Appendix S1

Appendix S1: Table S1 Plot variables

	Variable	Method	Source
COVERS	% shrub cover	ocular estimate of shrub cover	field
	% forb cover	ocular estimate of forbs	field
	% rock	ocular estimate of rock fragments (larger than 2.5 cm diameter)	field
	% litter	ocular estimate of litter	field
	% coarse woody debris	ocular estimate of woody debris > 7.6 cm diameter	field
	% live overhead canopy cover	ocular estimate of live overhead canopy > 2m height	field
	% basal vegetation	ocular estimate of the area covered by the bases of tree boles, shrub stems, and herb stems.	field
	stand basal area, live and dead	variable plot radius with basal area gauge	field
PHYSIO-GRAPHIC	elevation	recorded from GPS unit	field
	aspect	compass	field
	abs-aspect	absolute value of (180 – aspect)	field
	Topographical Index	TI = cosine(aspect) * slope(%)	field
	slope	clinometer (%)	field
CLIMATIC	maximum temperature	maximum temperatures averaged for the months April to September, then averaged annually.	Thorne et al. 2012
	annual precipitation	precipitation values were calculated by summing the total monthly precipitation and averaging annually.	
OTHER	distance to seed tree	measured with laser rangefinder from plot center to nearest potential seed tree (meters)	field
	seed tree species	conifer seed tree species	field
	seed tree direction	compass direction from plot center to potential seed tree	field
	shrub height	mean of shrub modal height	field
	fire severity class	ocular assessment of burn severity (Table 5)	
	season of fire	date of fire binned into early (June -- July), middle (August -- September) and late season (October – November) to assess cone maturation	date of fire
	time since last fire	extracted from FRID GIS data layer – Fire Return Interval Departure – USFS Remote Sensing Lab	fs.usda.gov

Appenidx S1: Table S2   Conifer regeneration densities by forest type and species

Forest type	N[1]	PIPO	PILA	PIJE	ABCO	ABMA	PSME	CADE	Mean conifers ha^{-1}	Median conifers ha^{-1}
Mixed evergreen	324	124	32	5	90	0	1,866	101	2,220	343
Moist mixed conifer	330	189	24	50	419	182	399	93	1,424	178
Dry mixed conifer	489	385	51	27	342	0	597	488	1,997	183
Yellow pine	246	139	12	32	71	0	40	154	476	0
Fir	101	43	29	0	1,082	1,411	398	198	3,161	362

N[1] = number of plots
*Species codes as in Table 3. Pinus species are first year seedlings identifiable to genus only.

Appendix S1: Table S3 AIC score and random effects for generalized linear mixed model

Model	1	2	3
AIC	7626.9	7490.2	7337.6
Random Effects			
Fire	0.96 sd	1.04 sd	0.64 sd
Cluster within Fire	0.90 sd	0.77 sd	0.72 sd
Dispersion parameter	0.30	0.33	0.40

Model 1:
total conifers/plot = (1| Fire/cluster)

Model 2:
total conifers/plot = fire severity + forest type + (1| Fire/cluster)

Model 3:
total conifers/plot = fire severity + distance to seed tree + shrub cover + litter cover + live basal area + slope + abs-aspect + annual precipitation + forest type + (1| Fire/cluster)

Appendix S1: Table S4 Output for generalized linear mixed model with random effects, all forest types

Model	2				3			
Categorical Variables								
Fire Severity	coeff	se	p		coeff	se	p	
linear	-0.521	0.157	<0.001	***	0.590	0.174	<0.001	***
quadratic	-0.806	0.141	<0.001	***	-0.460	0.151	<0.001	***
Forest Type								
Mixed Evergreen	-1.246	0.228	<0.001	***	-0.855	0.204	<0.001	***
Dry Mixed Conifer	reference				reference			
Moist Mixed Conifer	0.226	0.191	0.238		0.156	0.185	0.398	
Yellow Pine	-0.553	0.234	0.018	*	-0.401	0.217	0.064	
Fir	0.176	0.330	0.594		0.035	0.310	0.909	
Biotic Variables								
Distance to seed tree								
Linear					-0.977	0.158	<0.001	***
Shrub cover					-0.011	0.002	<0.001	***
Litter cover					0.010	0.002	<0.001	***
Live basal area (m)					0.018	0.004	<0.001	***
Abiotic Variables								
Slope					0.012	0.003	<0.001	***
Abs-aspect					0.005	0.001	<0.001	***
Annual precipitation					0.003	0.001	<0.001	***

