

Ecosystem Responses to Conifer Encroachment & Removal in a Northern California Oak Woodland



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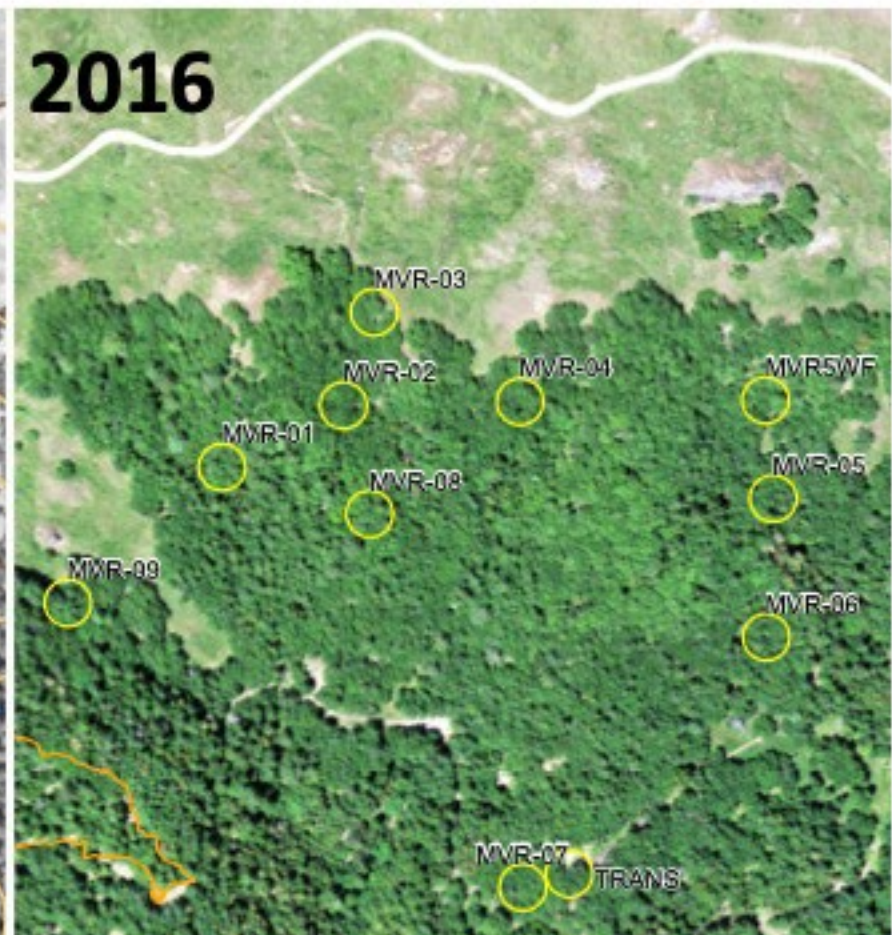
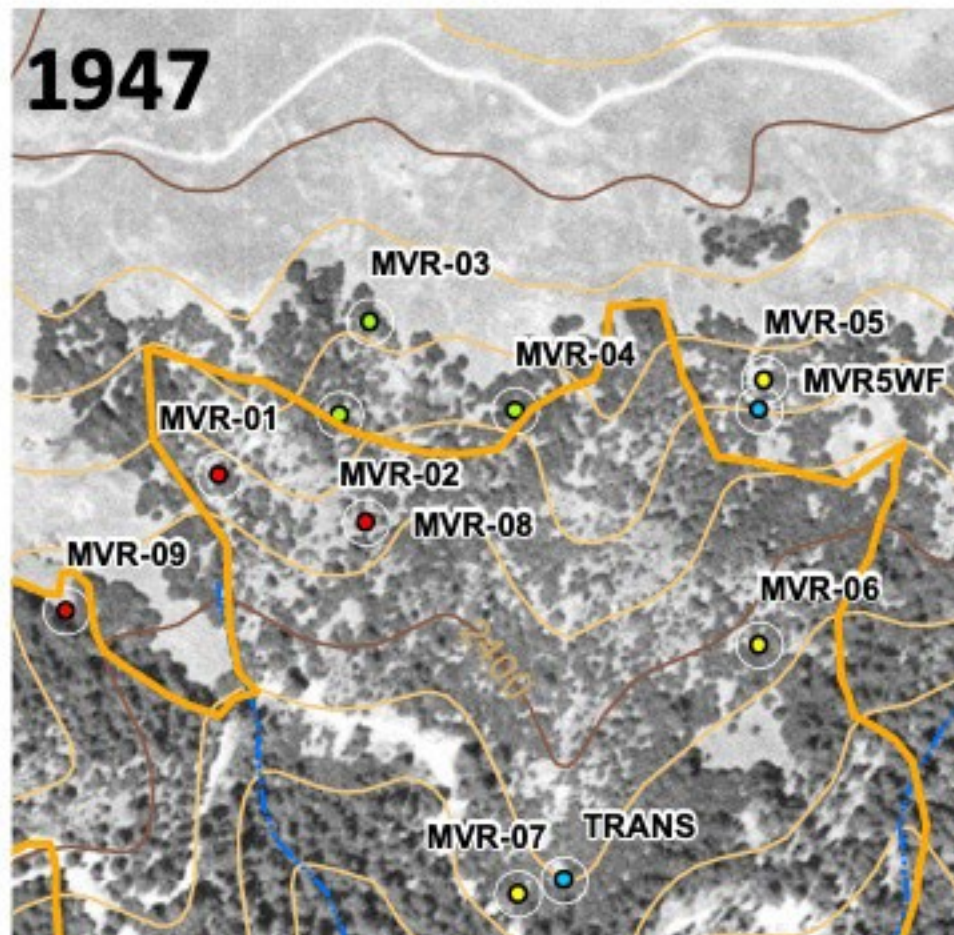
Oak Woodlands

- Biodiversity
- Indigenous cultures
- Iconic landscapes of the Pacific Northwest
- Threats: Habitat loss & conifer encroachment



Study Sites

- 2 Open
- 2 Moderately encroached
- 2 Moderately encroached, thinned
- 2 Heavily encroached
- 2 Heavily encroached, thinned



Questions

1. How does oak physiology vary with season, encroachment, treatment, & climate?
2. How does woodland biodiversity vary with encroachment & treatment?



Methods

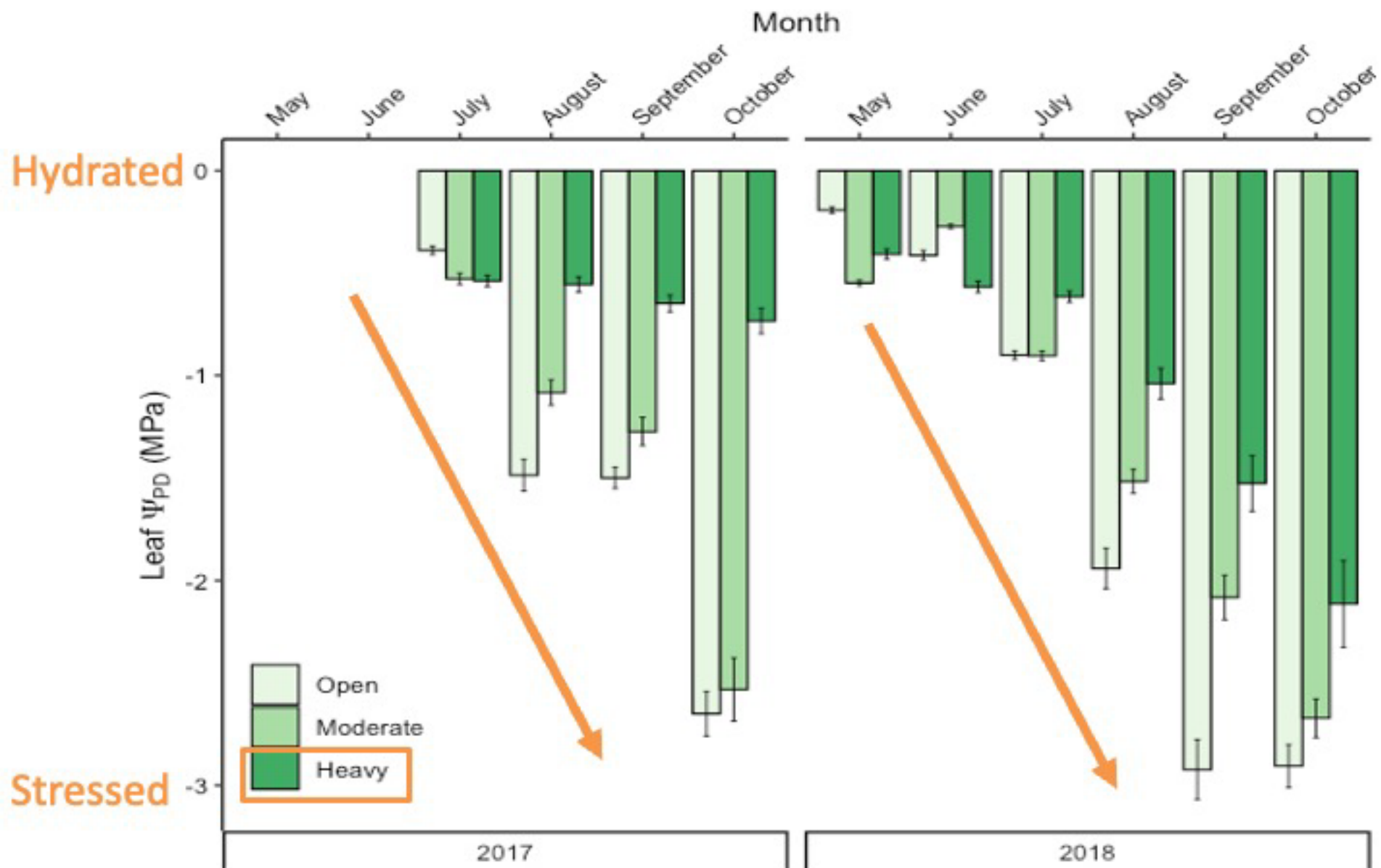
- 2017 (pre-thin), 2018, 2019
- Measurements
 - Water potential
 - Xylem water isotopic signature
 - Stomatal conductance
 - Biodiversity (post-thin only)
 - Plants
 - Mammals
 - Birds
- Physiology/Climate modeling



New Olympic Sport: Pole Pruning!?

