IFC SDI_{MAX} LODGEPOLE PINE MODEL:

EVALUATION OF SITE EFFECTS ON THE FRONTIER BOUNDARY

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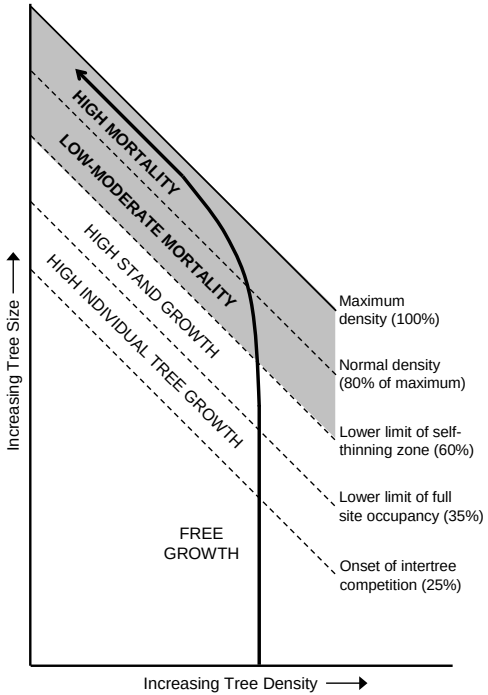
2017 ANNUAL MEETING

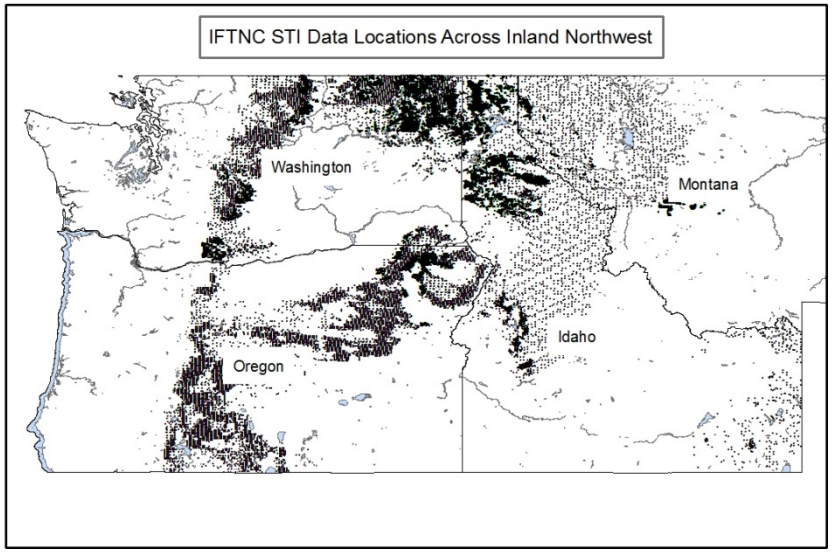
University of Idaho
Intermountain Forestry Cooperative