Model 1:
total conifers/plot = (1| Fire/cluster)

Model 2:
total conifers/plot = fire severity + forest type + (1| Fire/cluster)

Model 3:
total conifers/plot = fire severity + distance to seed tree + shrub cover + litter cover + live basal area + slope + abs-aspect + annual precipitation + forest type + (1| Fire/cluster)

Fire identity is specified as a random effect. Cluster (a grouping of spatially close plots) is nested within fire to account for variation at the local scale. Conifer stem count data are analyzed with a zero-inflated generalized linear mixed model, specifying a negative binomial distribution with a log link to account for strong overdispersion in the data. Model building occurred in three segments, where similar covariates were added to the model consecutively as a group. All coefficients are on the log-scale.

Appendix S1: Table S5 Confusion matrices based on YPMC model and high-moderate severity plots

A. Angora Fire (dry mixed conifer)

	ACTUAL		
PREDICTED	Above 494 seedlings/ha	Below 494 seedlings/ha	User's Accuracy:
Above 494 seedlings/ha	18	12	60%
Below 494 seedlings/ha	0	6	100%
			Overall accuracy:
Producer's Accuracy:	100%	50%	66%

B. American River Fire (moist mixed conifer)

	ACTUAL		
PREDICTED	Above 494 seedlings/ha	Below 494 seedlings/ha	User's Accuracy:
Above 494 seedlings/ha	19	0	100%
Below 494 seedlings/ha	0	0	100%
			Overall accuracy:
Producer's Accuracy:	100%	100%	100%

C. BTU Lightning Fire (moist mixed conifer)

	ACTUAL		
PREDICTED	Above 494 seedlings/ha	Below 494 seedlings/ha	User's Accuracy:
Above 494 seedlings/ha	5	3	62%
Below 494 seedlings/ha	0	0	100%
			Overall accuracy:
Producer's Accuracy:	100%	0%	62%

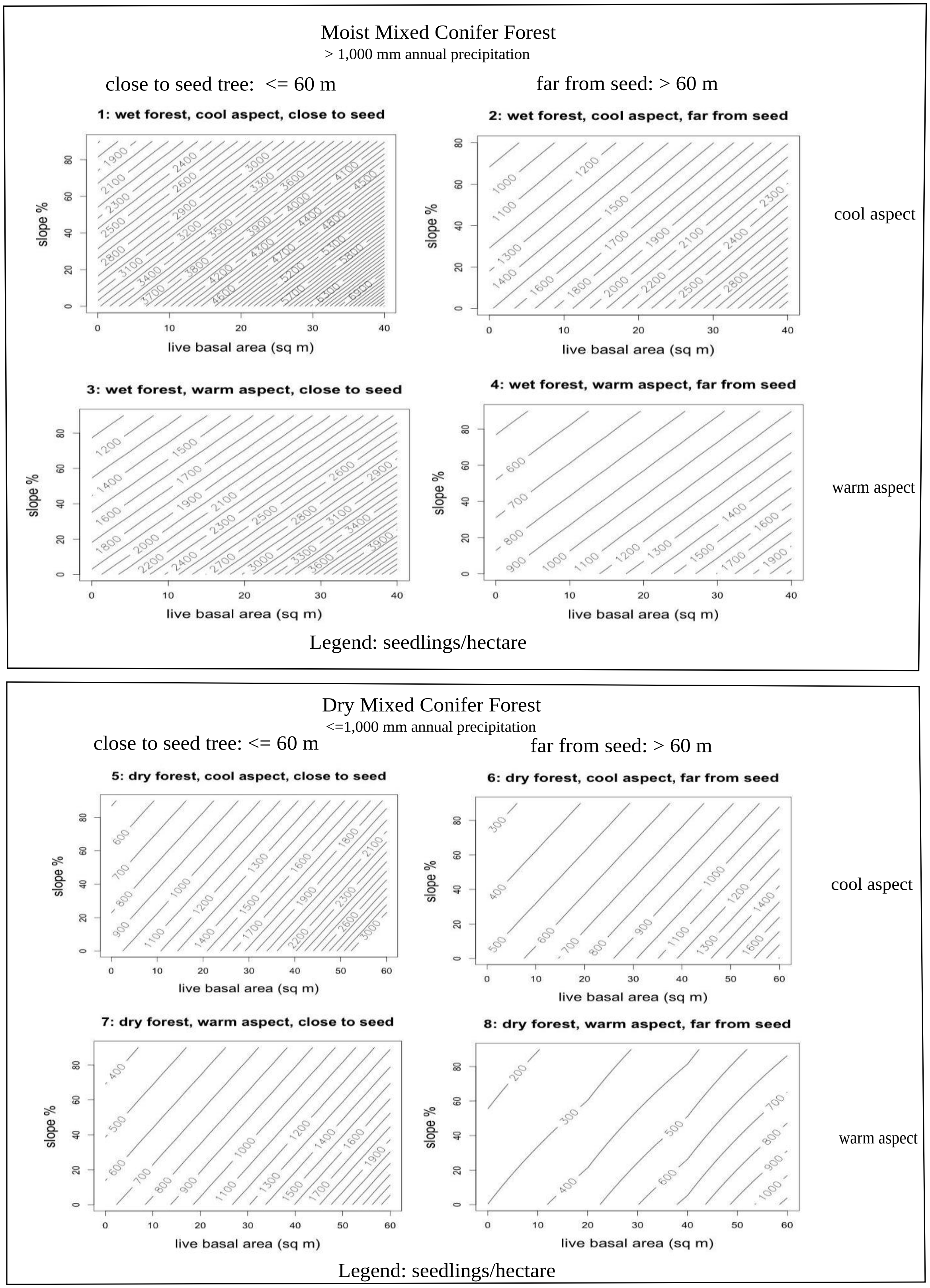
D. Rich Fire (moist mixed conifer)

