Fire as a Restoration Tool in a Warming Climate

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Center for Natural Lands Management

Joint Base Lewis-McChord Program

Overview

- Puget Sound Ecological Fire Program
- Climate trends / predicted changes
- JBLM fire effects monitoring project
- Mitigating against high severity effects

Puget Sound Ecological Fire Program

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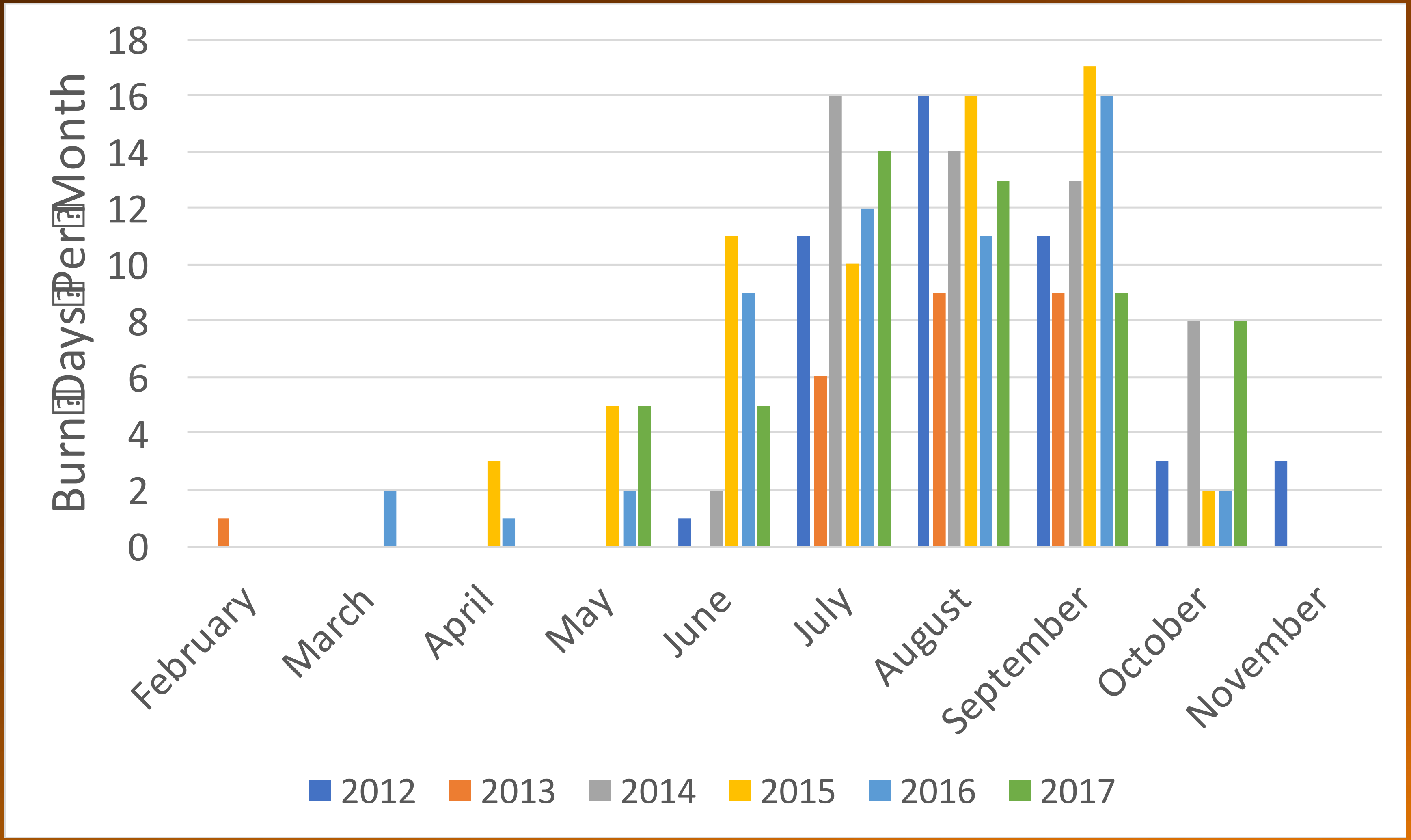
~2,000 acres burned each summer

