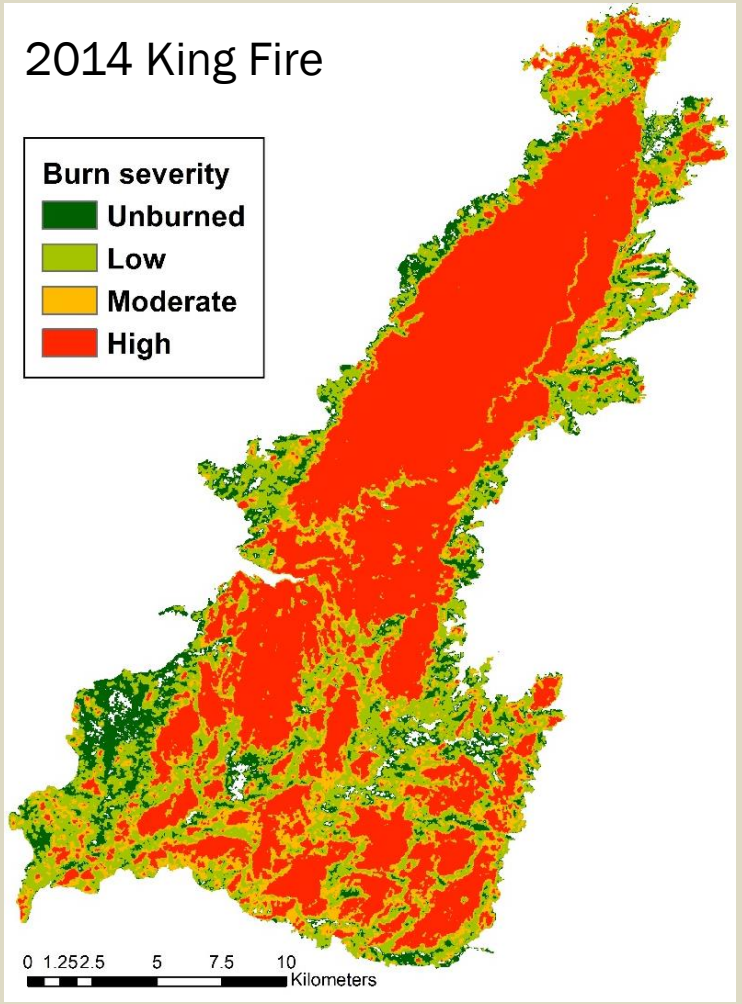
- Observed field data:
  - *24 wildfires*
  - *>1,800 field plots (~40% in high severity)*