	ACTUAL		
PREDICTED	Above 494 seedlings/ha	Below 494 seedlings/ha	User's Accuracy:
Above 494 seedlings/ha	14	0	100%
Below 494 seedlings/ha	5	0	0%
			Overall accuracy:
Producer's Accuracy:	74%	100%	74%

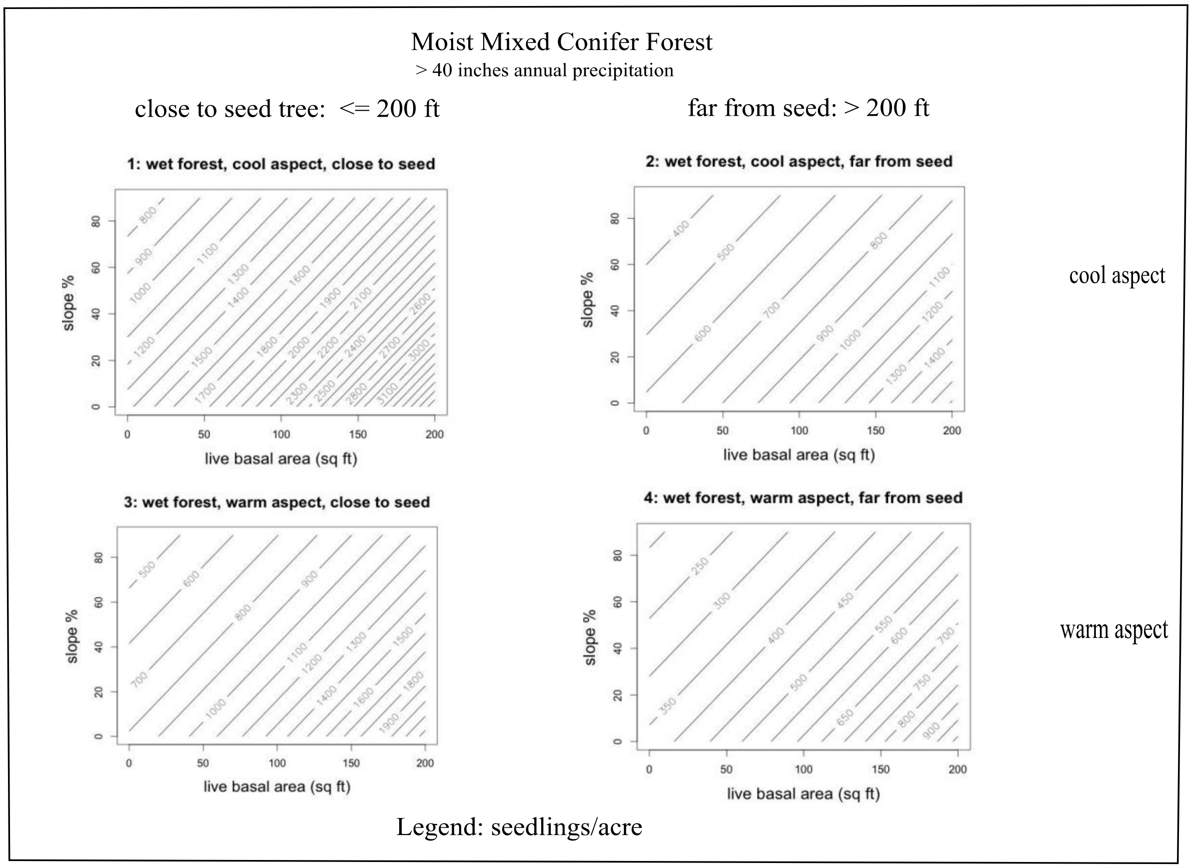
Appendix S1: Table S6 Proportion of plots in distance to seed tree class by fire severity class