Puget Sound Ecological Fire Program



Puget Sound Ecological Fire Program

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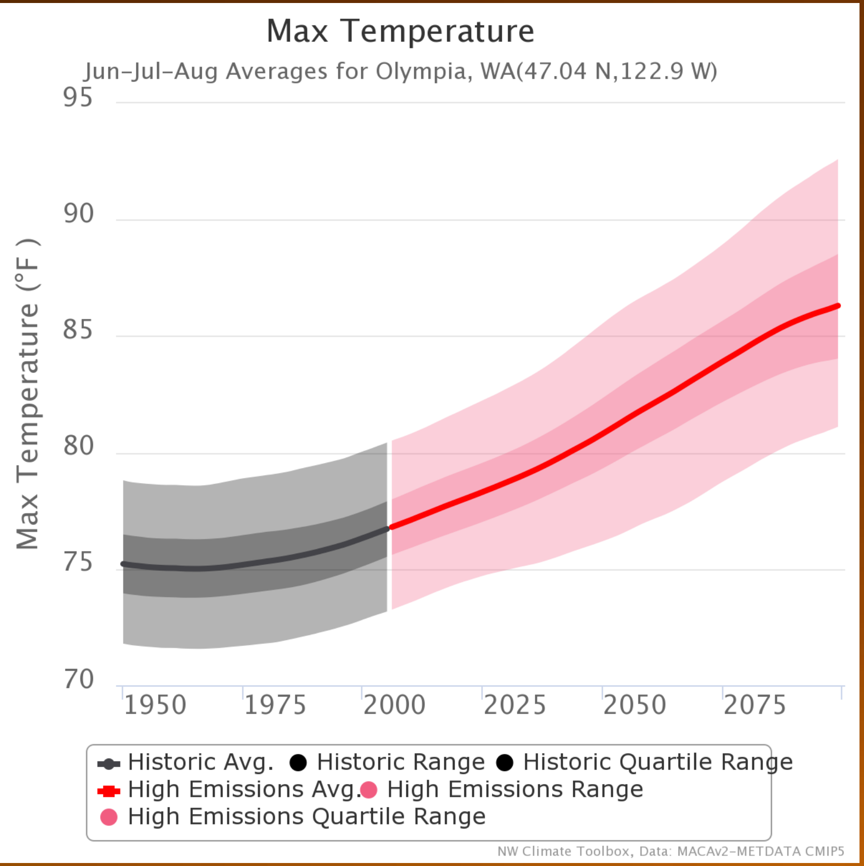
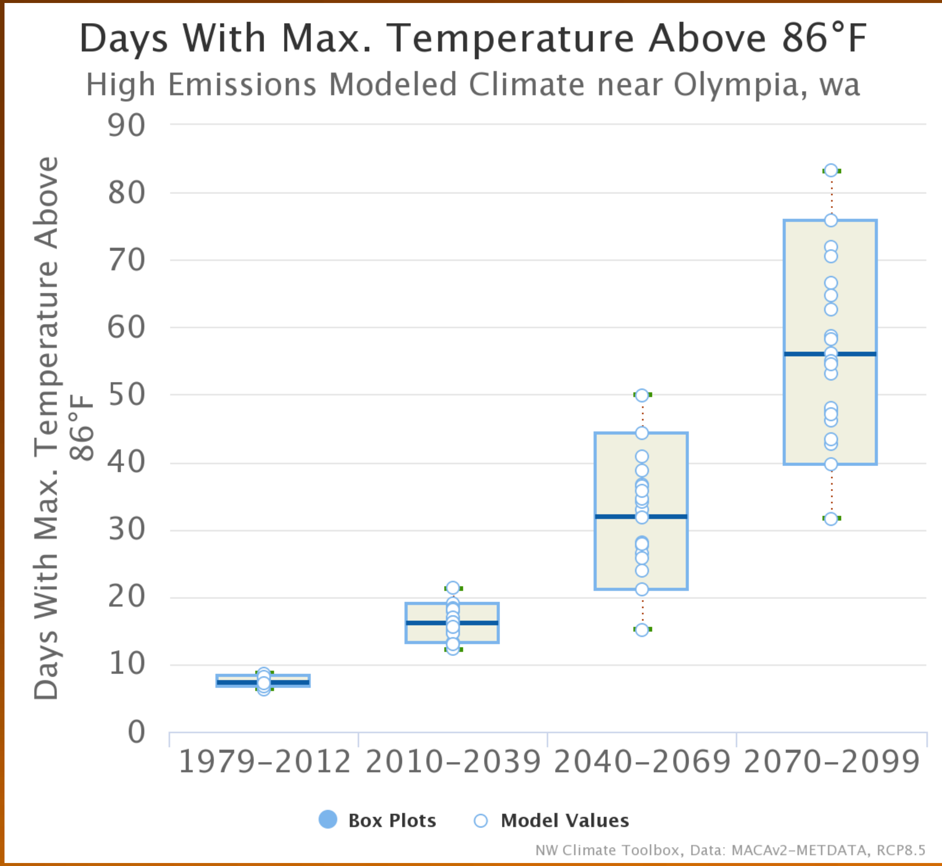
Climate Trends / Predictions





