SUPPLEMENTAL FILE

Supplemental file for article: *"Restoration thinning enhances growth and diversity in mixed redwood/Douglas-fir stands in northern California, U.S.A." Christa M. Dagley, John-Pascal Berrill, Lathrop P. Leonard, Yoon G. Kim.*

Contents:

Table S1. Density (stems/ha) of trees > 7.6 cm dbh for each species found within each treatment area. LR, Localized release; LD, Low density; HD, High density; C, Control.

	Treatment			
Species	LR	LD	HD	C
Abies grandis	1			
Acer macrophyllum				3.5
Alnus rubra	1	1		
Arbutus menziesii				3
Chamaecyparis lawsoniana			2.2	6
Chrysolepis chrysophylla var *minor*	5	1.6	1.6	
Cornus sessilis	0.4			
Notholithocarpus densiflorus	57	74	53.5	120
Pinus attenuata	1.6			4
Pseudotsuga menziesii var *menziesii*	373	203.4	297	799.5
Sequoiadendron giganteum		1	0.8	
Sequoia sempervirens	245	281	227.3	376
Thuja plicata	1	0.8	0.3	8
Tsuga heterophylla	1	3.2	4.3	1
Umbellaria californica				1
Count (stems/ha)	**685**	**566**	**587**	**1322**

Table S2. Density (stems/ha) and range of values among stands having structural attributes common to old-growth forests.

	Treatment					
Attribute	Localized Release		Low Thinning		Control	
Broken top	14.4	(2.7-28.8)	16.5	(5.5-48.0)	27.3	(4.1-53.5)
Forked top	29.1	(17.8-56.3)	36.4	(4.1-67.2)	83.8	(32.9-144.1)
Dead top	8.7	(8.2-16.5)	7.8	(2.7-15.1)	5.3	(0.0-16.5)
Snags	12.9	(2.7-31.6)	17.2	(5.5-32.9)	15.0	(4.1-41.2)
Dead down (CWD)	0.5	(0.0-1.4)	2.9	(0.0-11.0)	0.9	(0.0-4.1)

Table S3. Generalized linear mixed-effects models of basal area increment (BAI; cm^2 $year^{-1}$) for redwood, Douglas-fir, and tanoak in 20 stands. Dependent variable = $(BAI+1)^{0.5}$. Categorical variable for treatment: control, C; low thinning, LT; localized release, LR.

			Model								
			Redwood			Douglas-fir			Tanoak		
			Estimate	Std. error	Pr > |t|	Estimate	Std. error	Pr > |t|	Estimate	Std. error	Pr > |t|
Fixed effects	Intercept		4.7925	1.503	0.0333	2.7016	1.186	0.0850	-3.3585	0.425	0.0014
	Treatment	C	-1.2362	0.214	<0.0001	-0.8307	0.178	<0.0001	-0.7585	0.432	0.0793
		LT	-0.3635	0.169	0.0313	0.2747	0.152	0.0714	-0.1275	0.360	0.7233
		LR	0			0			0		
	$Age^{0.5}$		-1.5493	0.316	<0.0001	-1.2362	0.255	<0.0001			
	Crown ratio		1.1419	0.177	<0.0001	0.565	0.103	<0.0001	0.4804	0.133	0.0003
	$DBH^{0.5}$		1.8106	0.029	<0.0001	2.0569	0.027	<0.0001			
	*ln*DBH								3.1401	0.133	<0.0001
	Crown competition		-0.2728	0.029	<0.0001	-0.1917	0.015	<0.0001	-0.1776	0.026	<0.0001
Random effects	Block		0.3531	0.269	0.0948	0.0424	0.045	0.1720	0		
	Stand (Block)		0.0019	0.048		0.0323	0.032	0.1555	0.3157	0.162	0.0257
	Plot (Stand Block)		0.1633	0.059	0.0027	0.1088	0.031	0.0002	0.0937	0.049	0.0270
	Residual		1.5437	0.049	<.0001	0.6506	0.016	<0.0001	0.4564	0.024	<0.0001
Fit statistic	-2 Res Log Likelihood			6743.23			8048.12			1622.56	

Table S4. Summary data for basal area increment (BAI; cm^2 $year^{-1}$) of the largest 50 stems/ha redwood and Douglas-fir in 20 stands by treatment: LR, Localized release; LT, Low thinning; C, Control.