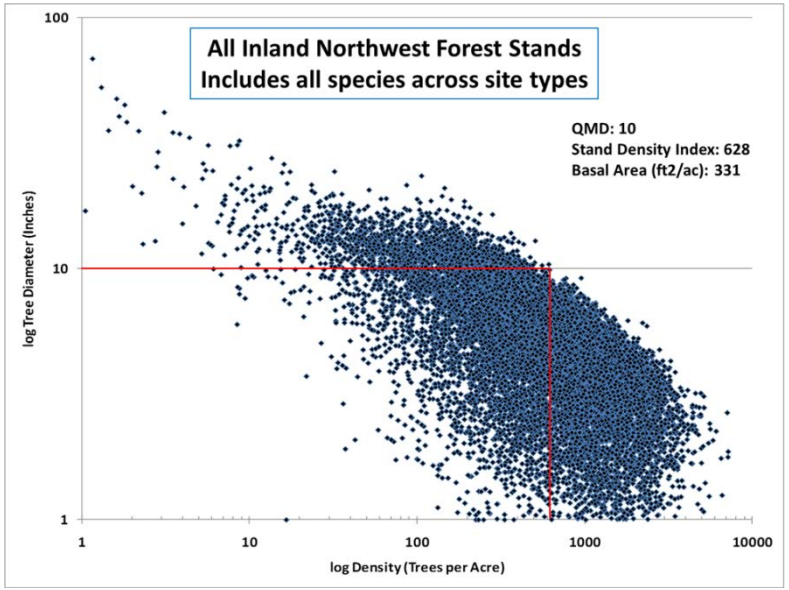
STAND DENSITY INDEX REVIEW

- For a given average tree size, there is a limit (maximum) to the number of trees per acre that may coexist in a stand
- % of max SDI an index of intra-tree competition for site resources
- Shifts in the slope & intercept reflect changes in site carrying capacity – site quality?
- Used to define upper and lower limit management zones

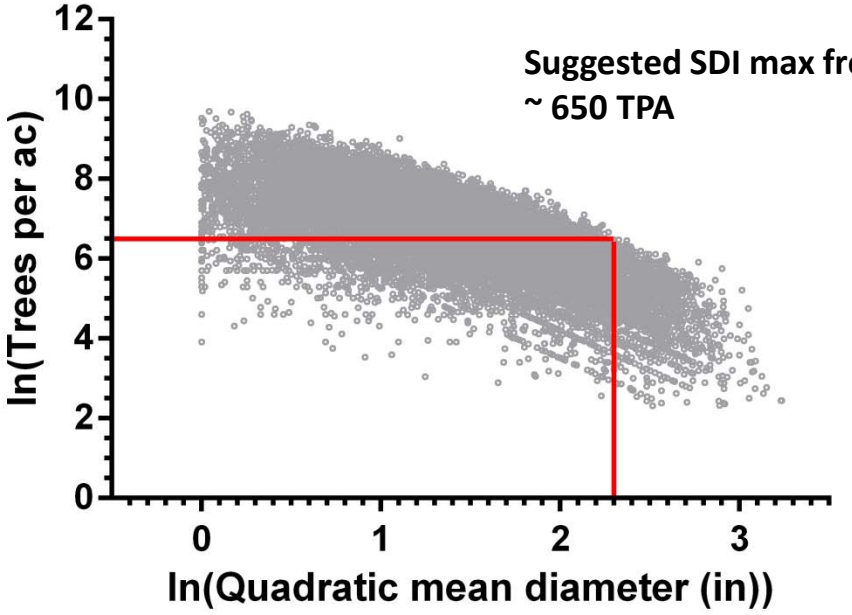


IFC PARTNER CONTRIBUTION





LODGEPOLE PINE SIZE-DENSITY PLOT



Suggested SDI max from data:
~ 650 TPA

From Long, 1985:
~ 690 TPA

A Practical Approach to Density Management

by

James N. Long[1]

Abstract

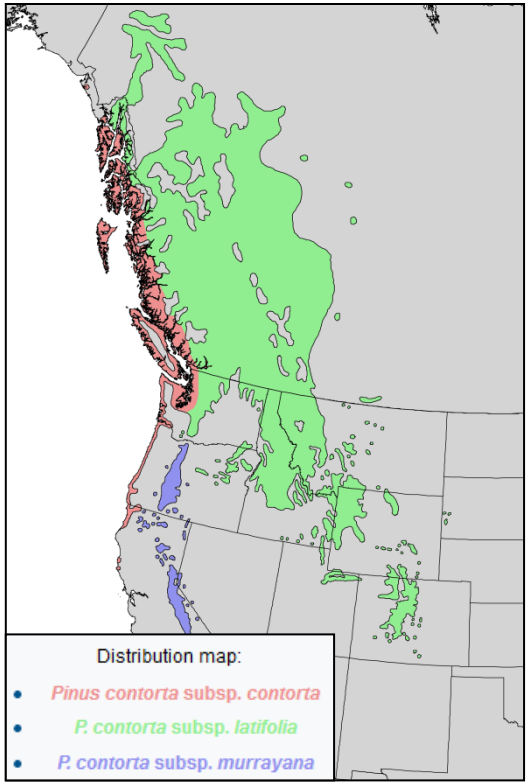
Density management is the control of growing stock, through initial spacing or subsequent thinning, to achieve specific management objectives. A biologically sound and easily applied approach to density management is illustrated for a hypothetical, even-aged stand under two contrasting types of management objectives.