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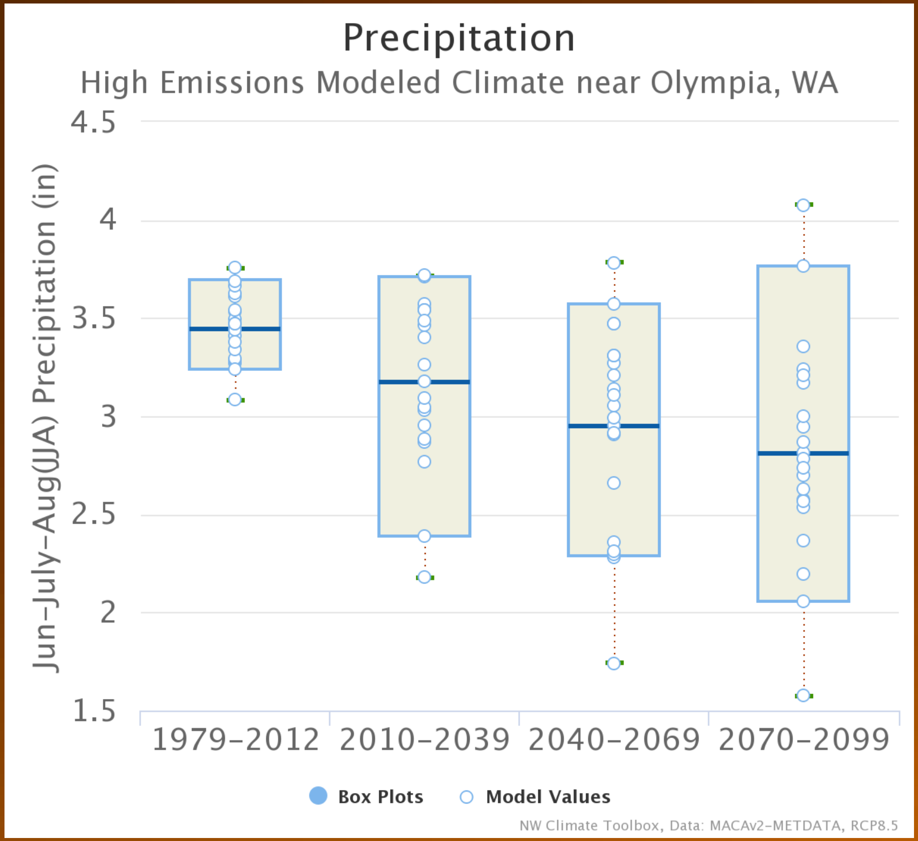
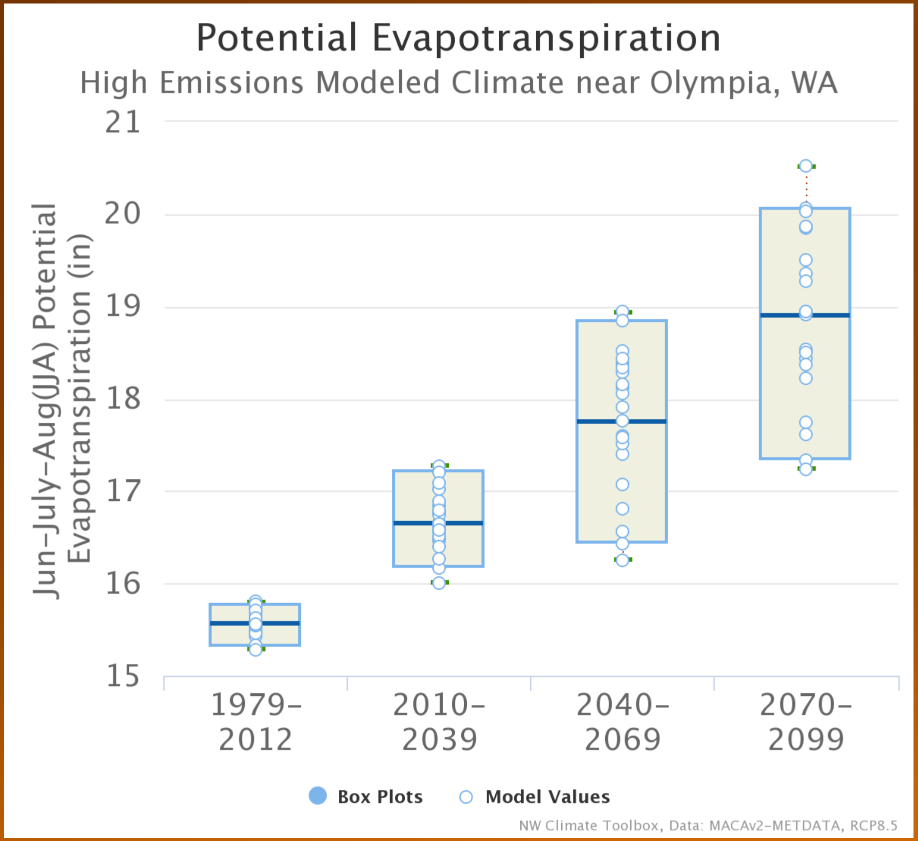




