



Climatic controls on post-fire regeneration and growth in ponderosa pine and Douglasfir

Tuesday, May 7, 2019 12:00 - 1:00PM MDT/11:00AM – 12:00PM PDT

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Climatic controls on post-fire ponderosa pine and Douglas-fir regeneration and growth

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Forest resilience to changes in fire and climate



Forest resilience to changes in fire and climate





Forest resilience to changes in fire and climate





Background | Annual climate | Microclimate | Conclusions

Regeneration failures following wildfire



Regeneration niche





Temperature



Regeneration niche





Temperature



Changes in microclimate



Research questions

- 1. How does annual climate affect post-fire recruitment?
- 2. How does annual climate affect post-fire seedling growth?
- 3. How does wildfire alter microclimate?

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- 2. How does annual climate affect post-fire seedling growth?
 - How does wildfire alter microclimate?

3.

Study sites and field sampling





CO data: Rother & Veblen 2017 Davis et al. 2019 PNAS

Background | Annual climate | Microclimate | Conclusions

Lab processing & tree aging



Sample size: Ponderosa: 1630 juveniles Douglas-fir: 1190 juveniles



Hankin et al. 2018 Forest Ecology and Management

Age structures



Age structures and modeling



Climate predictors	Non-climatic predictors
Mean June-August VPD	Time since fire
Max surface temperature	Distance to seed source
Spring soil moisture	Fire severity
Soil moisture driest month	

Ponderosa pine



Ponderosa pine



Douglas-fir



Douglas-fir



Climatic thresholds crossed in recent decades

Ponderosa pine



Climatic thresholds crossed in recent decades

Douglas-fir



Recruitment probability declined in recent decades



Douglas-fir

Davis et al. 2019 PNAS

Background | Annual climate | Microclimate | Conclusions

Recruitment probability declined in recent decades



Davis et al. 2019 PNAS

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Non-climatic factors are strongly influential



Research questions

- 1. How does annual climate affect post-fire recruitment?
- Warm and dry conditions limit regeneration
- The warmest & driest forests no longer have conditions suitable for regeneration
- Impacts of annual climate are mediated by multiple abiotic & biotic factors

Research questions

- 1. How does annual climate affect post-fire recruitment and growth?
- 2. How does annual climate affect post-fire seedling growth?
- 3. How does wildfire alter microclimate?

Study sites and field sampling







Map & photo: Lacey Hankin





Drier years = less growth, especially for ponderosa

PSME - juvenile



1995

1915

1935

1955

1975

1995

PIPO - juvenile

Drier years = less growth, especially for ponderosa

Higher max temp. = less growth, especially for ponderosa

1935

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PSME - juvenile



PIPO - juvenile

Drier years = less growth, especially for ponderosa

Higher max temp. = less growth, especially for ponderosa

Higher min temp. = more Doug-fir growth in past decades

Hankin et al. 2019 Ecosphere

- Ponderosa pine and Doug-fir forests may not recover following wildfires as they have in previous decades
- Climatic conditions are important to consider when planning post-fire planting
- Management practices to reduce high severity patch sizes will improve regeneration potential

Research questions

- 1. How does annual climate affect post-fire recruitment?
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- 3. How does wildfire alter microclimate?

Study sites



Davis et al. 2019 Ecography

Study design

Temperature/RH sensor

- 30 minute readings
- 3 growing seasons •



Oregon Coast Range

Bitterroot Mtns, ID

Lubrecht Forest, MT

Davis et al. 2019 Ecography

Study design





Variable	Max difference	Mean difference
Max temperature (°F)	-30.2	-6.2
Min temperature (°F)	16.5	5.6
Max VPD (kPa)	-4.98	-0.73

What does this mean for seedling regeneration after disturbance?

• Once the canopy is removed, microclimate will be more stressful for seedlings



Post-fire canopy cover







Post-fire canopy cover



Data: Kemp et al. 2016; Davis et al. 2019 Ecography



Post-fire differences in microclimate



Microclimate data: Kyra Wolf

Current conditions

Wetter, more productive forests buffer temperatures more



Future conditions

Wetter forest microclimates will change most in future



Davis et al. 2019 Ecography

Research questions

3. How does wildfire alter microclimate?

• Fires decrease canopy cover resulting in higher maximum temperatures and VPD.

Combined implications



Ficklin & Novick 2017 *Journal of Geophysical Research: Atmospheres*

Combined implications



Ficklin & Novick 2017 Journal of Geophysical Research: Atmospheres

Combined implications



Conclusions

• Some low-elevation forests have already crossed climate thresholds for recruitment.



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- Loss of canopy cover due to fire may push sites across climate thresholds.



Conclusions

- Some low-elevation forests have already crossed climate thresholds for recruitment.
- Loss of canopy cover due to fire may push sites across climate thresholds.
- Combined impacts of larger and potentially more severe fires and climate change may result in more episodic recruitment in the future, or recruitment failures.





• Target planting where no seed sources nearby but cooler/moister site conditions exist.



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- Management actions to reduce fire severity can increase post-fire regeneration by maintaining seed sources and a cooler microclimate.



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- Management actions to reduce fire severity can increase post-fire regeneration by maintaining seed sources and a cooler microclimate.
- May need to accept transitions to non-forest vegetation types in hottest and driest areas.







"Integrating Subjective and Objective Dimensions of Resilience in Fire-Prone Landscapes" Higuera et al. 2019 *Bioscience*







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Questions?



Contact Us, Share Your Ideas



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