Shive et al. 2018, Ecological Applications; Welch et al. 2016, Ecosphere

Building the Tool

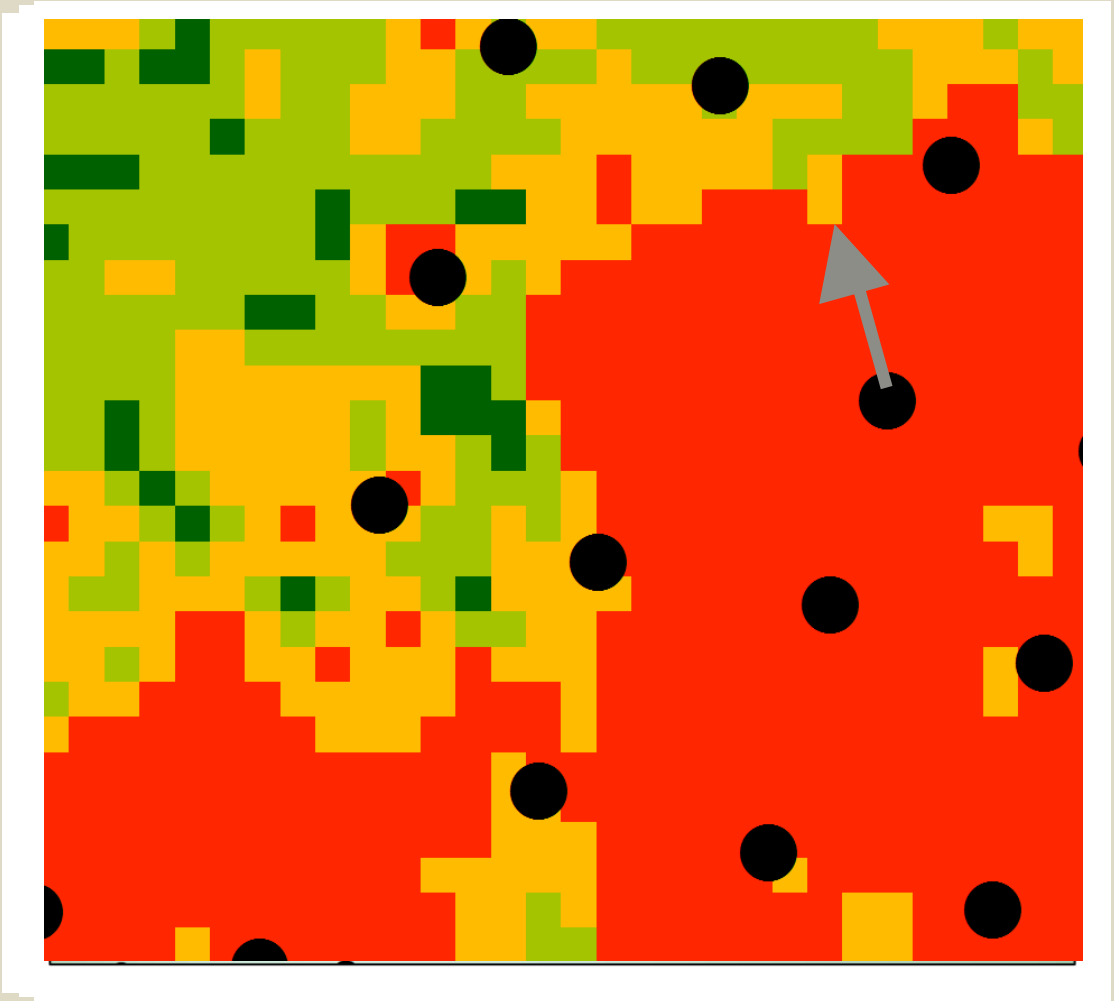
- Predictors: Widely available remotely sensed data
  - *Burn severity*
  - *30-year climate averages*
    - Annual precipitation
    - Actual evapotranspiration
    - Climatic water deficit
    - April snowpack
  - *Topography*
    - Aspect
    - slope
  - *Seed availability*
    - (modelled from estimated basal area maps and burn severity maps)



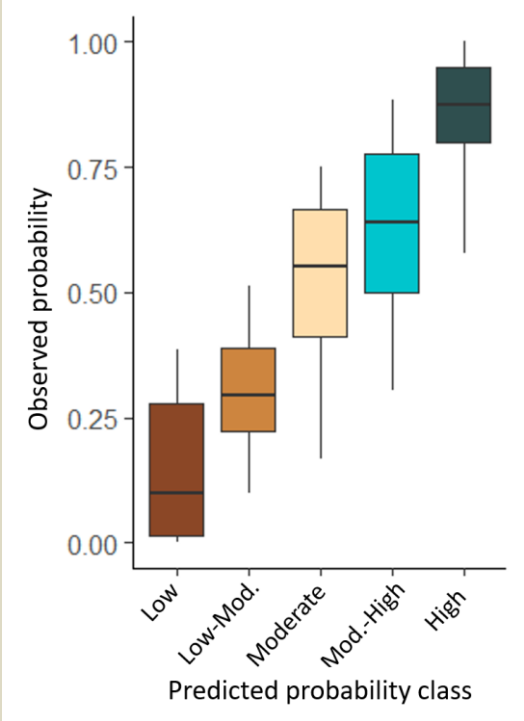
Shive et al. 2018, Ecological Applications

Creating Seed Availability proxies (SAPs)

- Euclidian distance
- Neighborhood seed availability
  - *Convert basal area/species to estimated annual seed production*
  - *Kernel density smoother at range of scales (50m-500m)*