JBLM Fire Effects Monitoring Project

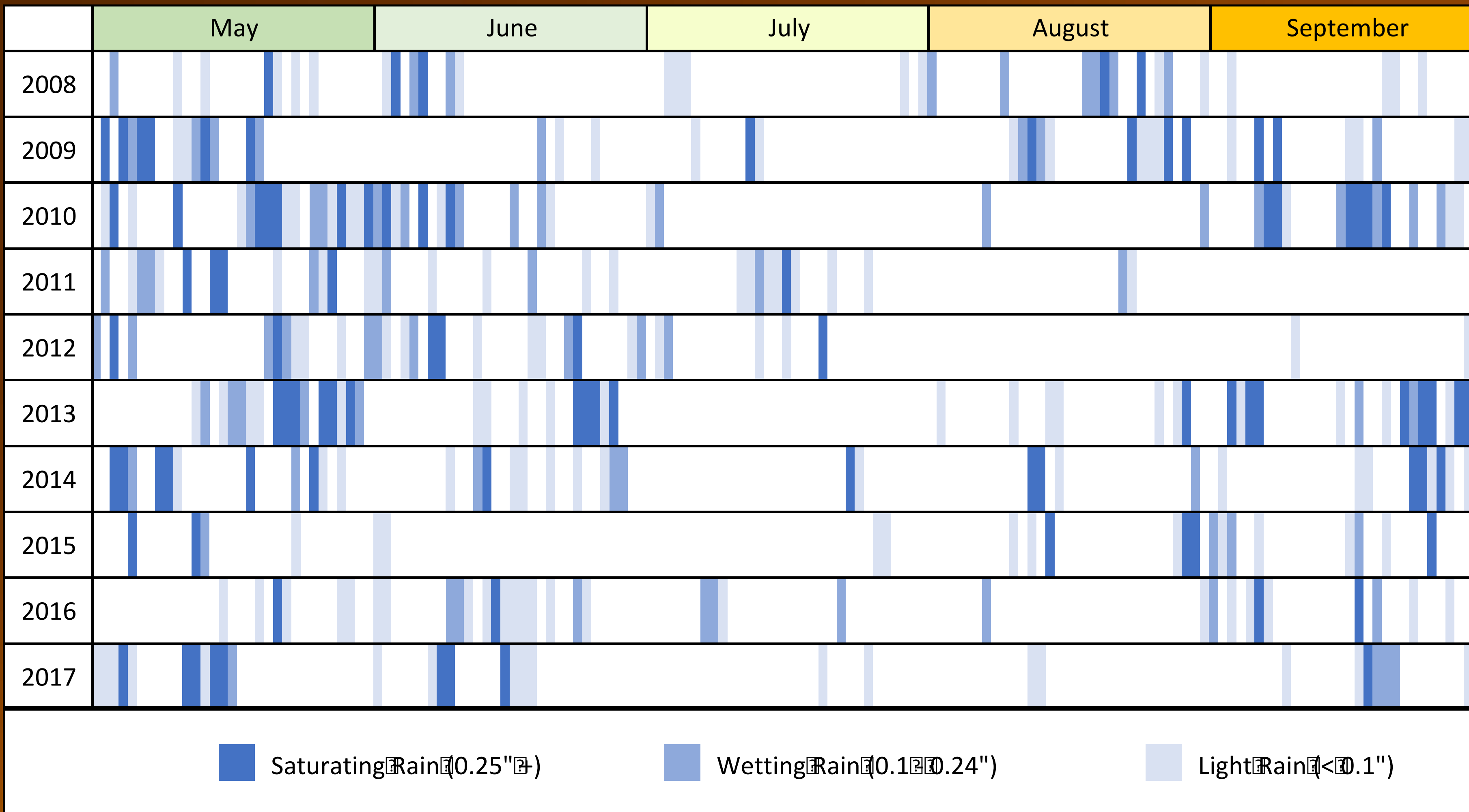
Predictors

- Temperature
- Relative humidity
- Wind speed
- Soil moisture
- Thatch depth
- Time of year
- Precipitation

Responses

- Surface temperature
- Belowground temperature
- Burn severity

JBLM Fire Effects Monitoring Project



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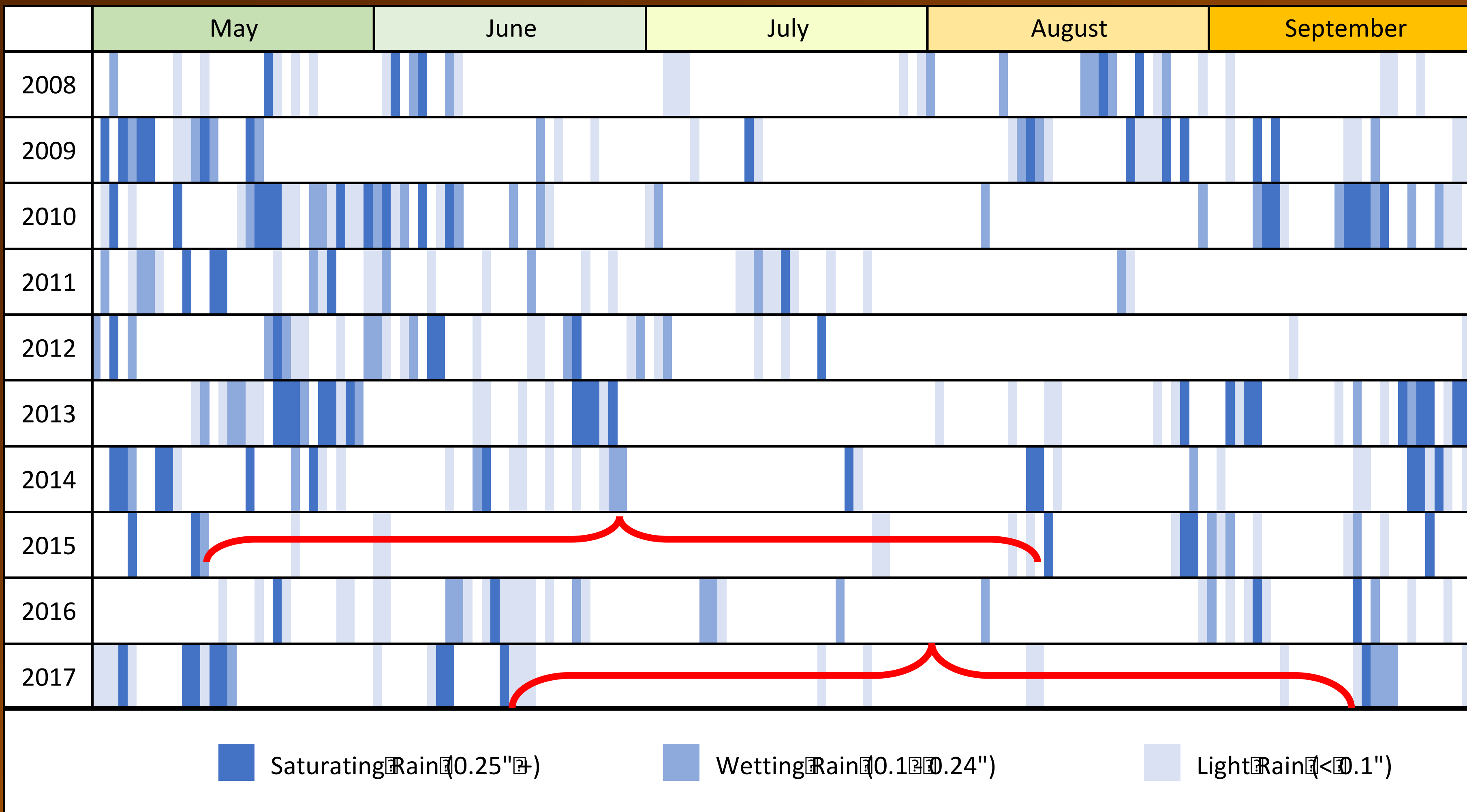

JBLM Fire Effects Monitoring Project

Peak surface temperature

Global model fit:
$R^2_{marg} = 0.67$; $p < 0.001$

Predictor	Relative Importance	Effect Size
Precipitation	**1.00**	**138.2ºC**
Wind speed	0.81	57.6ºC
Julian calendar day	0.63	54.0ºC
Air temperature	0.57	39.6ºC
Relative humidity	0.38	-19.7ºC
Thatch depth	0.26	9.1ºC
Soil moisture	0.22	6.5ºC