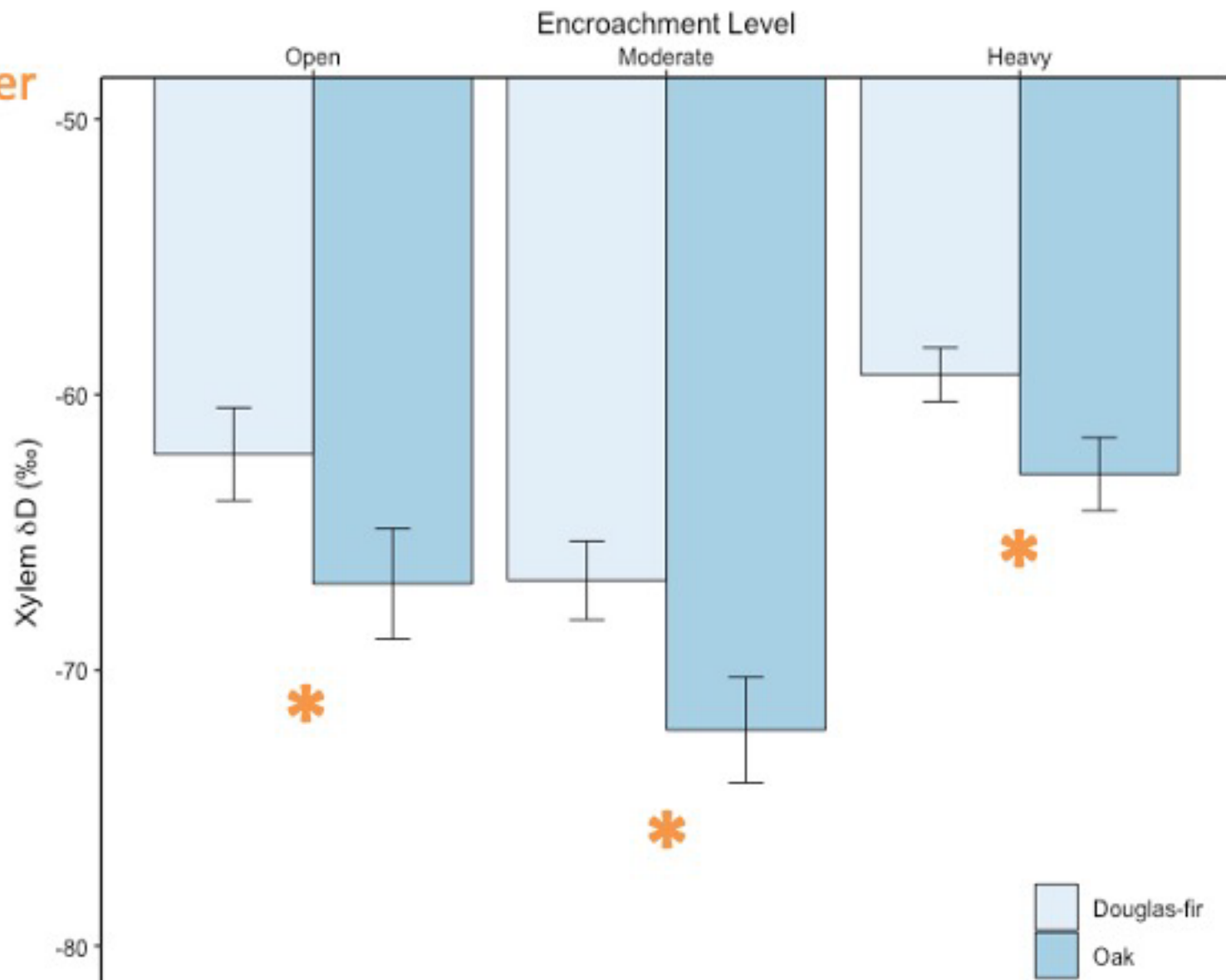


Ψ : Season & Encroachment Levels



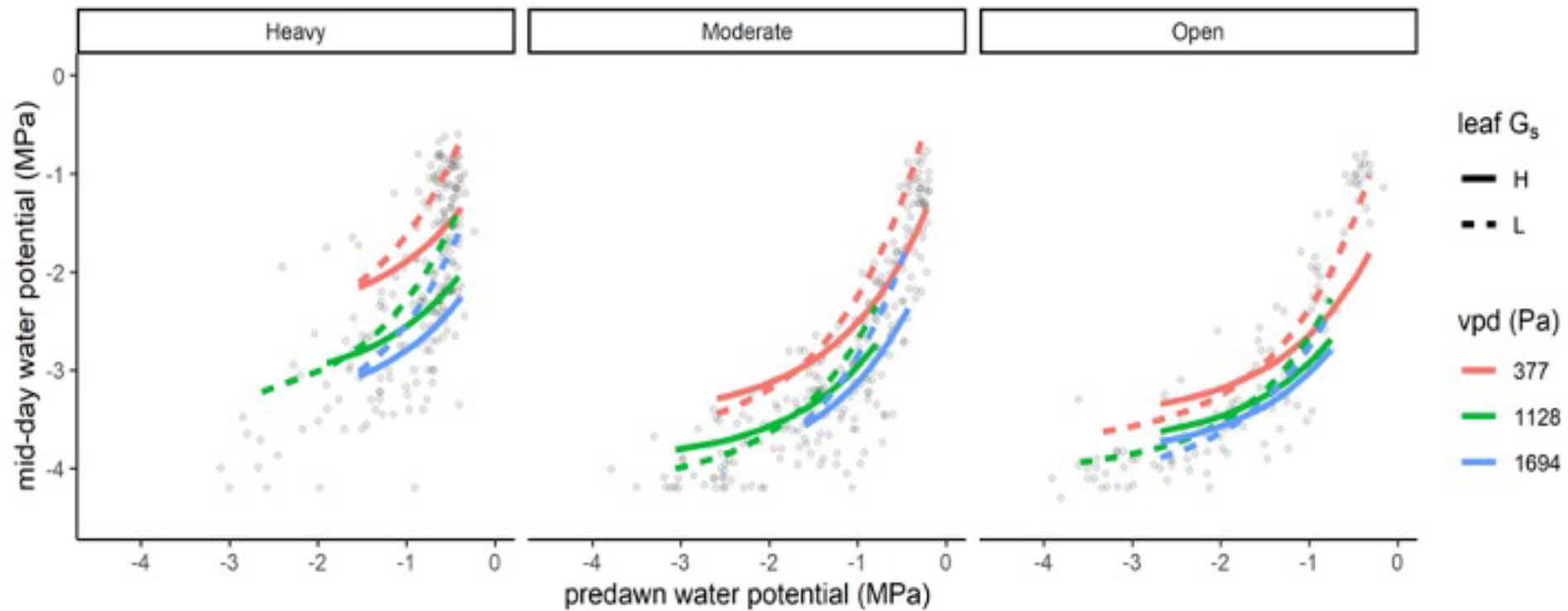
Tree Water Sources?