Résumé

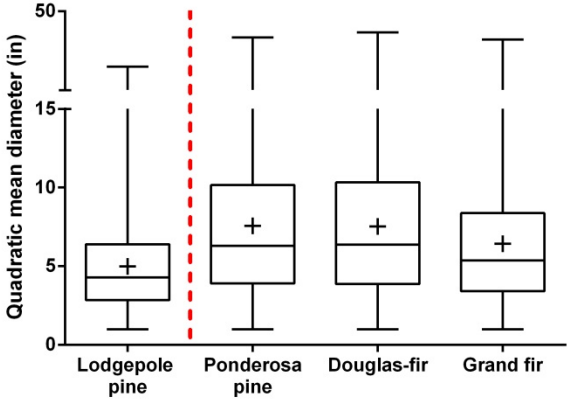
L'aménagement par densité est le contrôle du volume sur pied grâce à l'espacement initial et aux éclaircies subséquentes pour atteindre des objectifs d'aménagement spécifiques. Une approche biologiquement solide et facilement applicable de l'aménagement par densité est illustrée pour un peuplement équienne hypothétique selon deux différents types d'objectifs d'aménagement.

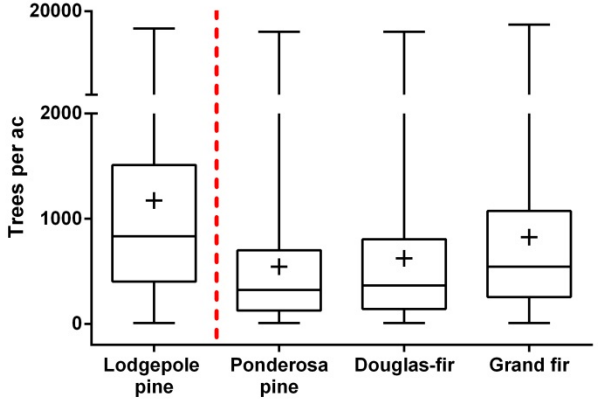
ECOLOGY OF LODGEPOLE

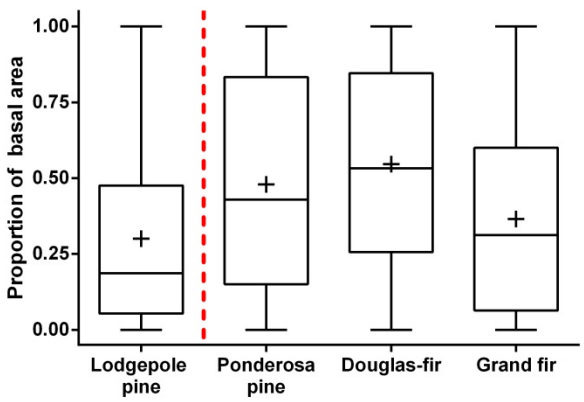
- Three major subspecies – two within the INW
- Wide geographic and physiographic amplitude
- Niches:
  - Seral species to more shade tolerant tree species
  - Relatively stable co-dominant with one or more other species
  - Pure, climax only tree species dominant
- Physiology varies by ecological niche and geography



SITE & STAND CHARACTERISTICS







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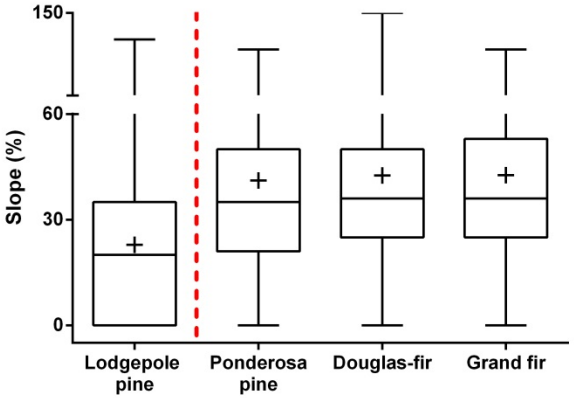