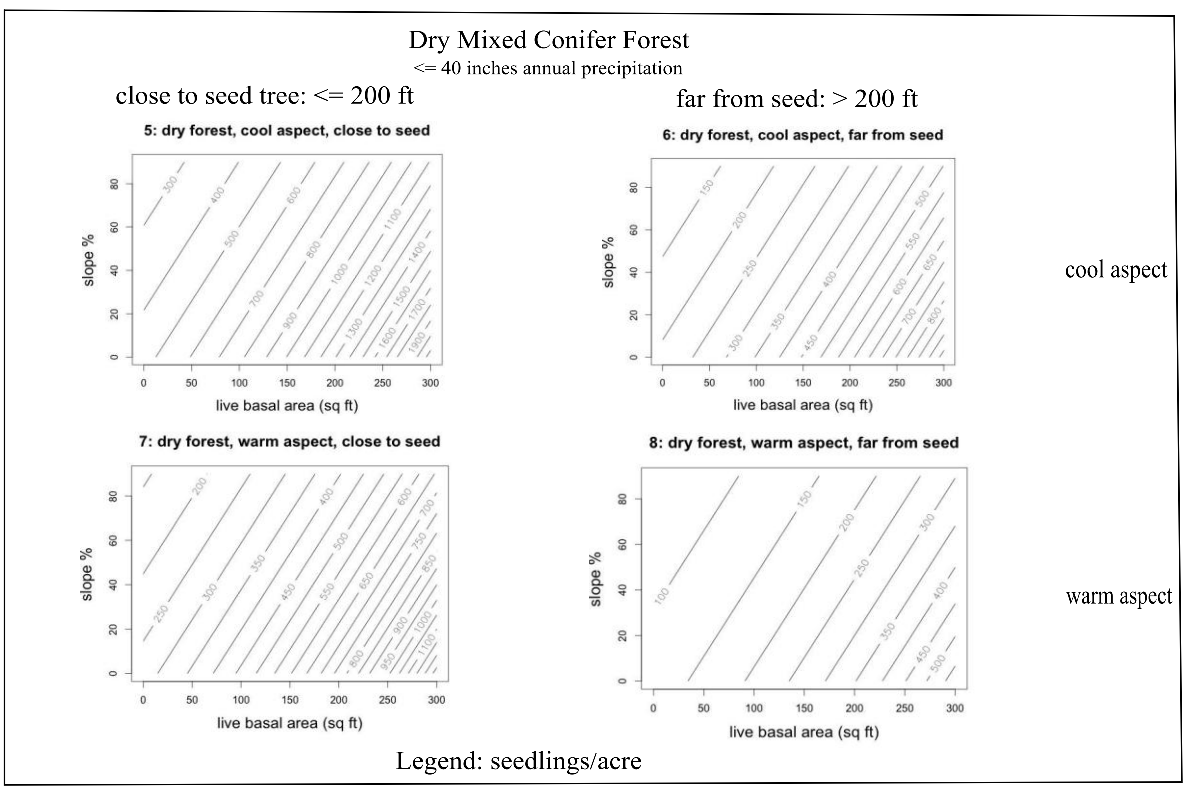
distance to seed tree class	fire severity class					Total
	unburned	low	low moderate	high moderate	high	
0 – 30 m	9.06%	6.91%	9.66%	11.48%	23.29%	60.40%
>30 m – 60 m	0.13%	0.40%	0.54%	0.40%	11.81%	13.28%
>60 m – 120 m	0.00%	0.13%	0.13%	0.13%	10.67%	11.06%
>120 m – 200 m	0.07%	0.00%	0.00%	0.13%	2.42%	2.62%
>200 m	0.07%	0.34%	0.07%	0.34%	11.81%	12.63%
Total	9.33%	7.78%	10.40%	12.48%	60.00%	100.00%