Shallower
Water

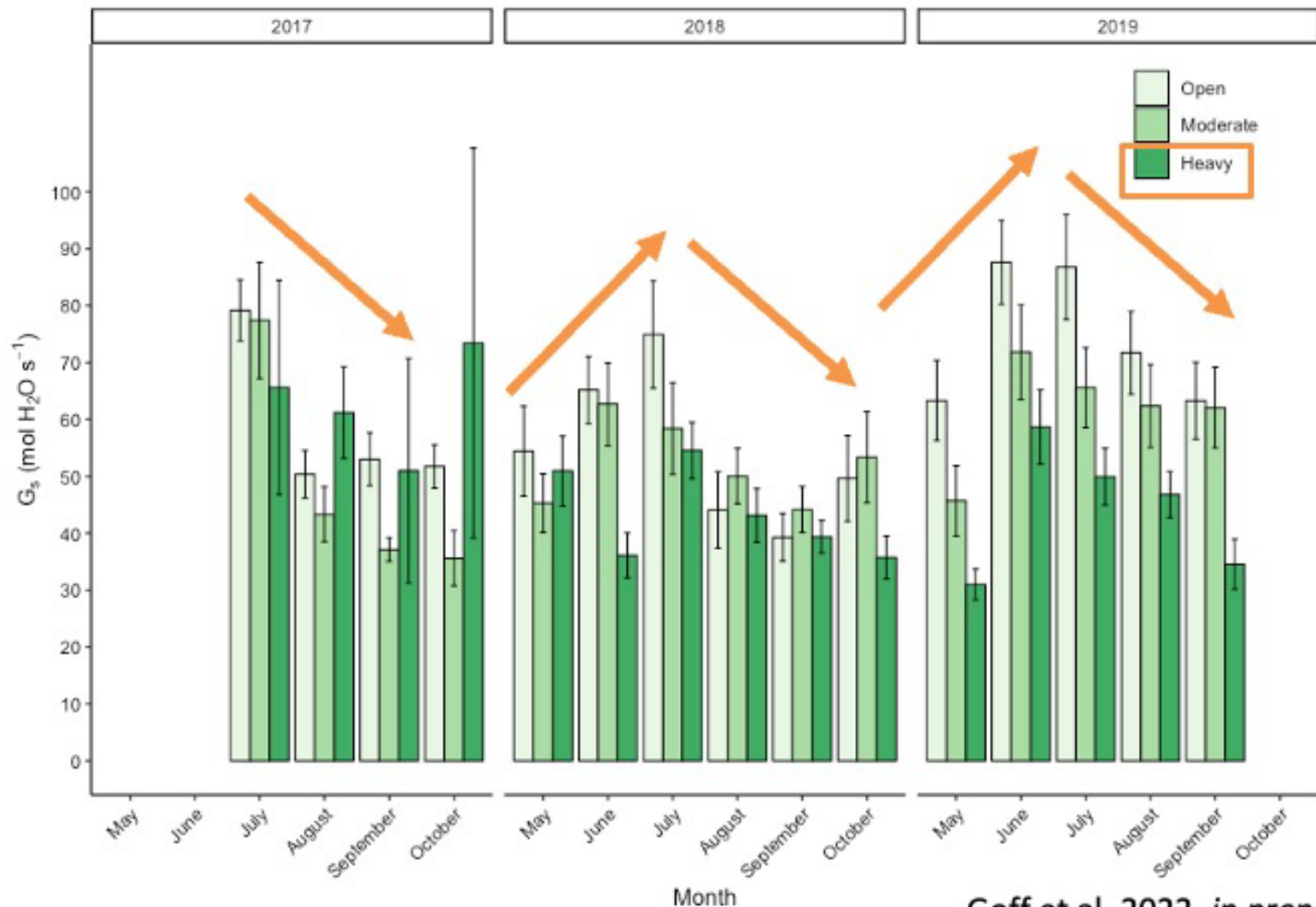


Deeper
Water

Encroachment Increases VPD Sensitivity

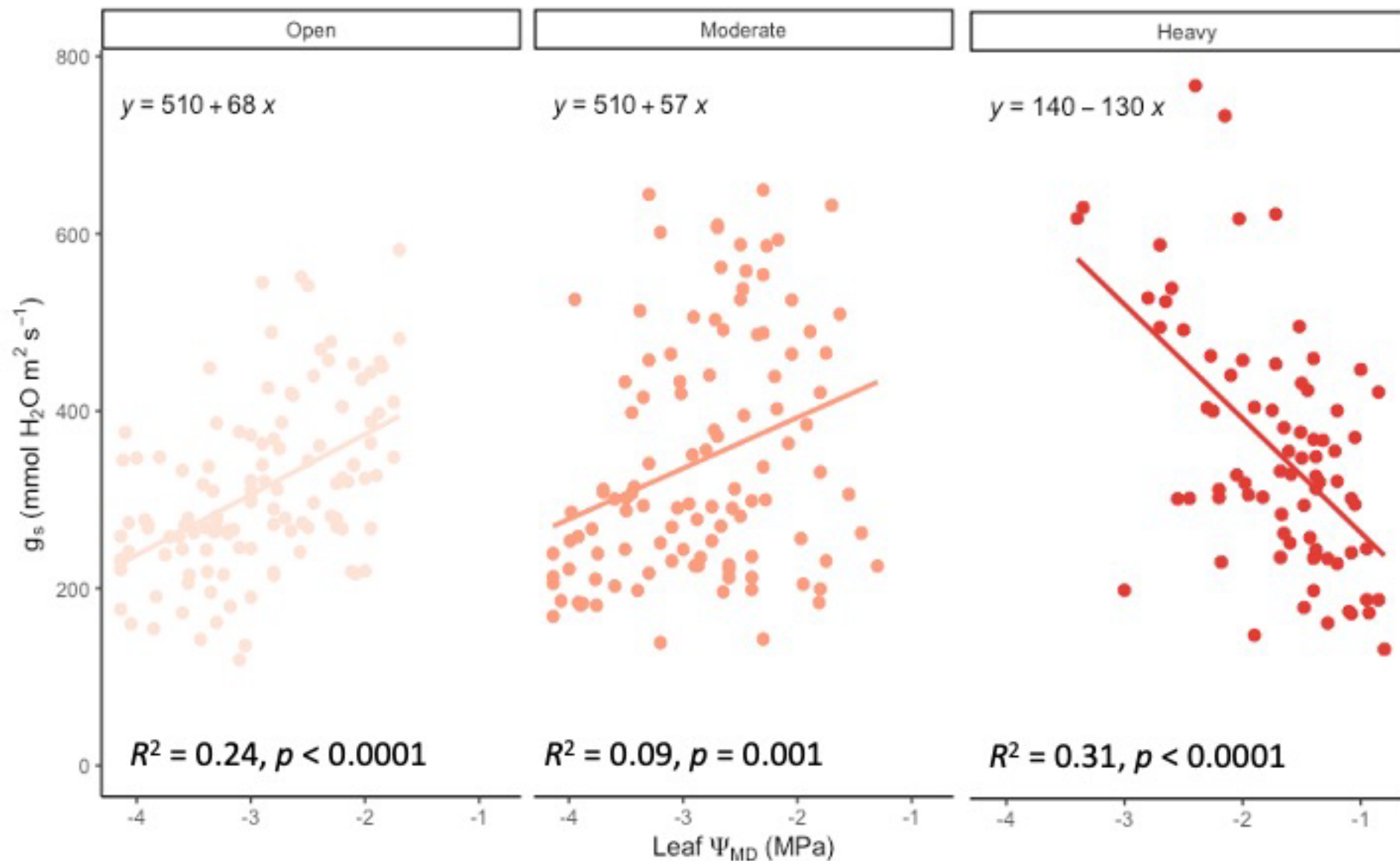


G_s : Season & Encroachment Levels

