Supplementary materials for "The enemy of my enemy… Exotic mammals present biotic resistance against invasive alien conifers"

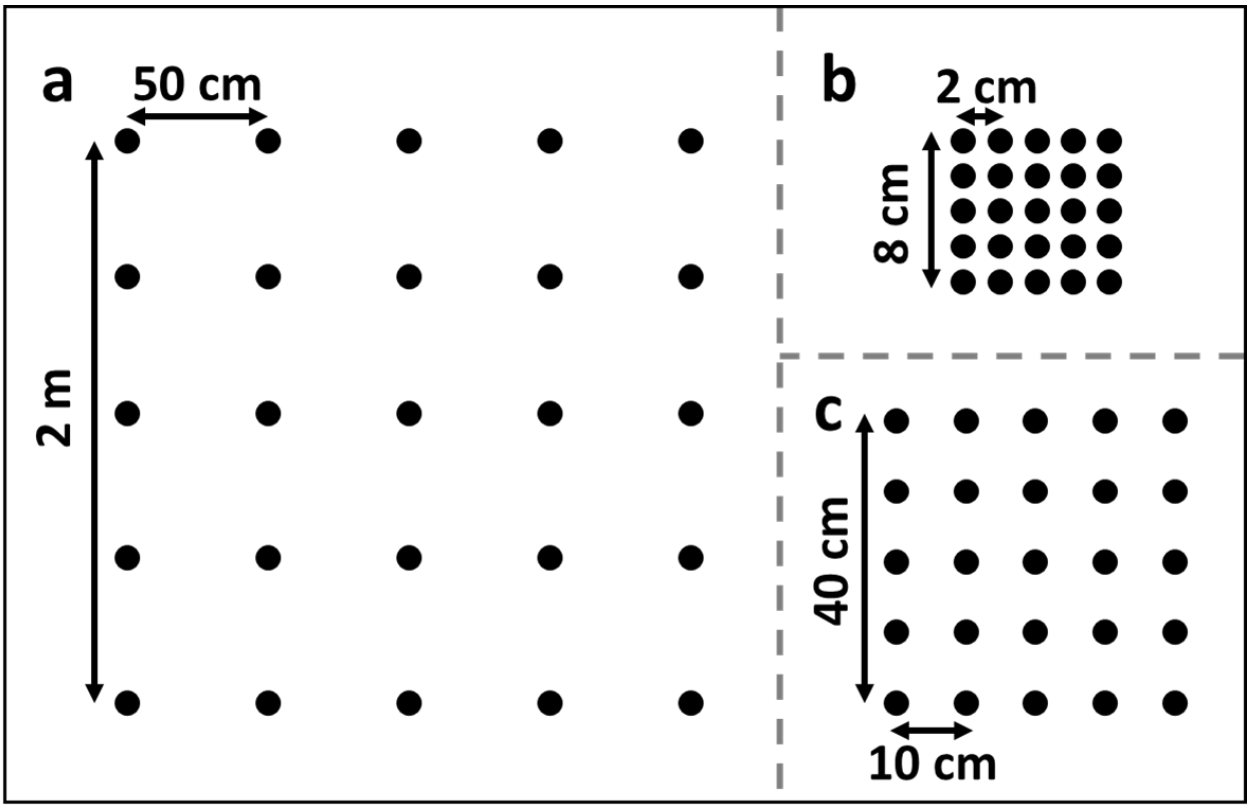

Figure S1. Three different density aggregations of *Pinus contorta* seed placed out to quantify seed predation pressures. Panel a) shows the "Far" density (4 m^2), b) shows the "close" density (0.064 m^2), and c) shows the "middle" density (0.16 m^2). Note that this figure is not to scale.