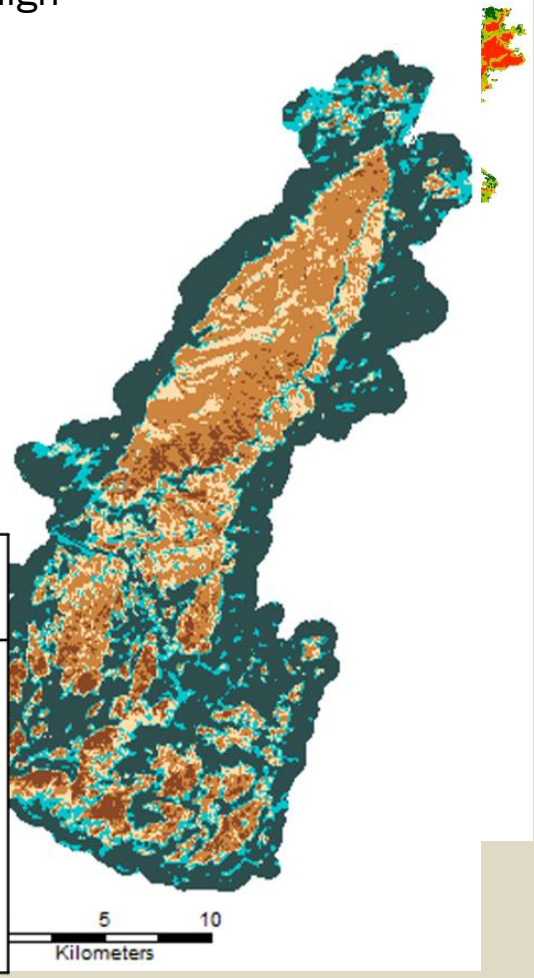


Post-fire Restoratic Tool



Prediction Classes (probability of observing ≥1 conifer at 5 years postfire)

- Low
- Low-Moderate
- Moderate
- Moderate-High
- High



Predicted probability class	Observed densities (seedlings/ac)			
	Min	95th Percentile	Median	Mean (±SE)
Low	0	135	0	58 (±35)
Low-Moderate	0	6,744	0	128 (±22)
Moderate	0	1,012	67	272 (±41)
Moderate-High	0	4,858	135	1,484 (±399)
High	0	11,019	540	2,551 (±306)

The Product & Interpretation

USDA Forest Service — Sierra Cascade Province Ecology Program | Region 5

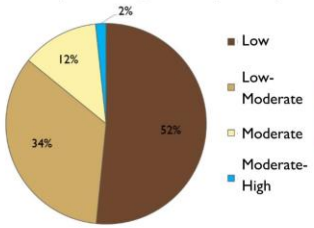
Conifer regeneration potential in the 2018 Whaleback Fire (Lassen National Forest)

We applied a spatially-explicit model developed by Shive et al. (2018) to produce a five-year post-fire predictive map of potential conifer regeneration following the 2018 Whaleback Fire on the Lassen National Forest. There are five predicted probability classes (see table on page 2) mapped across the burn area that relate to the probability of observing at least one regenerating conifer five years after fire at the 60-m^2

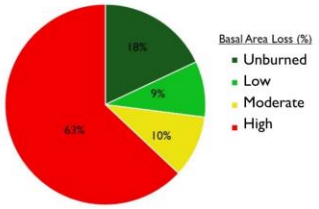
Key Findings

- 63% of the Whaleback Fire landscape burned at high severity (75%-100% basal area mortality).
- None (0%) of the burned area was within the highest prediction class for seedling density (80-100%).
- 86% of the burned area is within the two lowest prediction classes for seedling density (0-20% and 20-40%). When we limited seedling density predictions to those areas that were yellow pine or mixed conifer prior to the fire (see map on page 3), we found that 71% of the burned area was within the two lowest prediction categories.
  - In the lowest prediction categories, the probability of finding at least one regenerating conifer five years after fire (at the 60-m^2 scale) is between 0-20% and 20-40%.
  - Field data indicate that one can expect seedling densities in these categories that range from 0-14,666 seedlings/ha (mean: 144 ± 86 seedlings/ha) to 0-15,333 seedlings/ha (mean: 317 ± 55 seedlings/ha) respectively.
  - The median for both of these categories is 0 seedlings/ha suggesting that most of the Whaleback Fire area will likely have little to no conifer regeneration in the short-term.