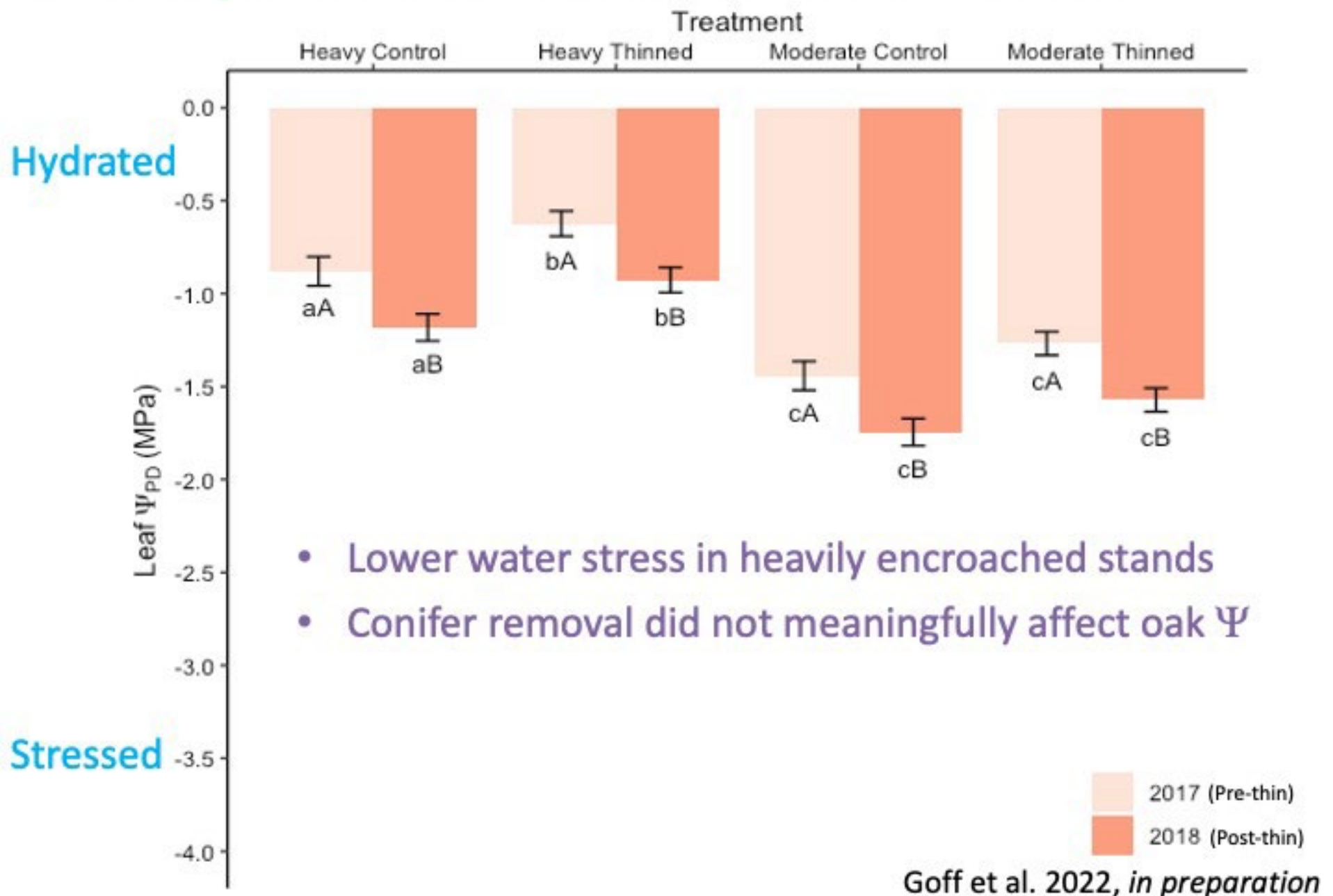


Goff et al. 2022, *in preparation*

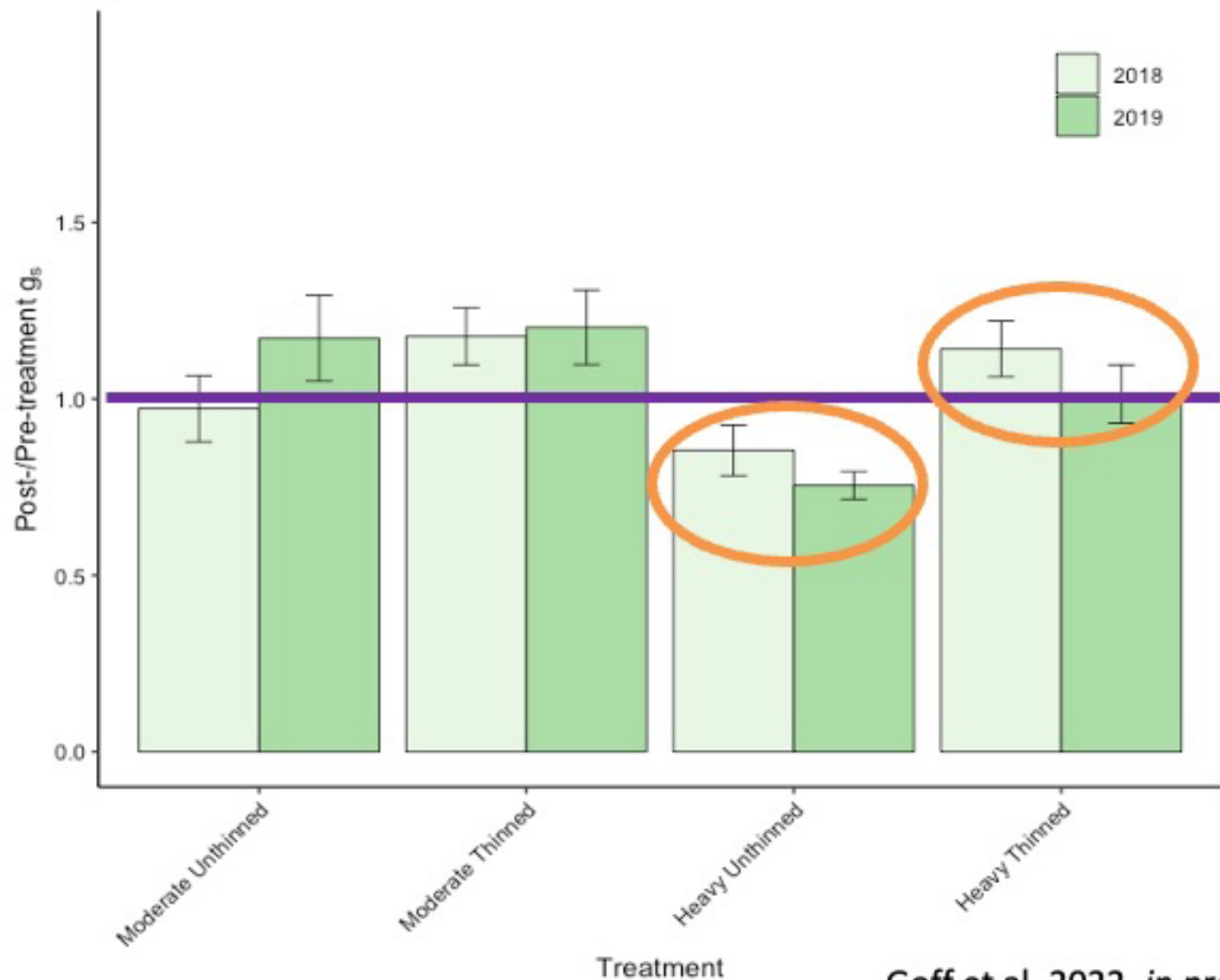
Physiological Acclimation?



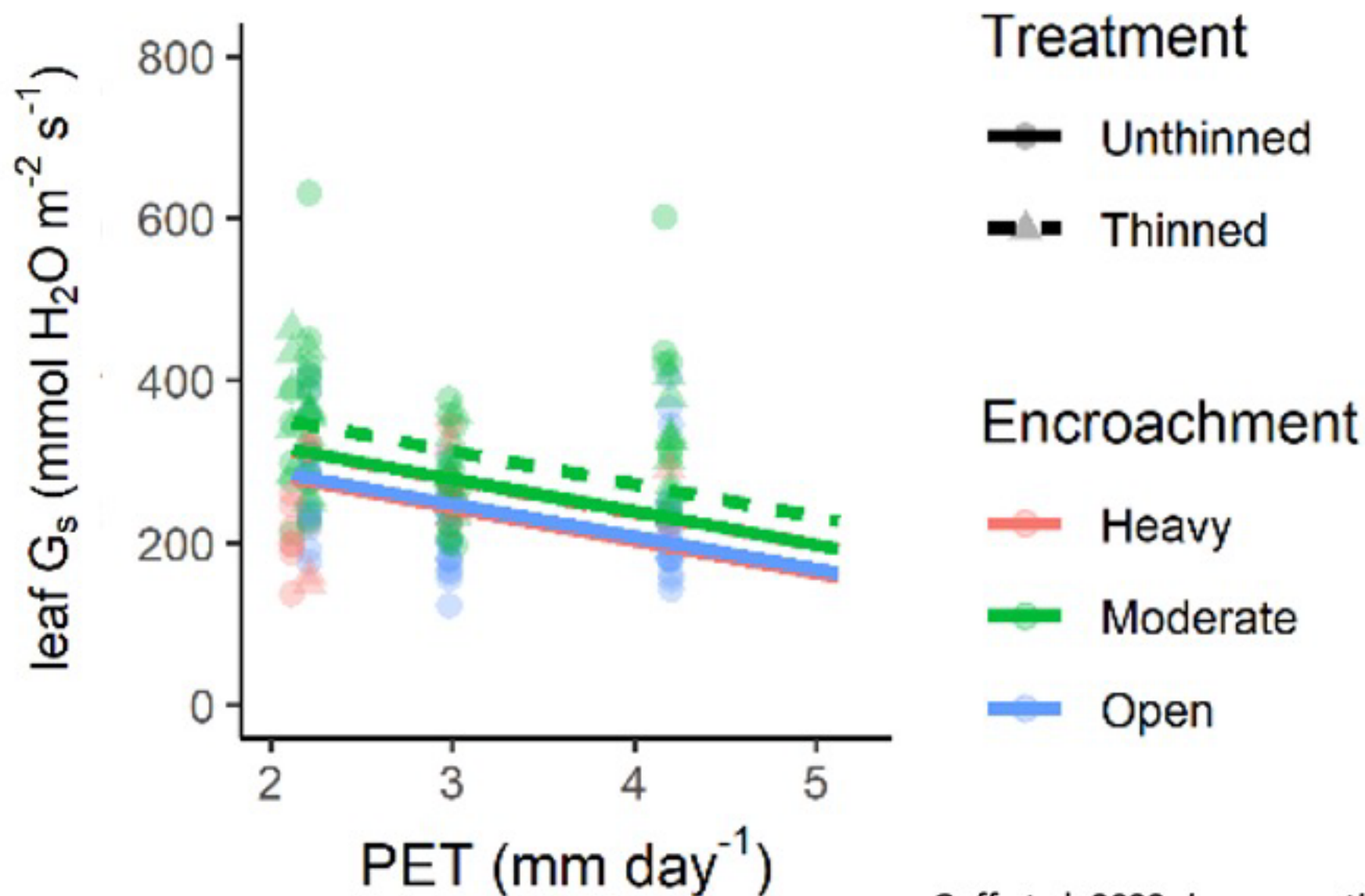
Ψ Response to Conifer Removal?