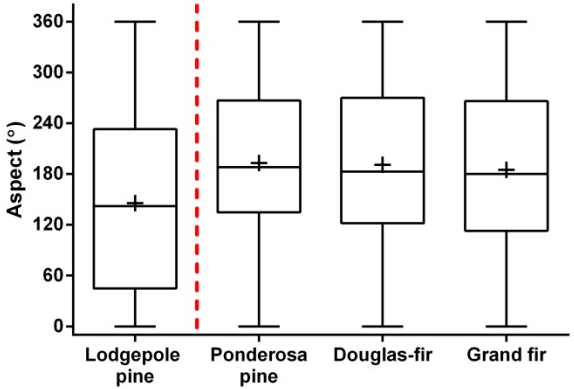

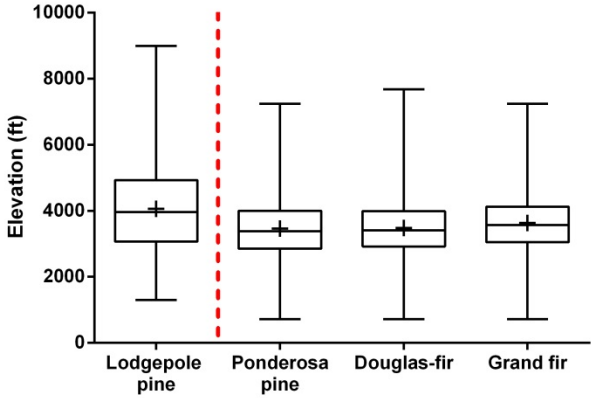

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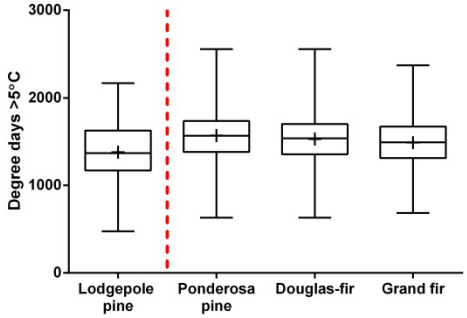
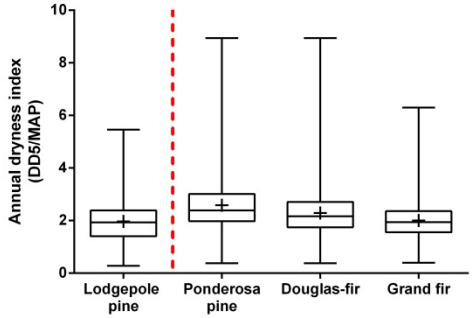
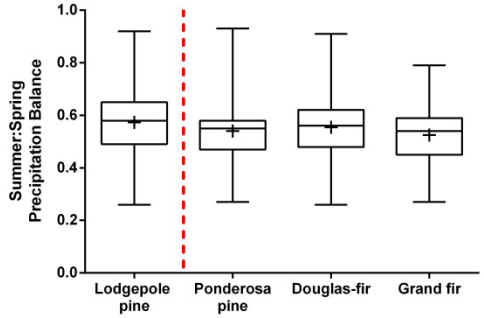
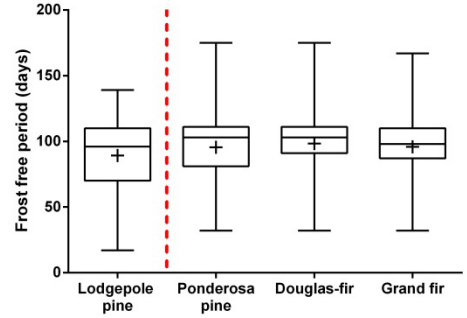
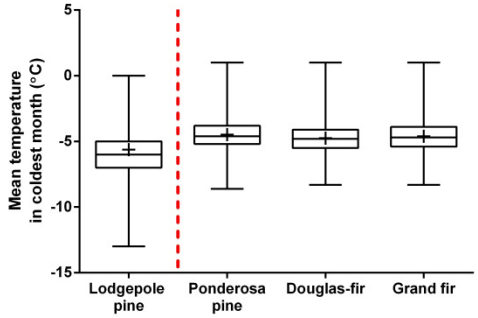