Distribution of predicted regeneration probability



Fire severity distribution in the Whaleback Fire



Variables used in model

Fire: *burn severity, time since fire*

Topography: *aspect, slope,*

Climate: *actual evapotranspiration, annual precipitation, snowpack, climatic water deficit*

Seed availability: *Seed availability proxy (SAP) 150-m neighborhood*

Link to GIS files: T:\FS\NFS\R05\Program\Ecology\GIS\RegionWide\PostFire_RegenModel\Individual_Fires\Whaleback_LNF

Citation: *Shive, K. L., Preisler, H. K., Welch, K. R., Safford, H. D., Butz, R. J., O'Hara, K. and Stephens, S. L. 2018. From the stand scale to the landscape scale: predicting the spatial patterns of forest regeneration after disturbance. Ecological Applications 28: 1626-1639.*

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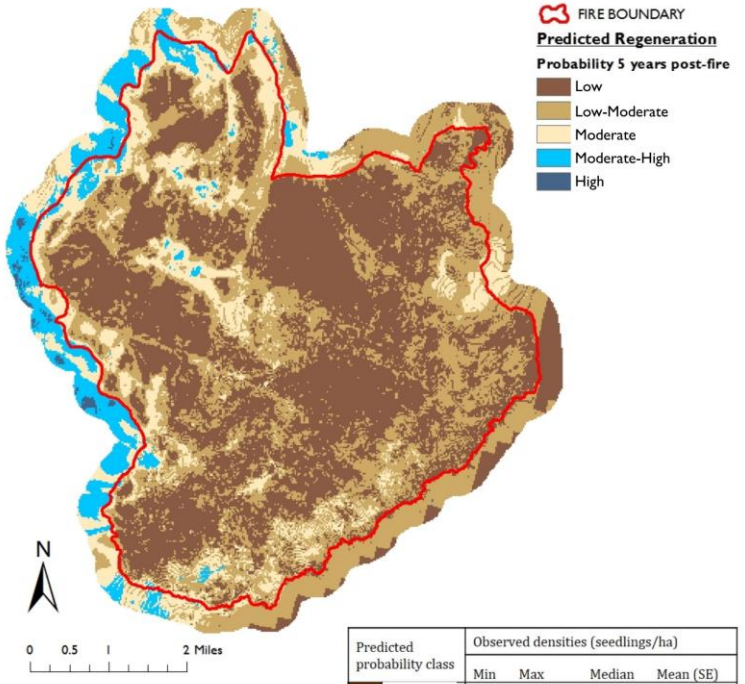
Predictive map showing the probability of observing at least one regenerating conifer five years after fire at the 60-m^2 (field plot) scale for the 2018 Whaleback Fire on the Lassen National Forest. The model combines six of the most common conifer species found in California yellow pine and mixed conifer forests (Douglas-fir, incense-cedar, Jeffrey pine, ponderosa pine, sugar pine, and white fir) into a single presence/absence variable. The fire boundary is shown in red.



Predicted probability class	Observed densities (seedlings/ha)			
	Min	Max	Median	Mean (SE)
Low	0	14,666	0	144 (86)
Low-Mod.	0	15,333	0	317 (55)
Moderate	0	17,166	166	672 (101)
Mod.-High	0	380,166	333	3,665 (985)
High	0	201,666	1,333	6,301 (755)

Table displays the minimum, maximum, median, mean, and standard error (SE) of observed conifer seedlings/ha for all 24 wildfires included in the Shive et al. (2018) forecast model by predicted probability class

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Publication available at: https://www.fs.usda.gov/treesearch/

Research Brief coming soon – California Fire Science Consortium

Differences under drought mortality conditions

- Spatial pattern and composition of residual trees likely drivers
- Residual live seed tree patterns are more spatially complex than in large high severity areas
- More similar to low-moderate severity fire areas
  - *No change in surface litter*
  - *No post-disturbance change in basal area imagery*
  - *Species composition ID at landscape scales remains a problem*