G_s Response to Conifer Removal?



Thinning Increases Gas Exchange



Biodiversity

- Lowest plant diversity in heavily encroached stands
- Lowest mammal diversity in open stands
- Bird diversity relatively invariable with encroachment & treatment



Take-Home Points

1. Conifer encroachment reduces oak water stress & gas exchange
2. Conifer removal does not meaningfully increase oak water stress & increases gas exchange
3. Woodland biodiversity responses to encroachment & treatment need further study
4. *Conifer removal should be aggressive*
5. *Heavily encroached stands are responsive to treatment*



Thank You!



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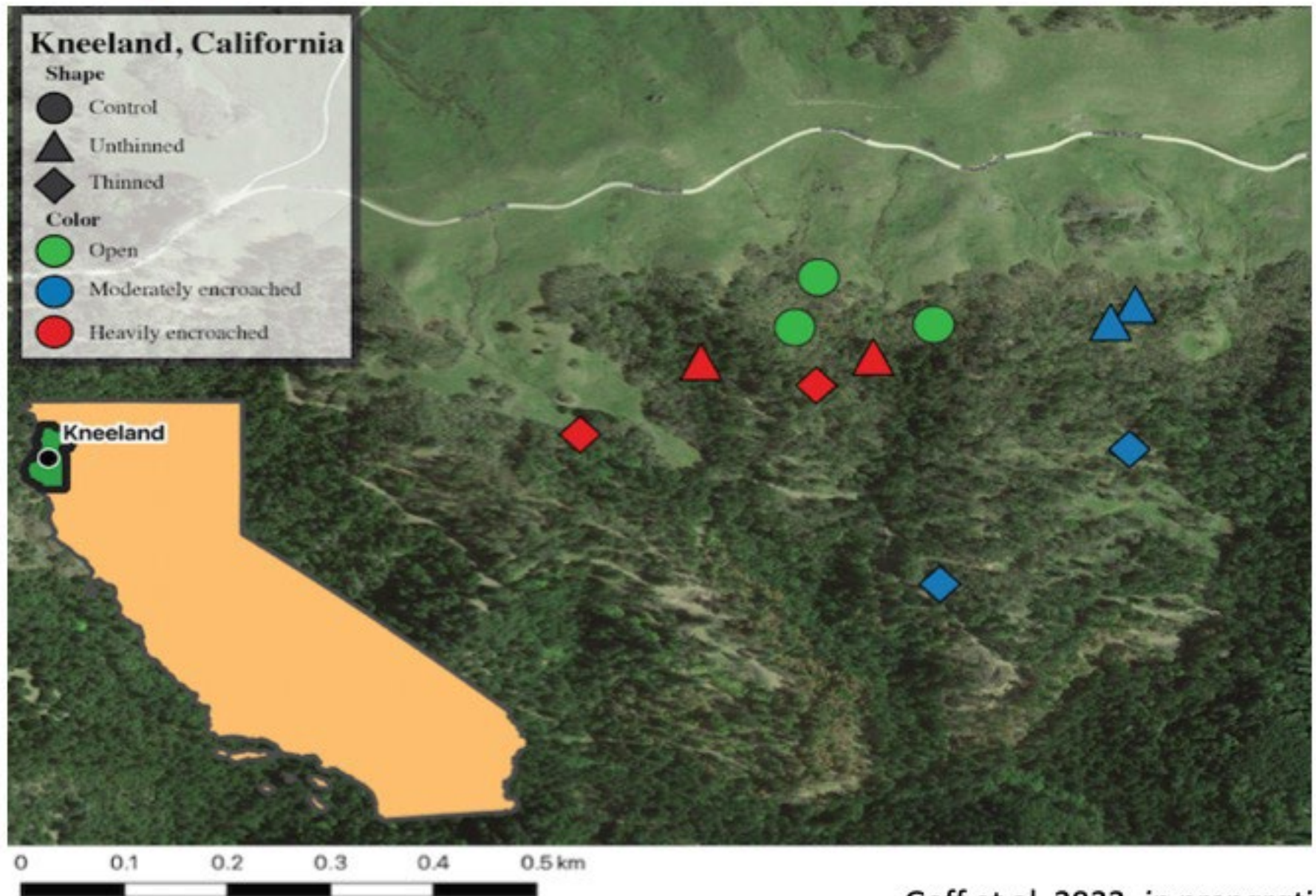
- Funders
- Collaborators
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- HSU Sponsored Programs Foundation
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- Humboldt Redwood Company
- Student Assistants
 - Tossa Hayward
 - Rachael Heller
 - Michelle Kunst
 - James Lamping
 - Wade Polda
 - Kevin Soland



Questions?