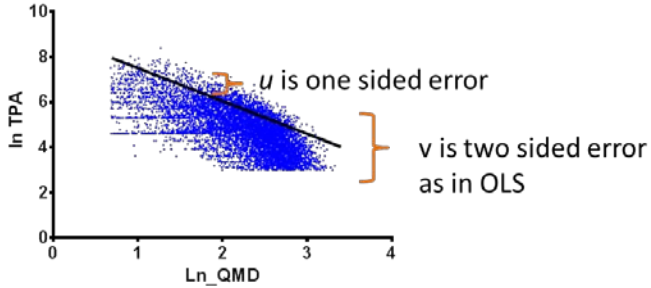






STOCHASTIC FRONTIER REGRESSION

- Econometrics fitting technique used to study production efficiency, cost and profit frontiers
- SFR Model:
  - *Ln(TPA) = α + β*Ln(QMD) + v - u*
  - *v* = two-sided random error (OLS error)
  - *u* = non-negative random error (Frontier error)
  - Maximum likelihood techniques estimate the frontier
- Fitting performed using SAS PROC QLIM



MODEL VARIABLE SPECIFICATION

- Stepwise model selection using the basic formula:

$$lnTPA = \beta_0 + \beta_1(lnQMD) + \ldots\ldots + \beta_n(factor\ n)$$

  - Stand characteristics (Q,P) – QMD, logit(LP BA proportion)
  - Geographic (G) – Latitude, Longitude
  - Topographic (T) – Slope, sin/cos(aspect), Elevation
  - Climatic (C) – DD5, ADI, FFP, MTCM, SMSPRPB
  - Soil Parent Material (S) – Geology, Volcanic Ash

MODEL SELECTION – AIC/LLR TESTS

		Stochastic Frontier Regression Statistics					
Species	**Model***	**σ^2**	**σ^2_v**	**σ^2_u**	**γ (σ^2_u/ σ^2)**	**AIC**	**LLR****
Lodgepole pine	Q	1.333	0.081	1.252	0.939	52730	-
	Q+P	1.312	0.083	1.229	0.937	52165	206
	Q+P+T	1.283	0.079	1.204	0.942	51453	714
	Q+P+T+G	1.242	0.078	1.164	0.937	50761	698
	Q+P+G+C***	1.229	0.073	1.156	0.941	50216	548
	Q+P+G+C+S	1.220	0.073	1.147	0.940	50141	80

* Q = QMD, P = % LP BA, T = Topography, G = Geography, C = Climate, S = Soil

**All sequential models to Model Q significant at α=0.05, Chi-square distribution

** Topography drops from model with climate variables

FINAL MODEL SELECTION

- Stochastic Frontier Regression Equation:

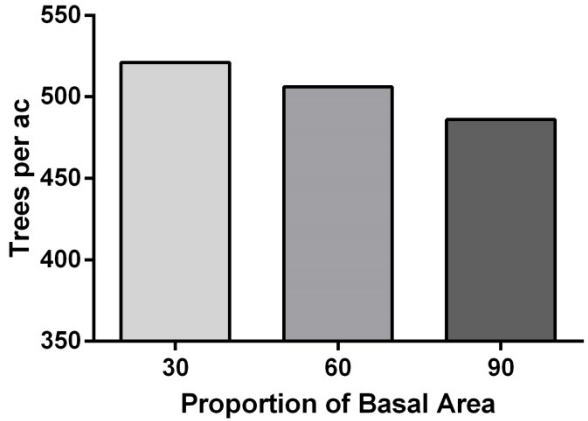
$$lnTPA = \beta_0 - \beta_1(lnQMD) - \beta_2\left(logit\left(\frac{PBA}{1-PBA}\right)\right) \quad \textbf{Stand}$$