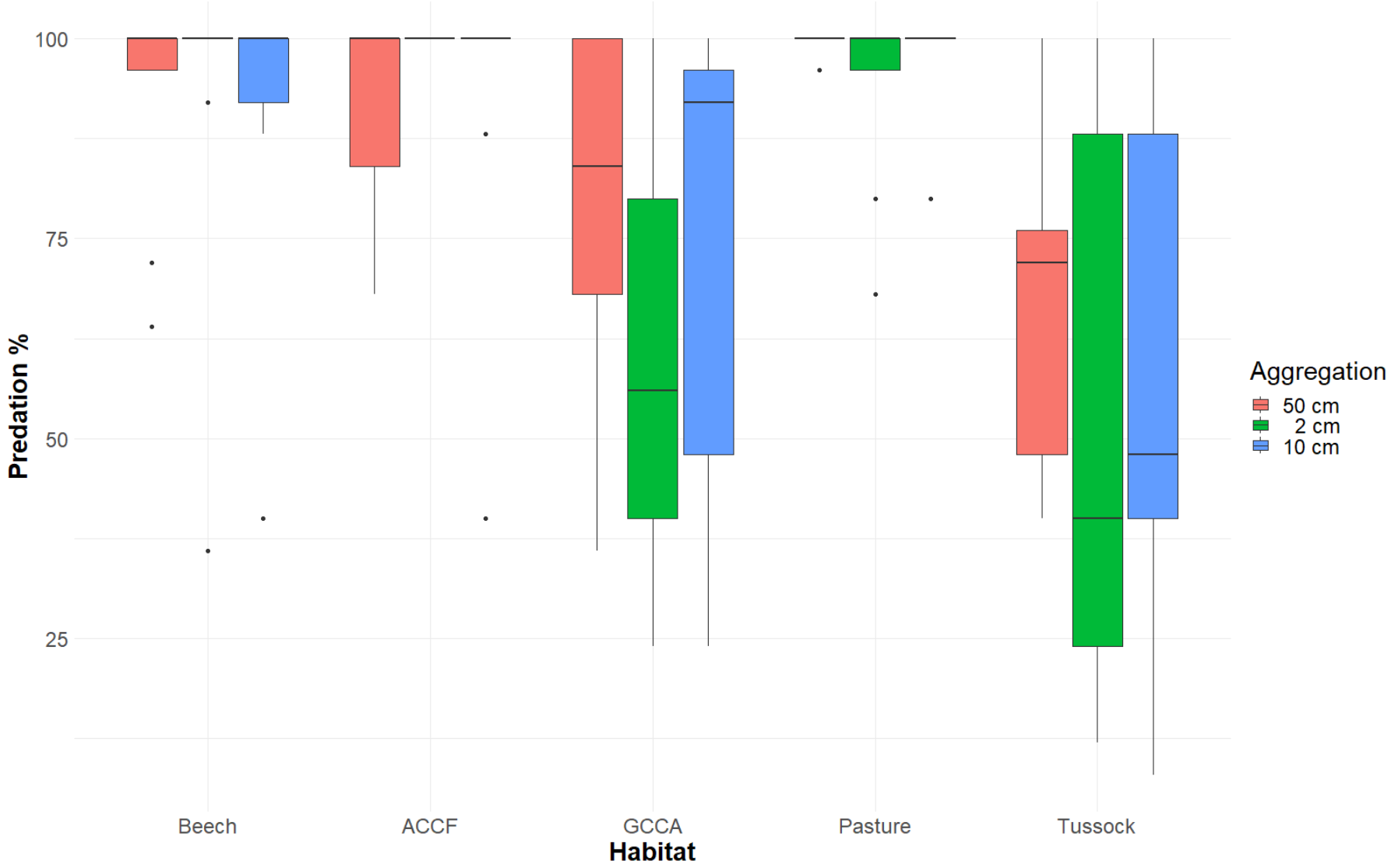

Figure S2. Percentage of total seed eaten in different habitats for *Pinus contorta* placed out in 3 different density aggregations which relate to the distance between seeds (Figure S1). No significant differences between aggregations were identified by pairwise tests ($p > 0.05$).

Table S1. Outputs from the one-inflated beta regression model. Significant terms are displayed in bold.

Proportion Seed Predation ~ Habitat*Seed-Species + Aggregation + (1|Plot)				
Mu Coefficient	***Estimate***	***Standard Error***	***z-value***	***Pr(>|z|)***
Intercept	1.4453	0.3150	4.589	**9.64e-06**
ACCF	-0.3540	0.4492	-0.788	0.43204
GCCA	-0.4699	0.3359	-1.399	0.16398
Pasture	0.6255	0.4512	1.386	0.16778
Tussock	-1.0293	0.3288	-3.131	**0.00211**
Species: *Ps. menziesii*	0.5742	0.6148	0.934	0.35183
2 cm Aggregation	-0.7202	0.2642	-2.726	**0.00720**
10 cm Aggregation	-0.3588	0.2510	-1.430	0.15500
ACCF:Species	-0.9632	0.7978	-1.207	0.22928
GCCA:Species	-0.5779	0.6815	-0.848	0.39783
Pasture:Species	-1.6876	0.7530	-2.241	**0.02656**
Tussock:Species	-1.8215	0.6897	-2.641	**0.00918**

Table S2: Model outputs from the *nparLD* package predicting levels of seed predation between treatments and across time. Four separate models were run, one for each *P. contorta* and *Ps. menziesii* two more for *P. contorta* at different density aggregations.