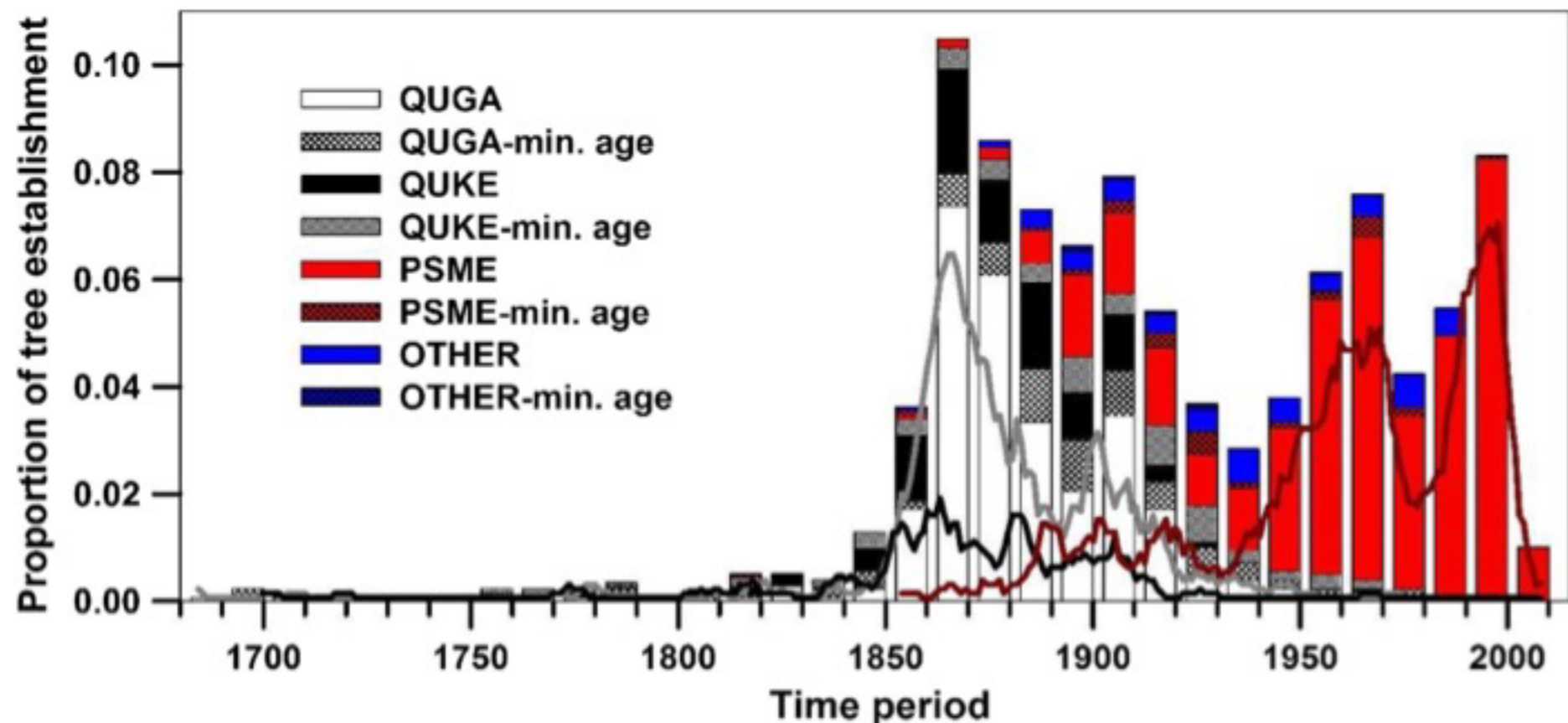
Study Sites



Goff et al. 2022, *in preparation*

Conifer Encroachment

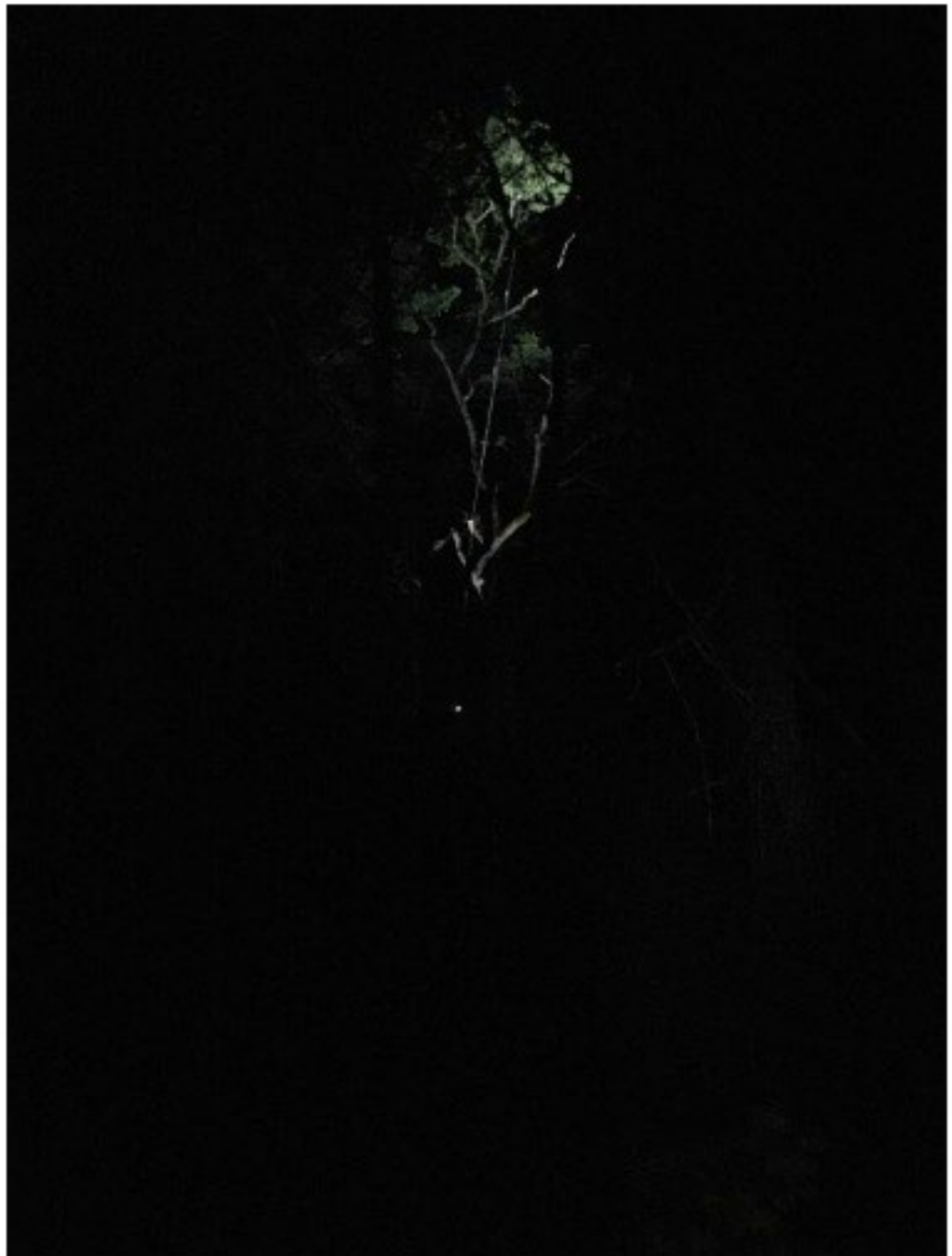
- In past 50-100 years, lost ~30% of oak woodlands in northern CA



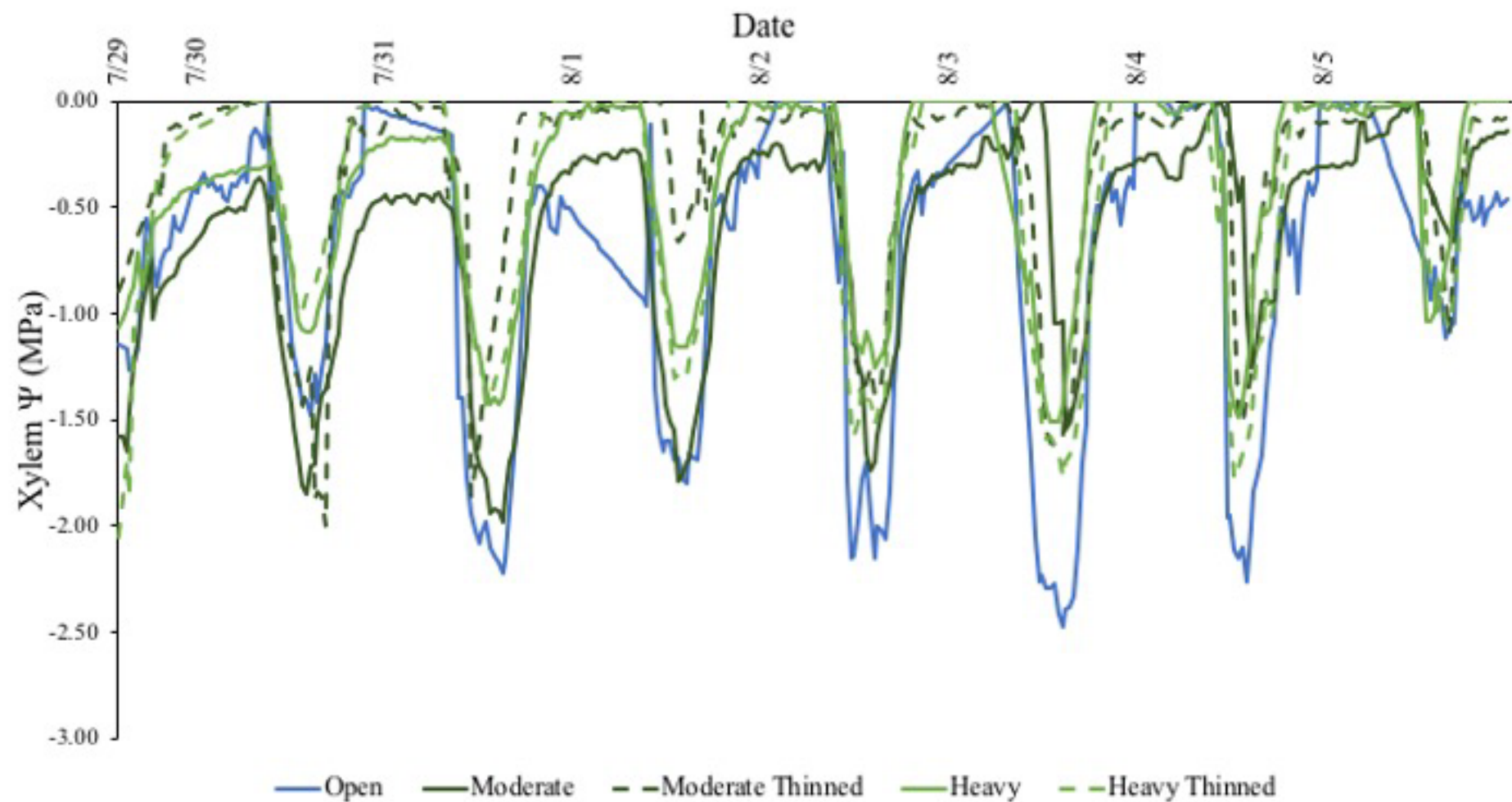
Study Sites

Encroachment	Treatment	Aspect	Slope	DBH (cm)	BA (m ² ha ⁻¹)	A _L (m ² tree ⁻¹)	N (Trees)
Open	Control	SE	36%	31 ± 3	83 ± 5	186 ± 19	19
Moderate	Unthinned	SE	54%	24 ± 2	115 ± 8	142 ± 12	19
Moderate	Thinned	S	35%	34 ± 4	95 ± 9	208 ± 27	20
Heavy	Unthinned	S	47%	29 ± 5	180 ± 16	173 ± 37	7
Heavy	Thinned	E	22%	30 ± 2	146 ± 12	183 ± 15	19
All Plots			39%	30 ± 2	124 ± 17	178 ± 11	94
<i>p</i> (Encroachment)				0.71	< 0.0001	0.71	
<i>p</i> (Treatment)				0.02	0.02	0.02	