	Species	*n*	Mean	Std. Dev.	Minimum	Maximum
LR						
	Redwood	156	44.41	30.14	0.15	165.52
	Douglas-fir	175	41.59	17.31	3.87	93.80
LT						
	Redwood	250	39.15	25.06	0.16	127.27
	Douglas-fir	337	50.64	19.71	1.56	120.49
C						
	Redwood	48	29.39	24.70	0.87	102.03
	Douglas-fir	56	41.62	17.73	9.96	87.96

Table S5. Generalized linear mixed-effects models of basal area increment (BAI; cm^2 $year^{-1}$) for the largest 50 stems/ha redwood and Douglas-fir in 20 stands. Dependent variable = $(BAI+1)^{0.5}$. Categorical variable for treatment: LR, Localized release; LT, Low thinning; C, Control. [a] Aspect (Cosine transformed) = cos(PI()/180*(22.5-Aspect))+1

			Model					
			Redwood			Douglas-fir		
			Estimate	Std. error	Pr > |t|	Estimate	Std. error	Pr > |t|
Fixed effects	Intercept		8.8791	2.034		7.4542	1.036	
	Treatment	C	-1.0923	0.323	0.0008	-0.9829	0.197	<0.0001
		LT	-0.3283	0.228	0.1509	0.1700	0.140	0.2249
		LR	0	.		0		
	$Age^{0.5}$		-2.2088	0.422	<0.0001	-2.0542	0.227	<0.0001
	Aspect[a]		-0.4546	0.163	0.0056	-0.1934	0.083	0.0206
	$DBH^{0.5}$		1.8604	0.124	<0.0001	1.9893	0.101	<0.0001
	Crown competition		-0.3441	0.078	<0.0001	-0.17	0.041	<0.0001
Random effects	Block		0.1304	0.142	0.1800	0		
	Stand		0			0		
	Plot		0.2068	0.110	0.0303	0.1031	0.040	0.0049
	Residual		2.3434	0.166	<0.0001	0.9225	0.058	<0.0001
Fit statistic	-2 Res Log Likelihood			1730.80			1620.61	

Table S6. Candidate logistic regression models and associated fit statistic -2 Log Likelihood (-2LL) for probability of occurrence of bear damage for redwood and Douglas-fir in 20 stands. Note: DBHI = diameter increment; Species = Dummy variable, Douglas-fir = 1, redwood = 0; Crown comp = competition values ranging 0-4 representing the number of sides the tree came in contact with a neighboring tree.

Model	-2LL	Δ
1/(1 + EXP(-(-3.0572 + 1.5686*DBHI - 1.0524*Species)))	36,758.21	
1/(1 + EXP(-(-3.4690 + 1.5126*DBHI - 1.1485*Species + 0.7682*Crown ratio)))	36,840.99	82.78
1/(1 + EXP(-(-2.3108 + 1.4536*DBHI - 1.2890*Species - 0.247*Crown comp)))	36,956.40	115.41

