Prescribed fire in plantations – shifting the paradigm

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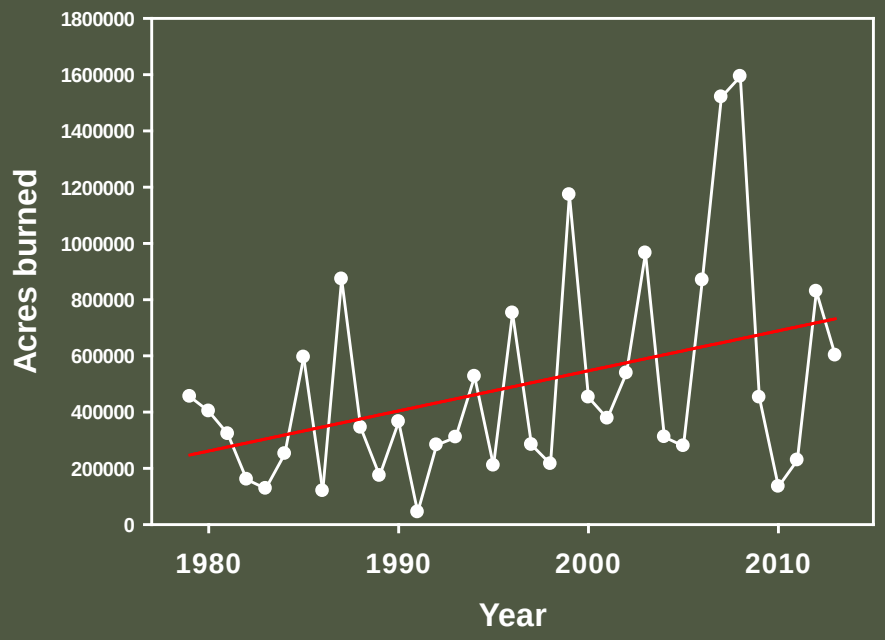
Old paradigm: manage plantations assuming wildfire will be kept out

Trends in fire activity: California



Planted after 1987 Stanislaus Complex
2013 Rim Fire

New paradigm: Plantations increasingly likely to encounter wildfire prior to commercial size

Structure of plantations can pose some challenges for wildfire resilience

- Small tree size
- Vertical and horizontal fuel continuity
  - Even aged
  - Even tree spacing

Predicting crown scorch/ mortality in hypothetical plantation under different conditions w/ BehavePlus

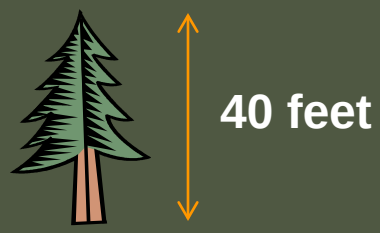
Scott and Burgan 2005

- Timber litter
  - Tl8 long needled pine litter
  - Tl9 needle drape
- Logging slash
  - Sb2 moderate logging slash
  - Sb3 heavy logging slash
- Shrub understory
  - Tu5 heavy load needles plus understory shrubs
  - Sh5 shrubs 4-6 ft tall, covering >50% of area

- Fine dead fuel moisture: 3 to 5%
- Live fuel moisture: 80%
- Air temperature: 90 ^{o}F

Crown scorch (%) and tree mortality prediction - wildfire conditions

	Wind speed: 0 mph				Wind speed: 7.5 mph				Wind speed: 15 mph		
	% slope				% slope				% slope		
Fuel Type	**0**	**30**	**60**		**0**	**30**	**60**		**0**	**30**	**60**
Needle litter	0-0	0-45	64-100		63-100	71-100	95-100		86-100	89-100	97-100
Logging slash	0-67	80-100	100		100	100	100		100	100	100
Litter + shrubs	30-64	99-100	100		100	100	100		100	100	100