JBLM Fire Effects Monitoring Project

Peak subsoil temperature

Global model fit:
$R^2_{marg} = 0.68$; $p < 0.001$

Predictor	Relative Importance	Effect Size
Precipitation	**1.00**	**53.6^{o}C**
Julian calendar day	0.87	19.3^{o}C
Wind speed	0.85	22.5^{o}C
Relative humidity	0.59	-13.7^{o}C
Thatch depth	0.54	-18.1^{o}C
Air temperature	0.44	11.2^{o}C
Soil moisture	0.24	-2.8^{o}C

JBLM Fire Effects Monitoring Project

Substrate severity

Global model fit:
$R^2_{marg} = 0.66$; $p < 0.001$

Predictor	Relative Importance	Effect Size
Precipitation	**1.00**	**3.71**
Wind speed	0.84	0.25
Relative humidity	0.24	-0.04
Thatch depth	0.23	0.03
Air temperature	0.14	0.01
Soil moisture	0.13	-0.01
Julian calendar day	0.02	0.01

Effects of high intensity & severity

Threshold temperatures for biological disruptions in soils (adapted from DeBano et al., 1998)

Biological component threshold	Temperature (°C)	Reference
Plant roots	48	Hare, 1961
Small mammals	49	Lyon et al., 1978
Protein coagulation	60	Precht et al., 1973
Fungi – wet soil	60	Dunn et al., 1985
Seeds – wet soil	70	Martin et al., 1975
Fungi – dry soil	80	Dunn et al., 1985
Nitrosomonas spp. – wet soil	80	Dunn and DeBano, 1977
Nitrosomonas spp. – dry soil	90	Dunn and DeBano, 1977
Seeds – dry soil	90	Martin et al., 1975
VA mycorrhizae	94	Klopatek et al., 1988

Effects of high intensity & severity

Threshold temperatures
from DeBano et al., 19

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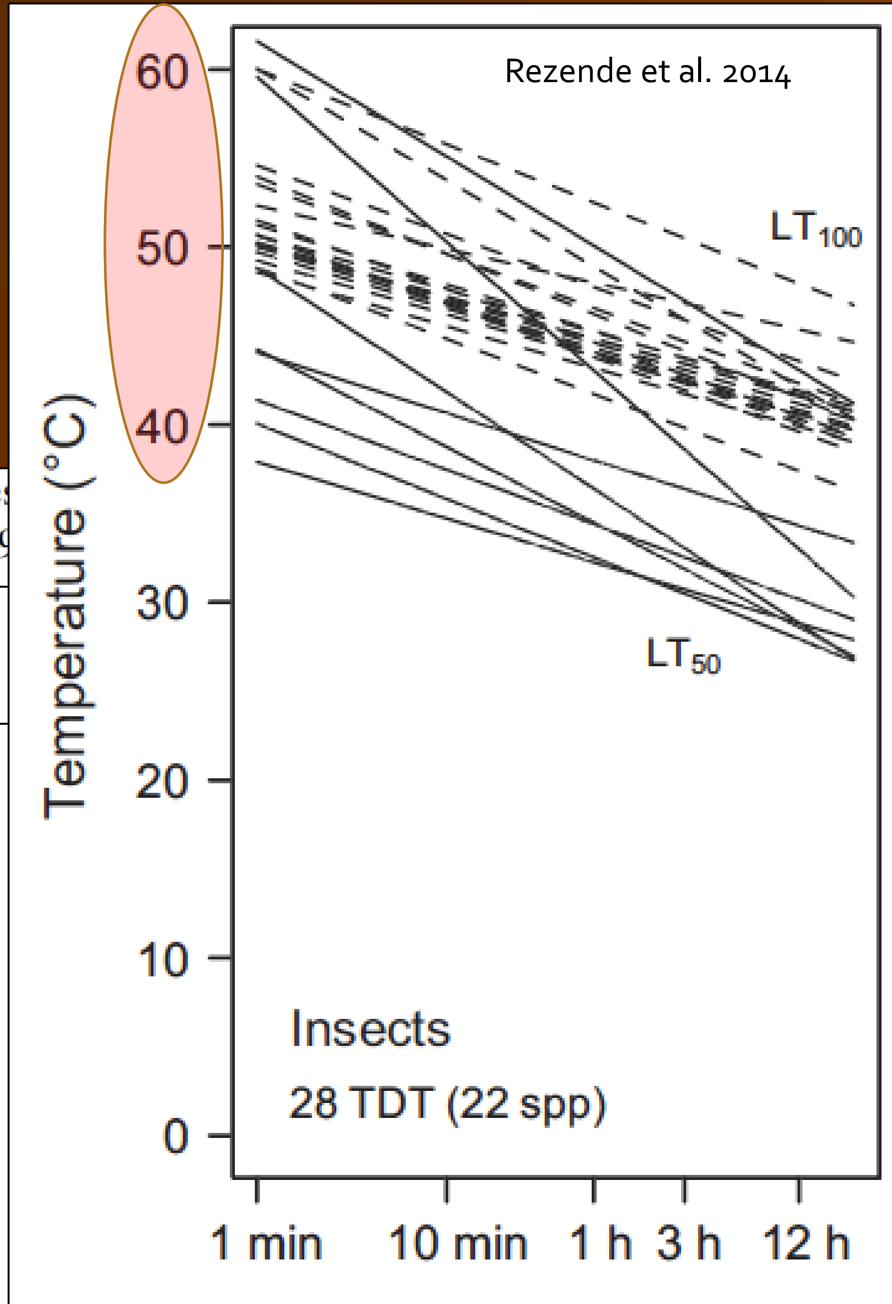
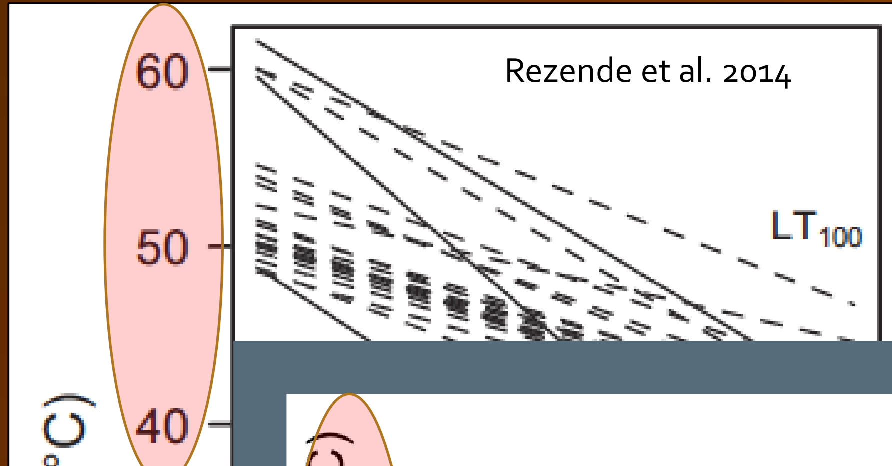