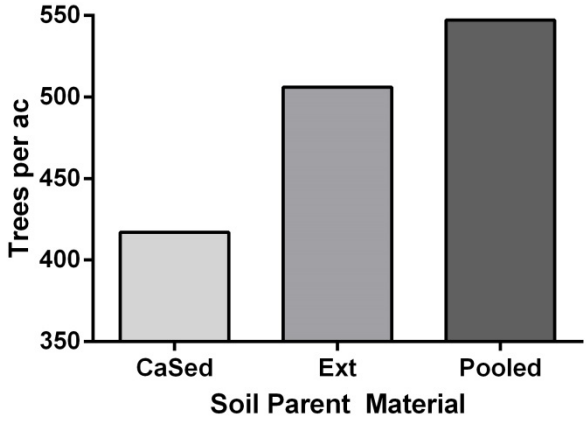
$$- \beta_3(Latitude - 42) + \beta_4(Abs(Longitude - 111)) \quad \textbf{Geography}$$

$$- \beta_5\left(\frac{DD5}{1000}\right) - \beta_6(ADI) + \beta_7(FFP) \quad \textbf{Climate}$$

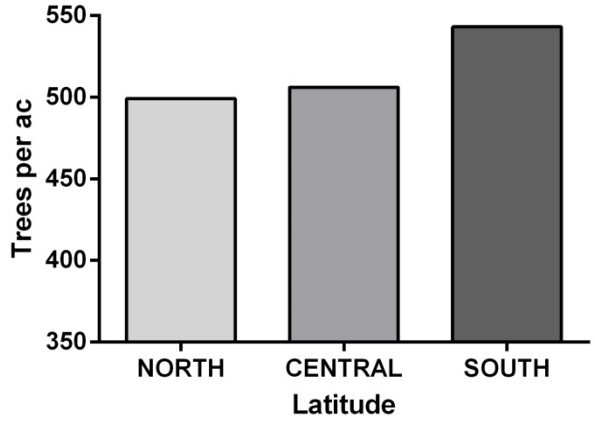
$$- \beta_8(CaSedimentary, 0) - \beta_9(Extrusive, 0) \quad \textbf{Soil}$$