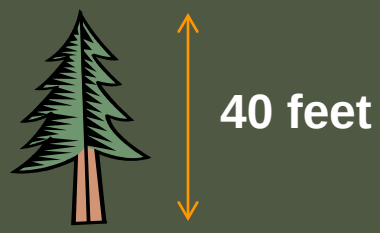
Probability of resilience

- **High (<25% mortality)**
- **Moderate (25-75% mortality)**
- **Very low (>75% mortality)**

Crown scorch (%) and tree mortality prediction – prescribed fire conditions

	Wind speed: 0 mph				Wind speed: 2.5 mph				Wind speed: 5 mph		
	% slope				% slope				% slope		
Fuel Type	**0**	**30**	**60**		**0**	**30**	**60**		**0**	**30**	**60**
Needle litter	0	0	0		0	0	0-26		0	0	0-39
Logging slash	0	0-23	42-100		0-69	15-91	71-100		44-100	60-100	90-100
Litter + shrubs	0	0	20-38		0-3	25-28	70-72		34-53	51-65	85-90

Fine fuel moisture: 9 to 11%
Live fuel moisture: 200%
Air temperature: 60 ºF



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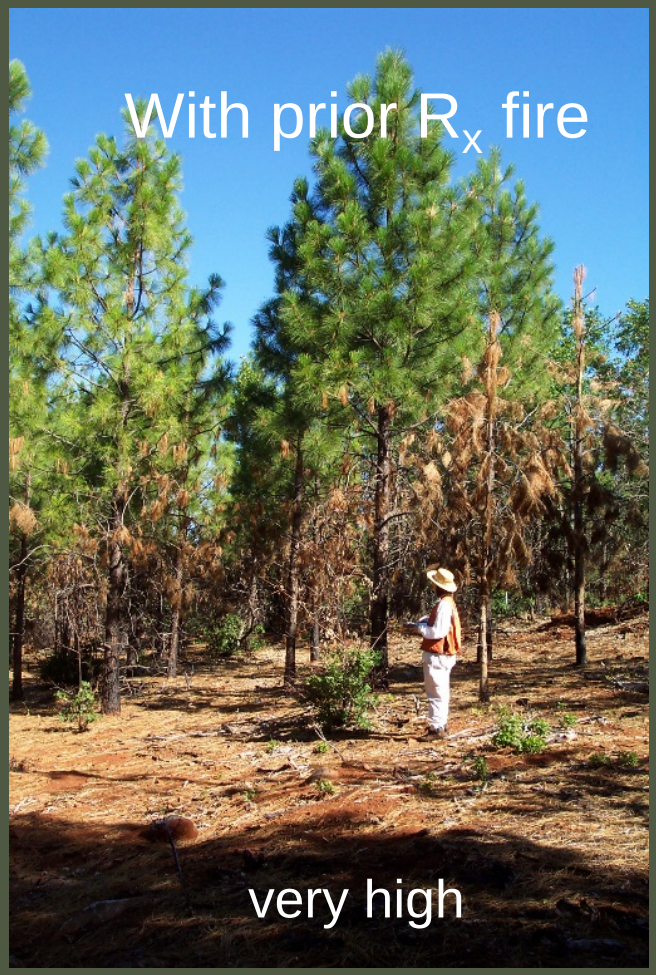
Small trees benefit the most from light fuels

Probability of surviving a wildfire



Why is so little burning done in young stands?

Mechanisms of tree mortality

crown scorch

Scorch height:
isotherm of >140°F
for over 1 minute

Flame length

bole charring

Large trees: Thick bark, heavy fuels
Small trees: Thinner bark, lighter fuels

Prescribed burning in plantations: tree mortality

timing – spring

fuels – pine litter + masticated brush

	Challenge	Whitmore
Variable	*P*	*P*
DBH	**0.006**	**<0.001**
CharHigh	0.520	**0.035**
CharLow	0.293	0.220
% CrownVolScorch	**<0.001**	**0.002**