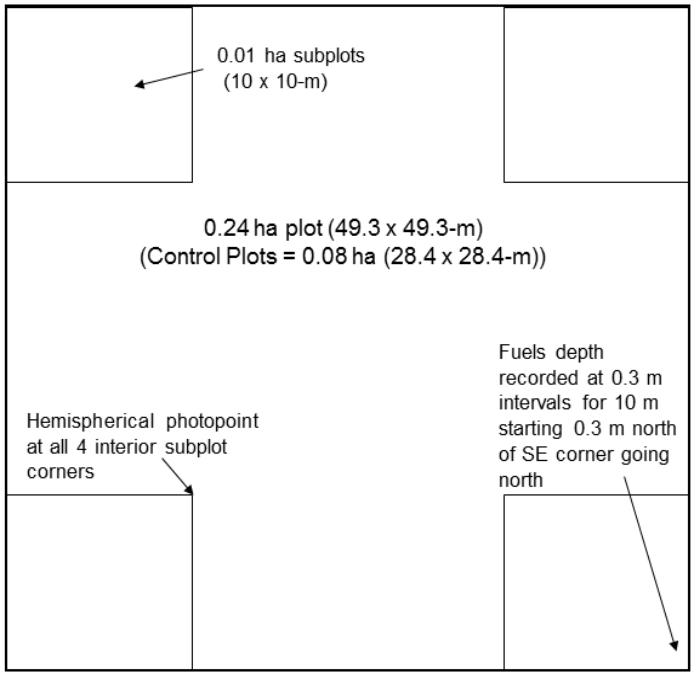

Figure S1. Permanent monitoring plot with four nested 0.01 ha subplots for small trees and understory vegetation.

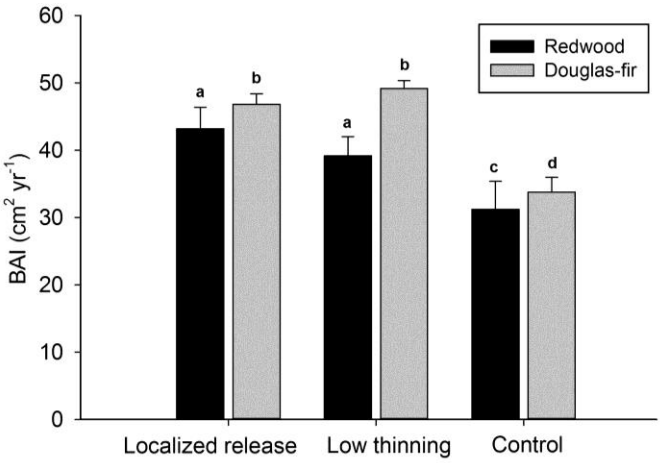

Figure S2. Adjusted least squares means (+SE) of average basal area increment (BAI; $cm^2\ yr^{-1}$) for the largest 50 stems/ha redwood and Douglas-fir within thinned and unthinned treatments. Error bars with different letters indicate significant differences among treatments ($p < 0.05$).

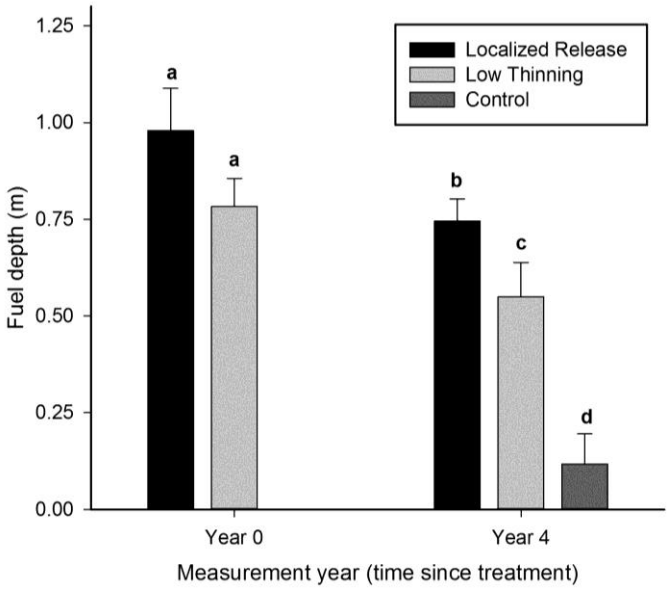

Figure S3. Adjusted least square means (+SE) of slash depth (fuel bed) from down and cut trees in each treatment, immediately after treatment (n = 16 localized release, n = 7 low thinning plots), and four years post-treatment (n = 16 localized release, n = 30 low thinning plots) compared against unthinned control stands (n = 12 plots). Error bars with different letters indicate significant differences among treatments ($p < 0.05$).