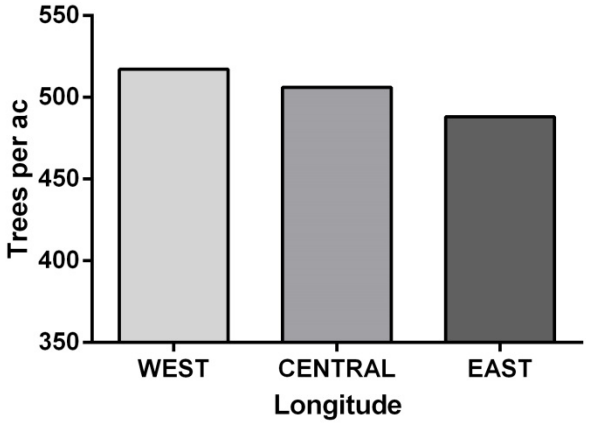
STAND & SOIL MARGINAL EFFECTS

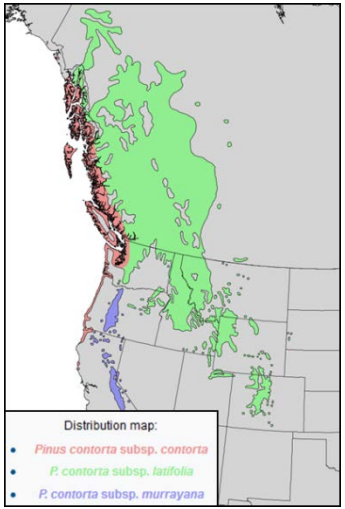




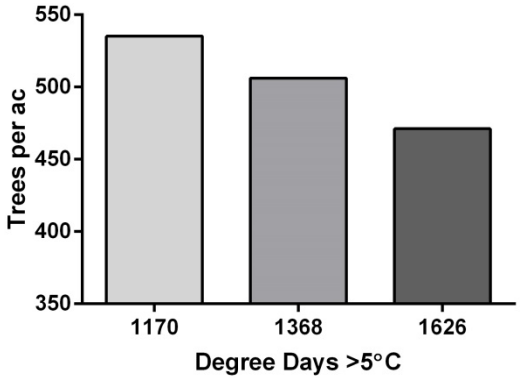
GEOGRAPHIC MARGINAL EFFECTS

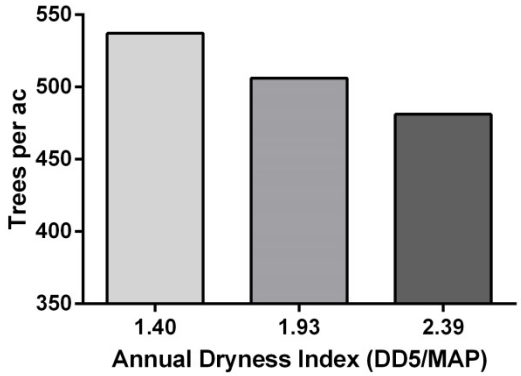


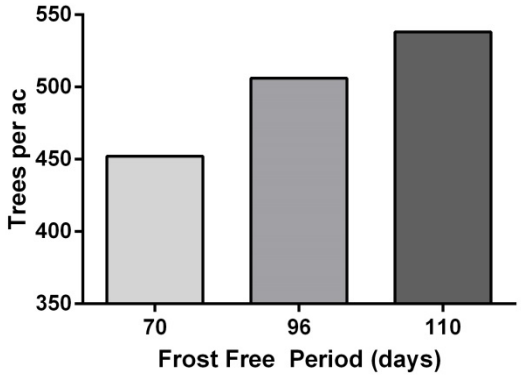




CLIMATE MARGINAL EFFECTS

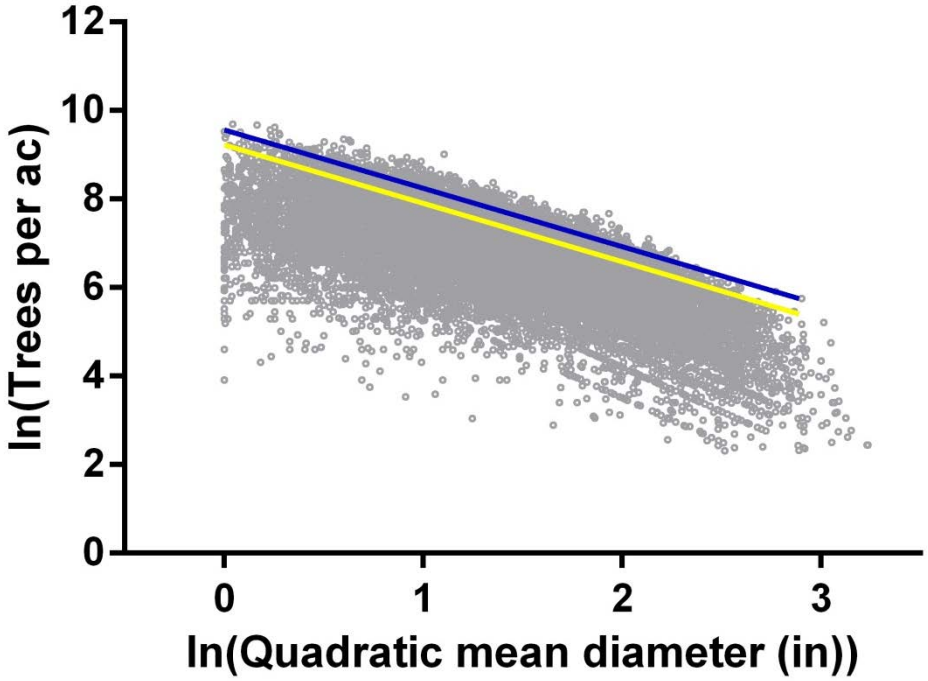


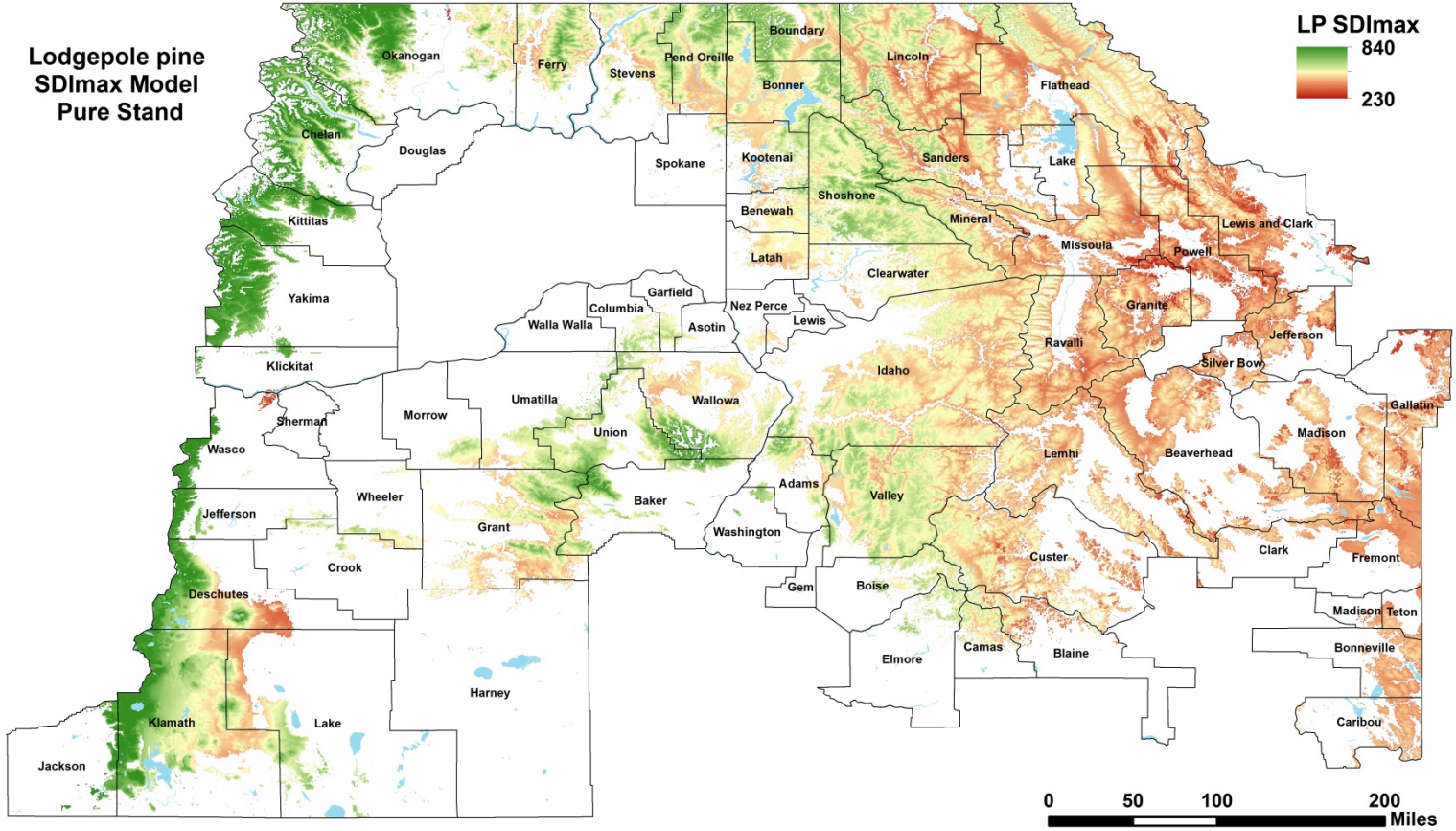




DEFINING THE SITE TYPE FRONTIER

- Blue Line:
  - 75th %tile Site Conditions @ 90% Purity
  - SDImax = 686 TPA
- Yellow Line:
  - 50th %tile Site Conditions @ 90% Purity
  - SDImax = 486 TPA





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ACCESS & RECOMMENDED USE

- Input layers and equation will be uploaded to OwnCloud\IFC
- Create an acre grid of your ownership and attribute the grid cell with species specific density drivers
- In your DBS, create an algorithm to select which species model to use based on dominant or desired species
- Calculate SDImax/ac for selected species using the appropriate SFR equation, setting the QMD and PBA values appropriately
- Average SDImax/ac values for each stand

THANK YOU – ANY QUESTIONS?

Contact Info:

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