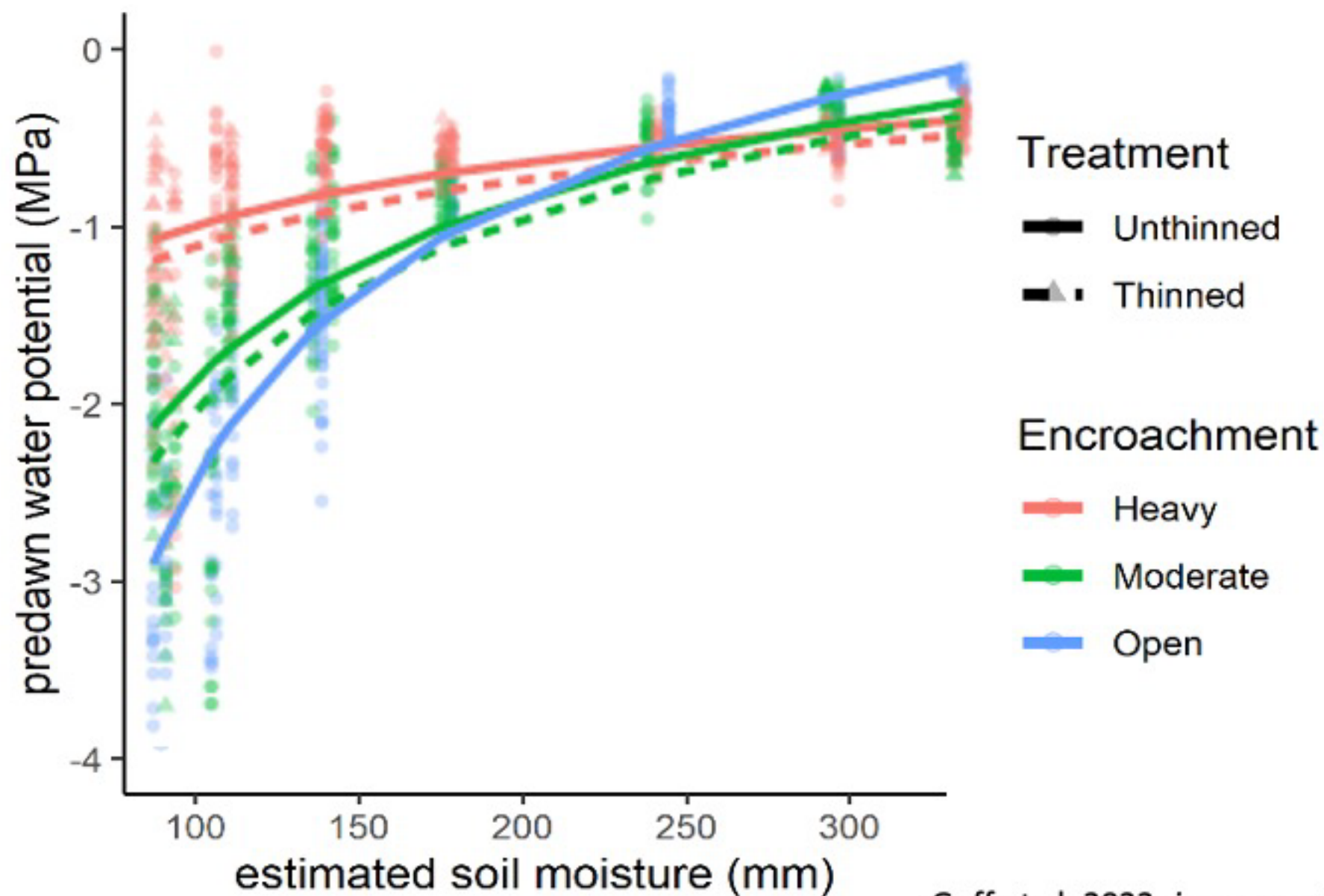
Predawn Pole Pruning!