Prescribed burning in plantations: tree mortality

- Fuels raked 1.5 ft from base of randomly selected trees

18/65 (28%) raked trees died
23/66 (35%) unraked trees died

Difference not statistically significant

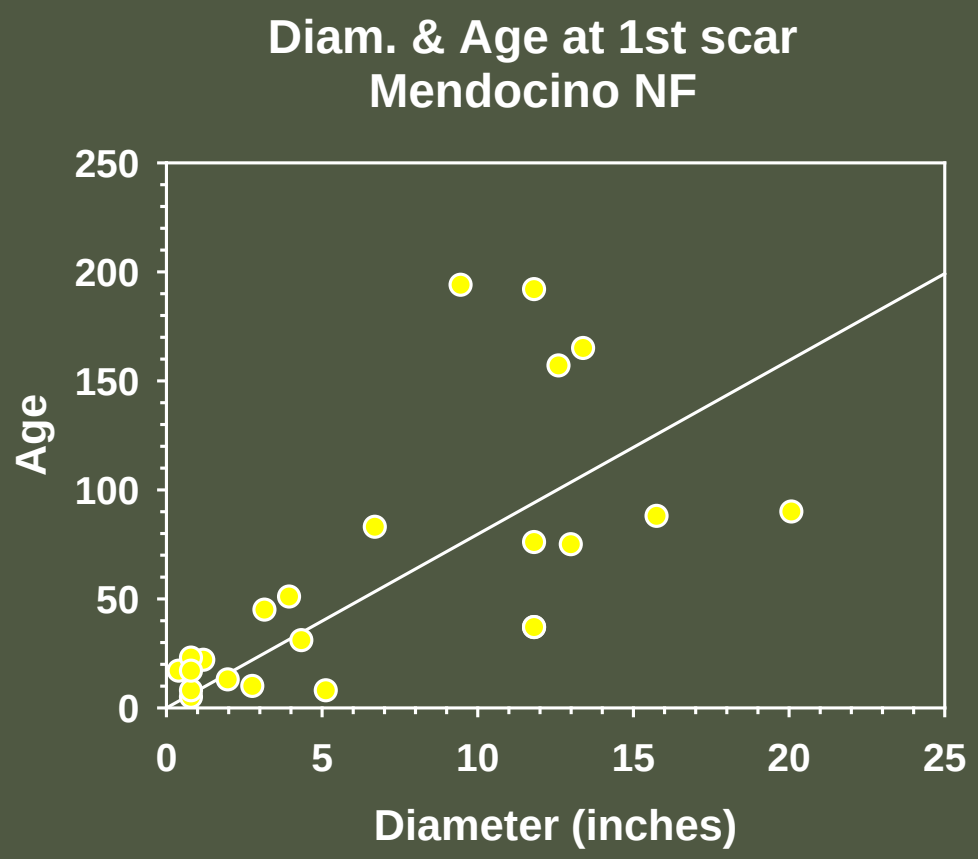
Prescribed burning in plantations: controlling crown scorch and the value of patience

	Slope º	Survival (%)
Challenge 1	8	91
Challenge 2	5	76
Challenge 3	12	9
Challenge 4	11	85
Whitmore 1	2	90
Whitmore 2	1	100
Whitmore 3	5	95
Whitmore 4	7	91

- Use more backing fire
- Burn when air temperature is cool
  - Burn at 50º vs. 80º ~ 35% reduction in crown volume scorched

What is the ideal age/tree size to introduce fire to young stands?

Evidence from historical data



What is the ideal age/tree size to introduce fire to young stands?

Chips Fire, Lassen NF (2012)

What is the ideal age/tree size to introduce fire to young stands?

- Site specific
  - Site productivity
    - Time to tree size that can survive fire
  - Fuel bed development
    - Needle cast – related to basal area
    - Grasses, shrubs
    - Dead fuel additions
      - Pre-commercial thin/ lop and scatter
      - Mastication

Prescribed fire in young stands: final thoughts

- Old paradigm – any fire will jeopardize investment
- New paradigm – some prescribed fire losses acceptable if it protects against total loss with wildfire
  - Other benefits
    - Produces within stand heterogeneity
    - Option: Prescribed fire before thinning - remove damaged trees
- Planting units are ideally thought of as future burn units