Effects of high intensity & severity



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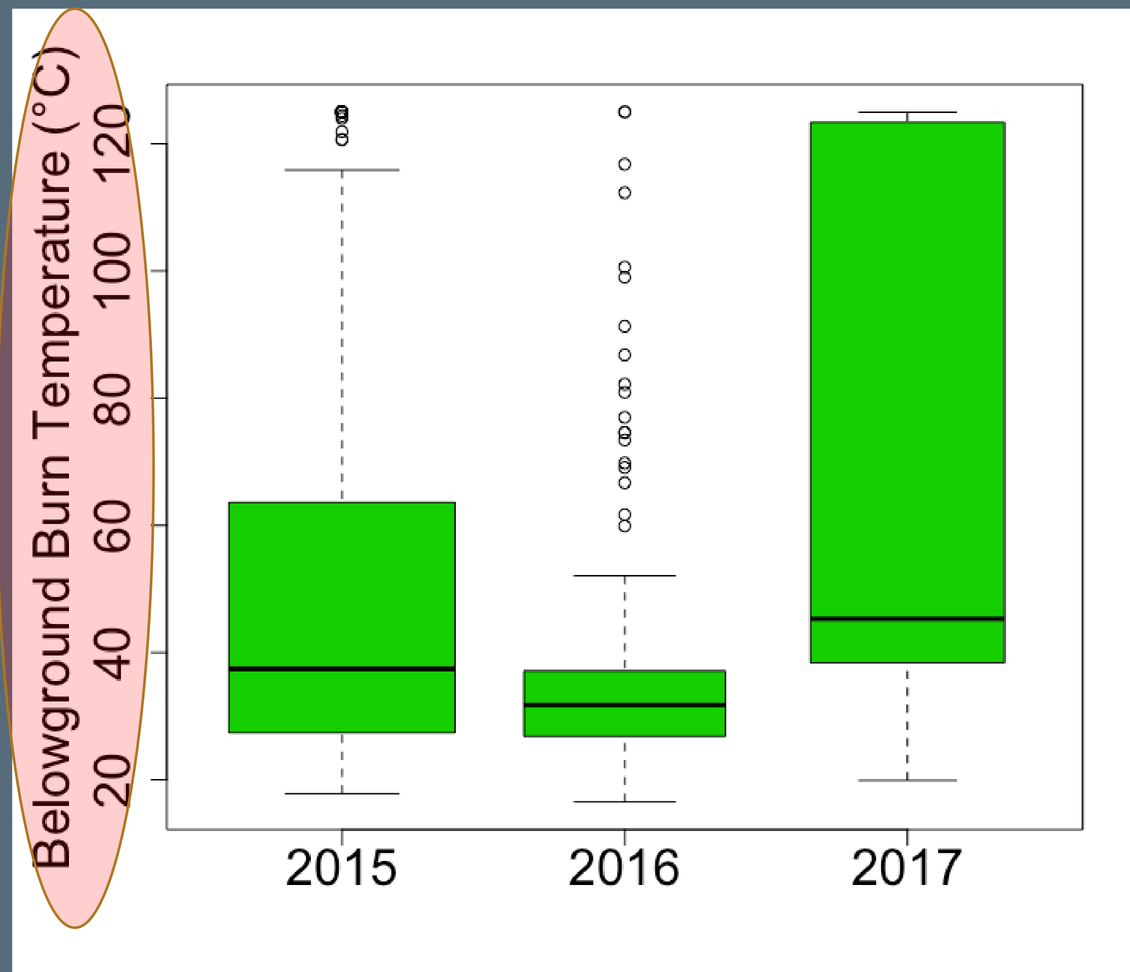
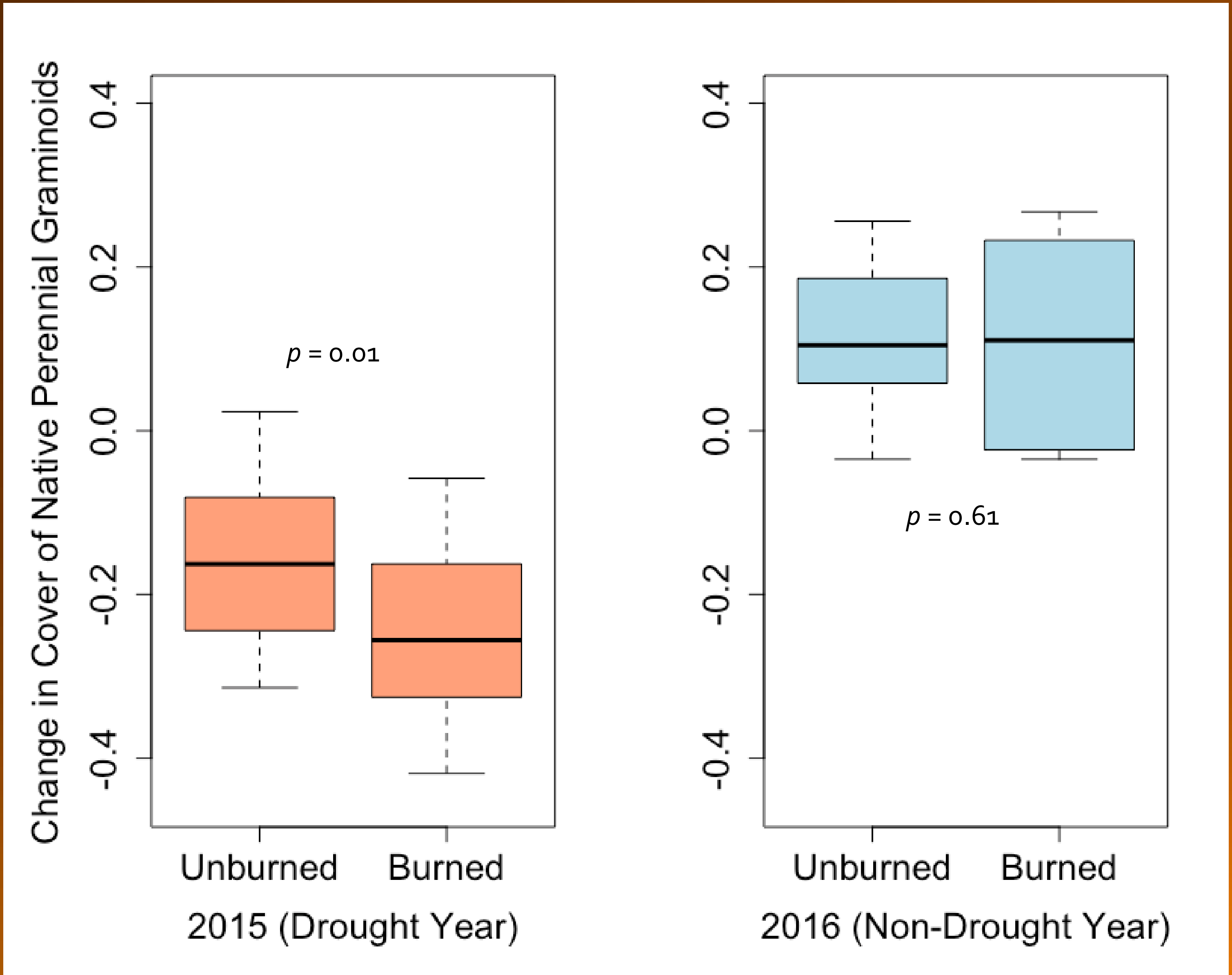
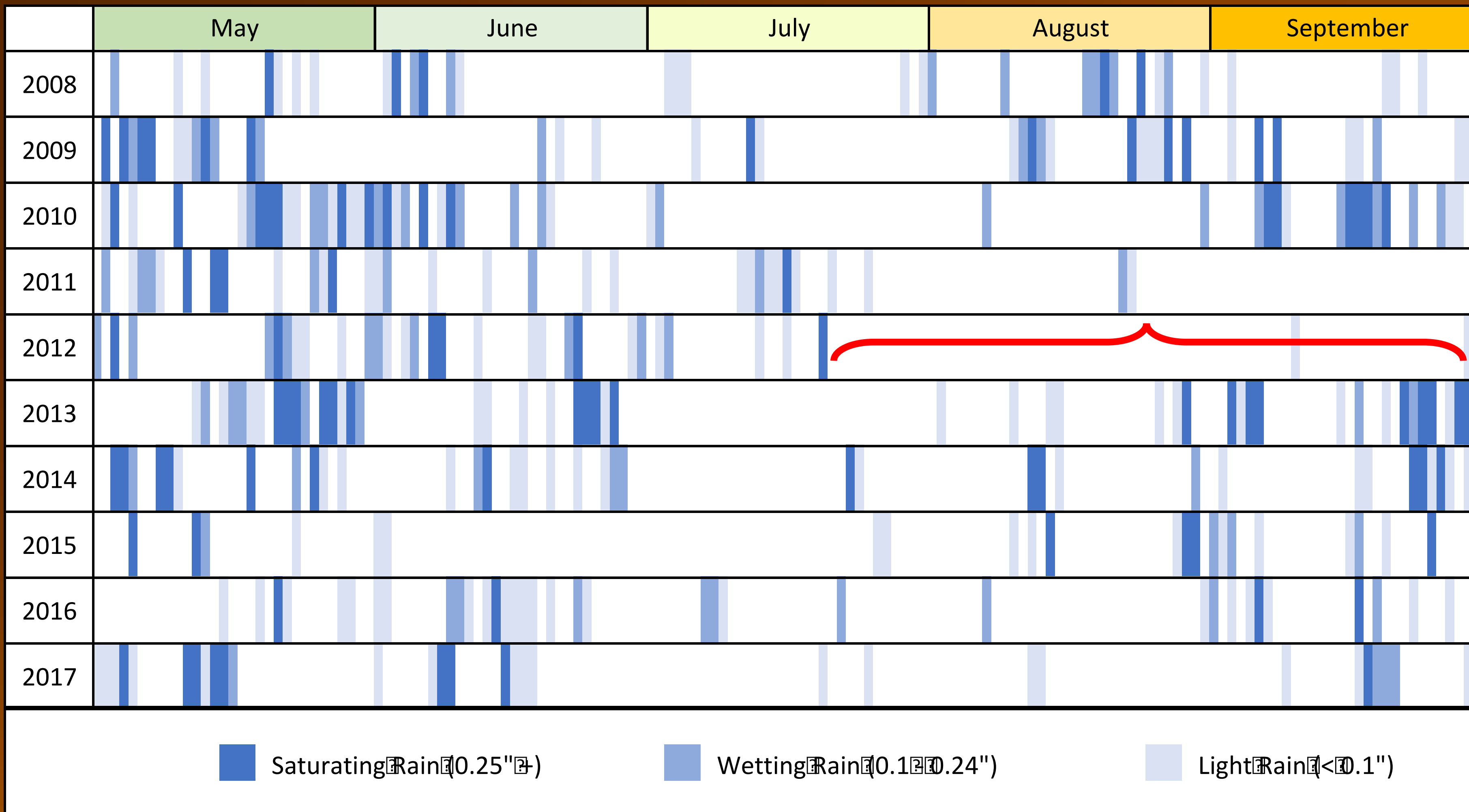