Ψ Diurnal Trends

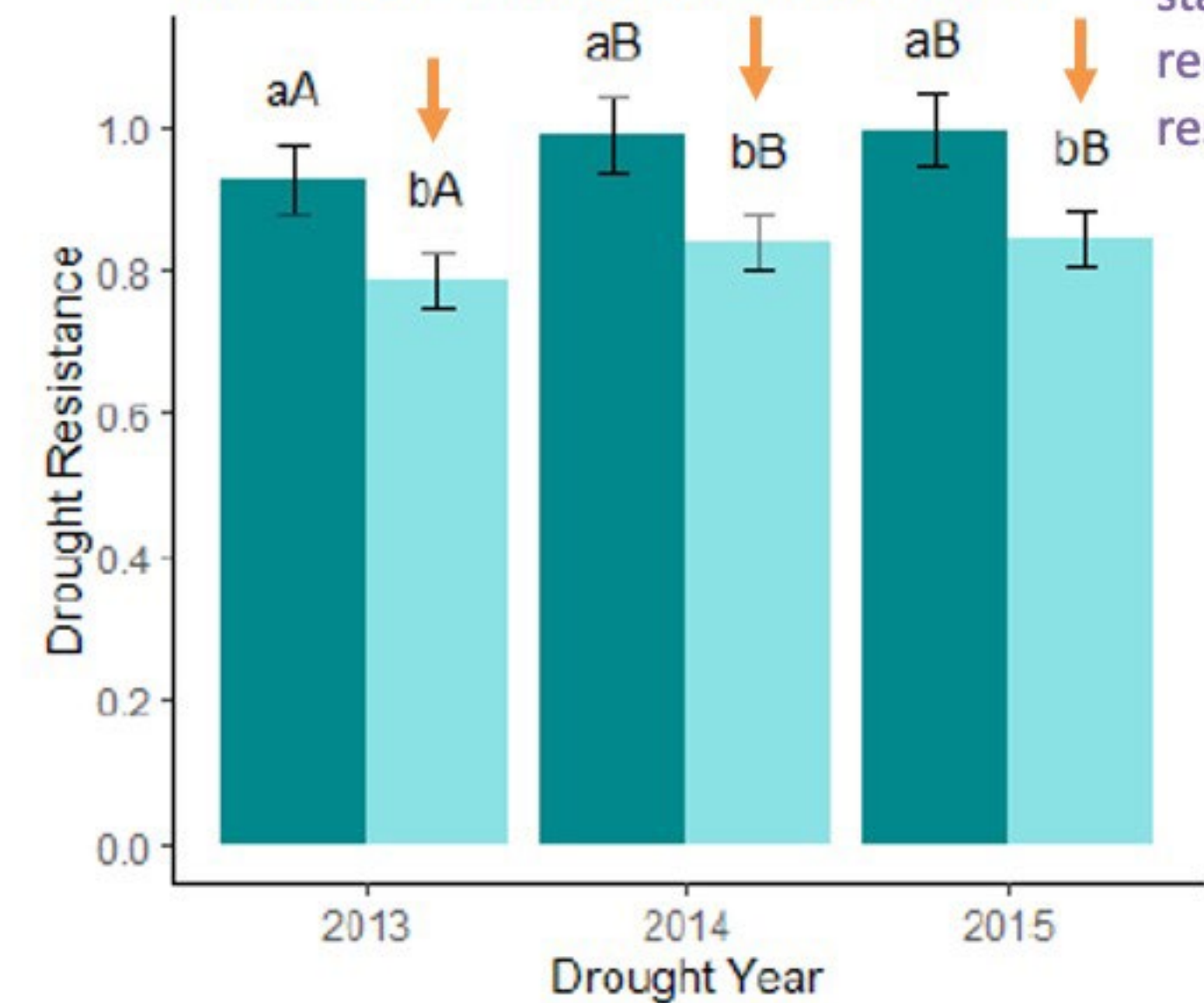


Thinning Decreases Water Status



Drought Resistance

White Oak Trees, Stand Condition

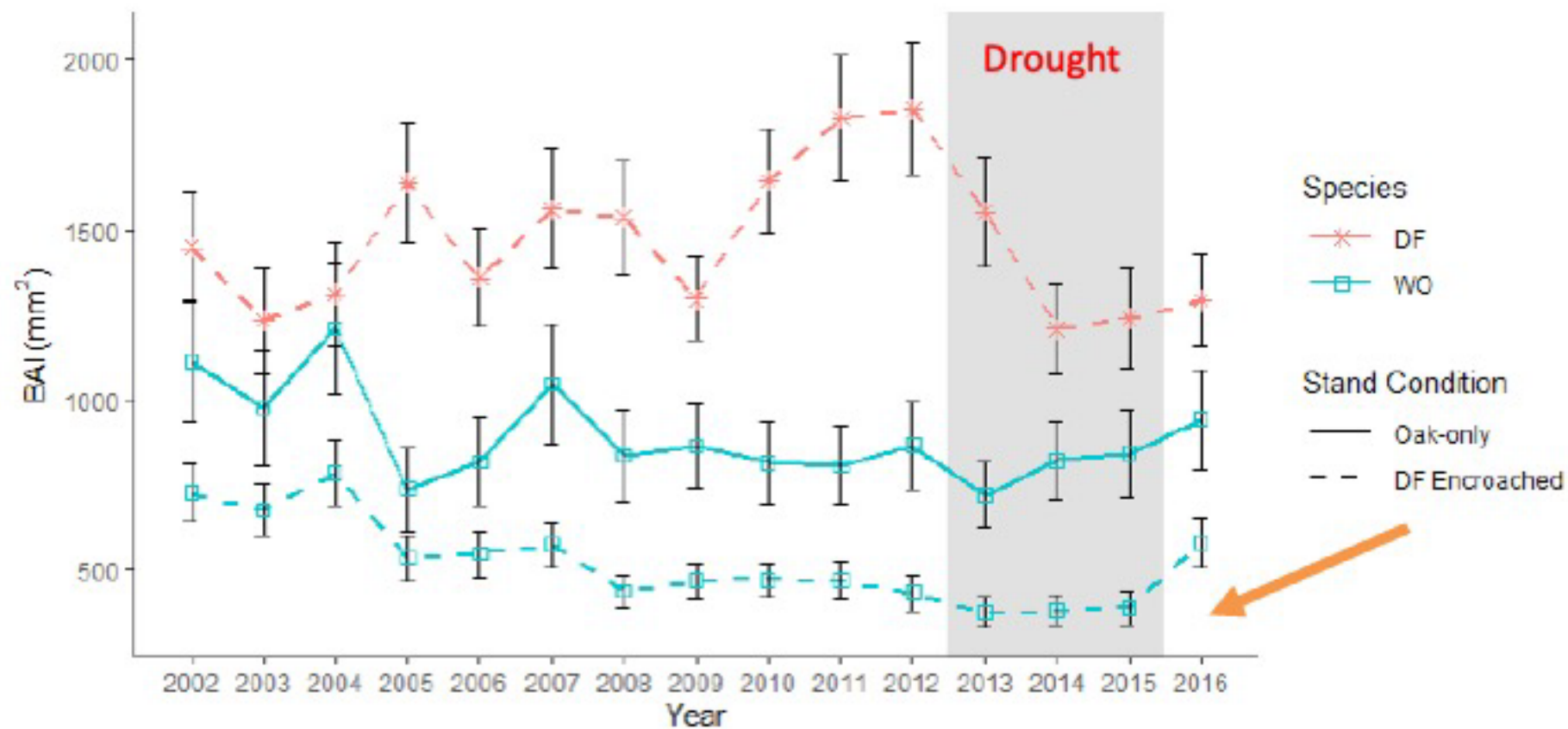


Thoughts? PSME
Enhances oak water
status but yet
reduces drought
resistance?

Stand Condition

- Oak-only
- DF Encroached

Growth



Oak Growth Release

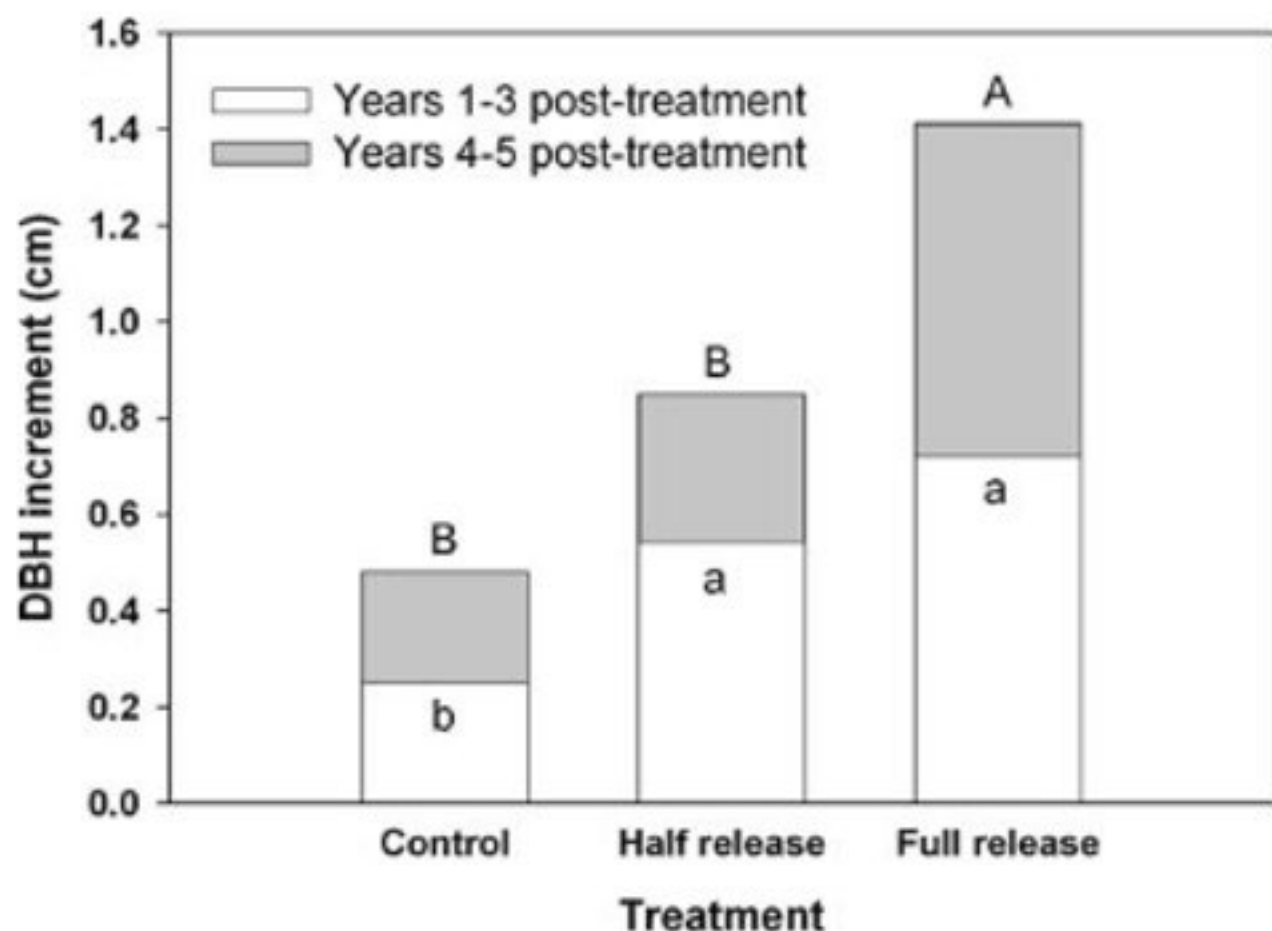


Fig. 1 Diameter at breast height (DBH) growth increment after three release treatments. Same lowercase letters denote no difference ($P \geq 0.05$) in response for years 1–3 only; same uppercase letters denote no difference ($P \geq 0.05$) in response for years 1–5

Biodiversity

	Encroachment	Year	Treatment	S	D	H'
Plants						
	Open	2018	Control	18 ± 2	29.02 ± 1.37	1.86 ± 0.08
		2019		18.5 ± 0.5	18.61 ± 0.22	2.71 ± 0.11
	Moderate	2018	Unthinned	18 ± 3	25.27 ± 0.65	2.05 ± 0.21
		2019		13.5 ± 3.5	17.83 ± 1.17	2.14 ± 0.34
	Moderate	2018	Thinned	18 ± 2	26.10 ± 1.59	1.98 ± 0.23
		2019		21 ± 3	21.10 ± 2.03	2.70 ± 0.13
	Heavy	2018	Unthinned	9.5 ± 5.5	7.09 ± 16.89	1.27 ± 0.61
		2019		12 ± 9	11.56 ± 22.69	1.31 ± 0.55
	Heavy	2018	Thinned	12.5 ± 3.5	29.19 ± 4.15	1.53 ± 0.10
		2019		13 ± 4	18.44 ± 2.93	2.01 ± 0.22
Mammals						
	Open	2018	Control	3.5 ± 0.5	0.28 ± 0.074	0.55 ± 0.094
		2019		4 ± 1	0.38 ± 0.137	0.13 ± 0.494
	Moderate	2018	Unthinned	5.5 ± 0.5	0.69 ± 0.001	1.24 ± 0.005
		2019		10.5 ± 0.5	0.72 ± 0.039	0.34 ± 0.043
	Moderate	2018	Thinned	4 ± 0.5	0.64 ± 0.049	1.09 ± 0.103
		2019		6.5 ± 0.5	0.64 ± 0.054	0.13 ± 0.298
	Heavy	2018	Unthinned	6 ± 1	0.63 ± 0.042	1.19 ± 0.114
		2019		8.5 ± 0.5	0.65 ± 0.033	1.25 ± 0.138
	Heavy	2018	Thinned	5 ± 0.5	0.56 ± 0.073	0.98 ± 0.182
		2019		5.5 ± 1.5	0.59 ± 0.065	0.82 ± 0.386
Birds						
	Open	2018	Control	14.5 ± 1	0.90 ± 0.003	2.36 ± 0.045
		2019		15 ± 1	0.90 ± 0.014	2.36 ± 0.105
	Moderate	2018	Unthinned	10.5 ± 1.5	0.87 ± 0.002	2.09 ± 0.079
		2019		18 ± 1	0.91 ± 0.003	2.55 ± 0.012
	Moderate	2018	Thinned	11 ± 1	0.88 ± 0.010	2.15 ± 0.016
		2019		15 ± 1	0.89 ± 0.001	2.35 ± 0.082
	Heavy	2018	Unthinned	14 ± 3	0.91 ± 0.010	2.36 ± 0.161
		2019		13.5 ± 0.5	0.90 ± 0.004	2.35 ± 0.048
	Heavy	2018	Thinned	18.5 ± 2	0.93 ± 0.001	2.65 ± 0.025
		2019		17 ± 2	0.92 ± 0.007	2.53 ± 0.111