Appendix S1: Figure S1 Predicting conifer regeneration (seedlings ha^{-1}) in YPMC forests 5 years after high-moderate severity fire using basal area gauge (sq meters) and clinometer.

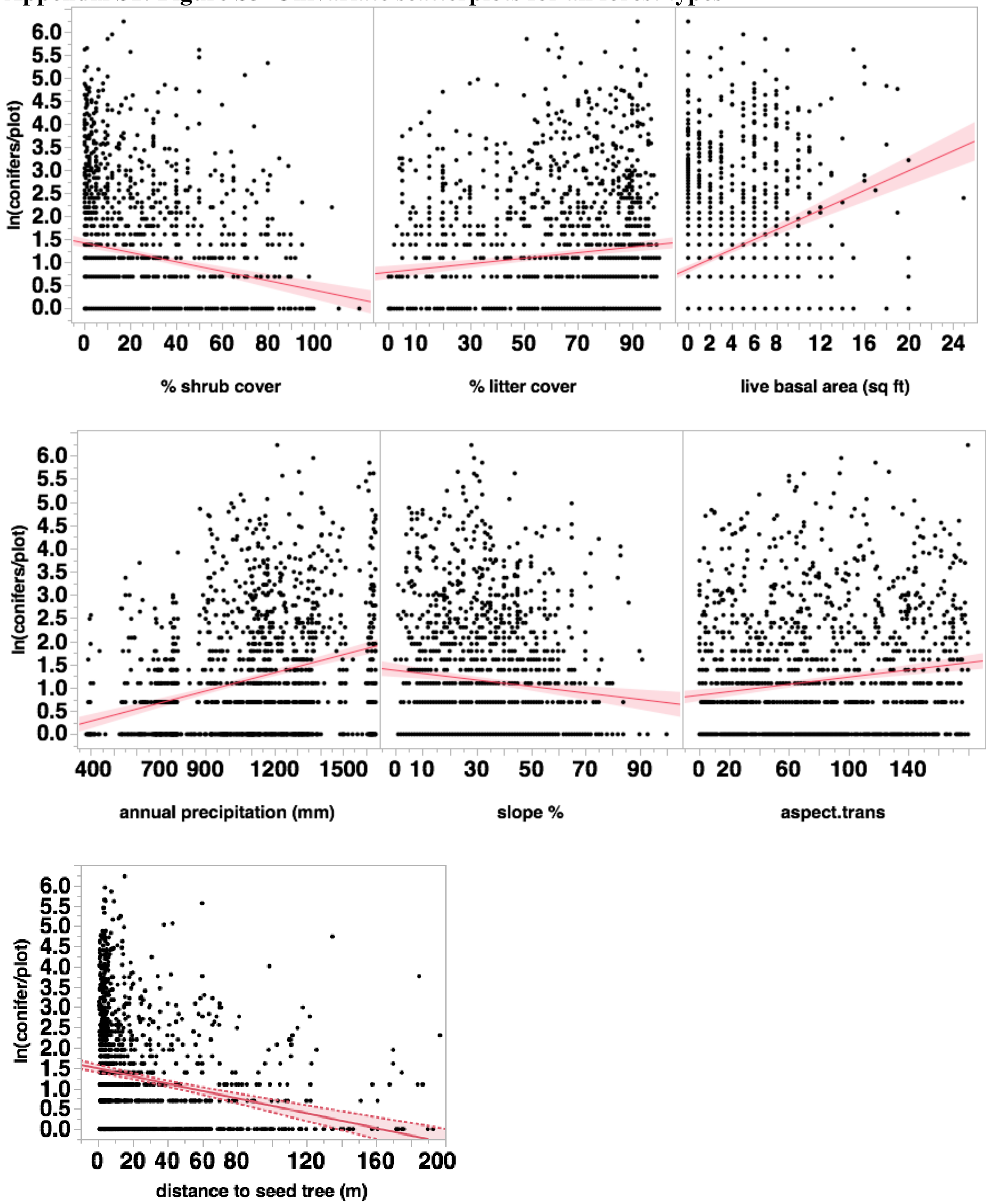


Appendix S1: Figure S2 Predicting conifer regeneration (seedlings acre^{-1}) in YPMC forests 5 years after high-moderate severity fire using basal area gauge (sq feet) and clinometer.