Effects of high intensity & severity

Vegetation effects in a drought year



The Pacific Northwest 'Dry' Season



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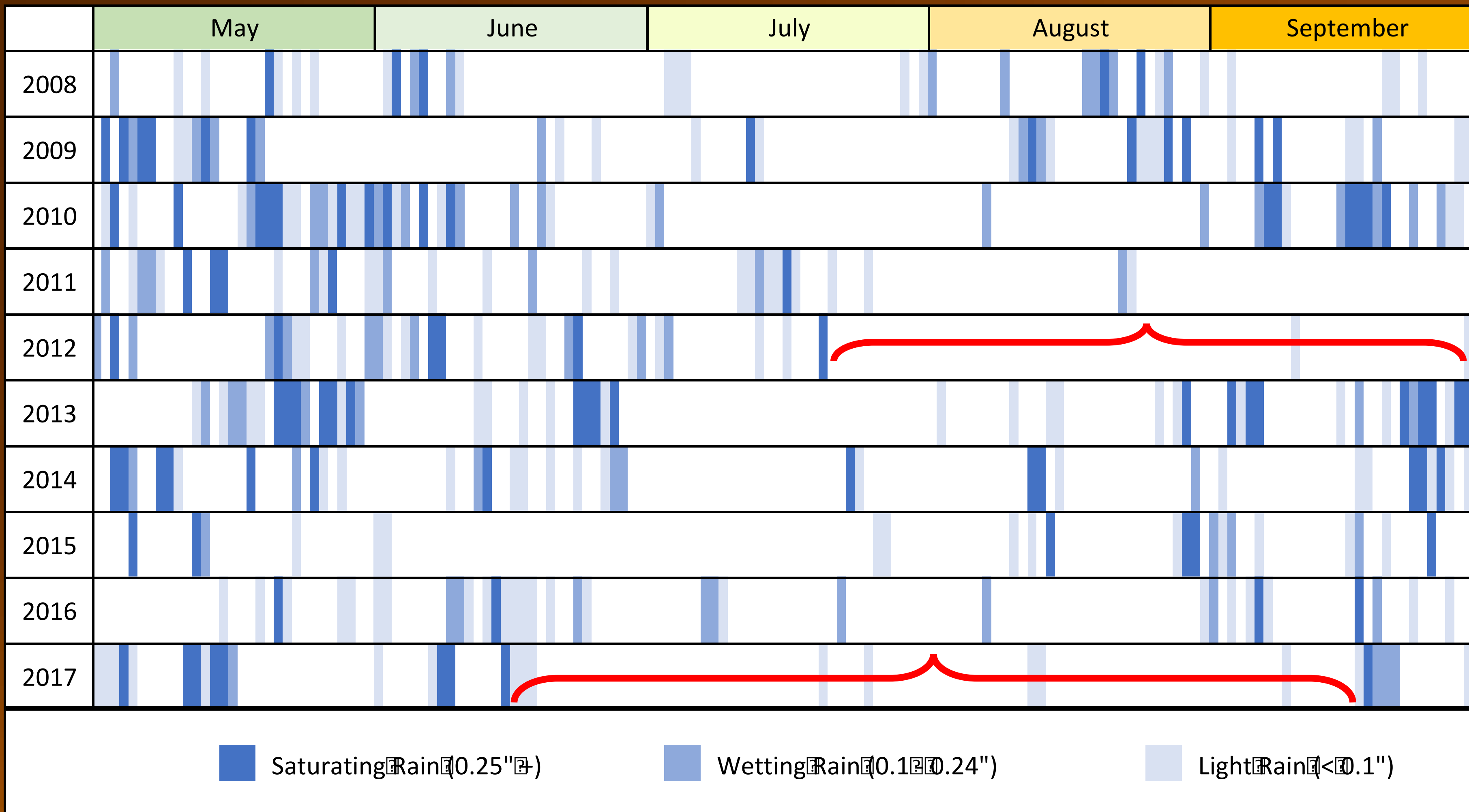

Mitigation Strategies

"Shoulder season" burns

- Poor consumption

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Take advantage of rain events

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Deeper thatch
- Mechanism unclear

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- Requires knowing soils

Pre-burn irrigation
- High-quality native patches

Fire as a Restoration Tool

Why do we burn?

- Keep invasive shrubs and trees from encroaching
- Stimulate growth of fire-adapted native species
- Open up space for post-burn seeding

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We need fire

but we'll need to adapt our use of fire as the climate changes

Thank you:

Bill Kronland, CNLM Prairie Restoration Project Manager

R. Adam Martin, CNLM Prairie Restoration Specialist

Mason McKinley, CNLM JBLM Restoration & Ecological Fire Program Manager

John Richardson, JBLM Fish and Wildlife Prescribed Fire Program Coordinator