Appendix S1: Figure S3 Univariate scatterplots for all forest types



Appendix S1: Suggested protocol for field assessment of predicted seedling densities 5-6 years after fire

Typically, a preliminary assessment of postfire reforestation need will be made based on remotely-sensed imagery (of fire severity, for example) and/or aerial photography and/or field reconnaissance, using variables such as fire severity, aspect, and distance to forest edge. Polygons are then drawn on maps with preliminary hypotheses of probable reforestation need. Figures 9 (metric units) and 10 (English units) provide information to be used in subsequent field verification of the preliminary polygons for dry and moist mixed conifer forests that have burned at high severity (≥75% loss of prefire basal area). Field sampling protocols will vary according to need, ease of access, and size of the areas to be assessed, but in general we recommend that a protocol be adopted that visits at least one percent of the area in question. Each of our 60 m^2 (646 ft^2) plots is equivalent to 0.6% of a hectare and 1.5% of an acre, so we recommend sampling a minimum of two plots per hectare or one plot per acre.

Steps:

1. Develop a datasheet for the data to be collected.
2. Determine whether the area to be visited is within dry or moist mixed conifer forest. Use local knowledge of precipitation and vegetation patterns, and/or climate datasets like PRISM, and/or maps of potential natural vegetation (local maps or the LANDFIRE BpS data, for example). Remember that north slopes in areas with <1000 mm precipitation may support moist mixed conifer forests (dominated by shade tolerant conifers like firs and Douglas-fir), and some south and west slopes or thin soils in areas with >1000 mm precipitation may support dry mixed conifer forests (dominated by pines and black oak).
3. Visit a set of previously selected GPS locations, which were ideally selected through some sort of stratified random process laid over a spatial grid in GIS. GIS data can be used to assign the appropriate forest type, aspect class, and distance from forest edge to the plot locations before they are visited, however all of these assignments must be verified in the field since all of these variables have major influence on predicted seedling densities. In the case of the distance to forest edge value, there are often living trees within high severity patches and the distance to nearest seed tree is therefore typically less than the distance to the forest edge.
4. At each site in the field,
    a. Verify the forest type.
    b. Determine the aspect class (warm: south and west; cool: north and east).
    c. Use a rangefinder to measure the distance to the nearest living seed tree.
    d. Measure the slope inclination with a clinometer (% slope).
    e. Use a basal area gauge or prism to estimate the live basal area in the surrounding stand.
5. Determine whether there are any seedlings within a circular area of 60 m^2 around the GPS point. 60 m^2 has a radius of 4.37 m (14.3 ft), which corresponds to 5.7 paces for a standard human (a pace = 76.2 cm or 30") (CIA 2013).
6. Using forest type, distance class to nearest living seed tree, and aspect class, choose the appropriate subgraphic within Figure 9 or Figure 10.

7. Using percent slope (y-axis) and live basal area (x-axis), locate the appropriate x,y coordinate for the plot being visited.
    a. If there is at least one seedling in the sample plot, enter the predicted seedling density (the value at the x,y coordinate). This is a prediction of the seedling density that one would sample at this site 5-7 years after fire given the site variables.
    b. If there are no seedlings in the plot, enter the following in the predicted seedling density field:
        i. The predicted density from Figure 9 or 10, of the plot is <30 m from the nearest living seed tree.
        ii. Half of the predicted density from Figure 9 or 10, if the plot is 30-60 m from the nearest living seed tree.
        iii. "0", if the plot is >60 m from the nearest living seed tree.
8. After collecting the field data, enter the data into a spreadsheet or database and calculate predicted median seedling densities. Compare the median seedling density against your desired stocking rate to determine if the area is a candidate for reforestation. This comparison can also serve to prioritize areas.