50 cm Aggregation *Pinus contorta*				
Wald-Type Statistic	*Statistic*	*df*		*p-value*
Treatment	7.226522	4		1.243909e-01
Timepoint	3.864757	2		1.448034e-01
Treatment:Timepoint	68.041082	8		**1.204939e-11**
Anova-Type Statistic	*Statistic*	*df*		*p-value*
Treatment	1.377560	3.202763		2.45907283e-01
Timepoint	1.952396	1.976511		1.42497022e-01
Treatment:Timepoint	3.818707	5.372799		**0.1367015e-03**
Modifed Anova-Type Statistic for Whole-Plot Factors	*Statistic*	*df1*	*df2*	*p-value*
Treatment	1.37756	3.202763	30.03239	2.680946e-1
2 cm Aggregation *Pinus contorta*				
Wald-Type Statistic	*Statistic*	*df*		*p-value*
Treatment	41.09538	4		**2.568343e-08**
Timepoint	17.34057	2		**1.716099e-04**
Treatment:Timepoint	20.63682	8		**8.177393e-03**
Anova-Type Statistic	*Statistic*	*df*		*p-value*
Treatment	10.95800	3.774792		**1.668578e-08**
Timepoint	10.48275	1.886205		**4.286303e-05**
Treatment:Timepoint	1.22065	4.708620		0.2974040
Modifed Anova-Type Statistic for Whole-Plot Factors	*Statistic*	*df1*	*df2*	*p-value*
Treatment	10.958	3.774792	37.05254	**7.976412e-06**
10 cm Aggregation *Pinus contorta*				
Wald-Type Statistic	*Statistic*	*df*		*p-value*
Treatment	41.09538	4		**2.568343e-08**
Timepoint	17.34057	2		**1.716099e-04**
Treatment:Timepoint	20.63682	8		**8.177393e-03**
Anova-Type Statistic	*Statistic*	*df*		*p-value*
Treatment	10.95800	3.774792		**1.668578e-08**
Timepoint	10.48275	1.886205		**4.286303e-05**
Treatment:Timepoint	1.22065	4.708620		2.974040e-01
Modifed Anova-Type Statistic for Whole-Plot Factors	*Statistic*	*df1*	*df2*	*p-value*
Treatment	10.958	3.774792	37.05254	**7.976412e-06**

10 cm Aggregation *Pseudotsuga menziesii*				
Wald-Type Statistic	*Statistic*	*df*		*p-value*
Treatment	5.786822	4		2.156442e-01
Timepoint	4.241879	2		1.199189e-01
Treatment:Timepoint	38.143203	8		**7.083243e-06**
Anova-Type Statistic	*Statistic*	*df*		*p-value*
Treatment	0.8415391	3.734311		4.9193081e-01
Timepoint	1.9538032	1.976252		1.4230432e-01
Treatment:Timepoint	2.4888450	6.203509		**1.940776e-02**
Modifed Anova-Type Statistic for Whole-Plot Factors	*Statistic*	*df1*	*df2*	*p-value*
Treatment	0.8415391	3.734311	36.53422	0.5013229

Table S3. Output from the *drop1* function to simplify models of seed predation by different damage types (seed predators). Significance of individual terms are bolded and relate to the associated change in model performance if that term were removed from the model. Non-significant terms can be removed will little to no model performance penalty as measured by the AIC.

Pinus contorta **Original Model: *Seed Predation ~ Predation Type + Habitat + Aggregation* + (1|Plot)**								
Model Term	***df***	**AIC**			**LRT**		**Pr(>χ)**	
None	-	2881.3			-		-	
Habitat	4	2880.1			6.84		0.1445	
Predation Type	5	4254.1			1382.83		**<2e-16**	
Aggregation	2	2879.8			2.54		0.2806	
Comparison of *P. contorta* Models **Simplified Model: *Seed Predation ~ Predation Type* + (1|Plot)**								
Model	***df***	**AIC**	**BIC**	**logLik**	**Deviance**	**χ^2**	***df***	**Pr(>χ^2)**
Simplified	8	2879.5	2917	-1431.7	2863.5	-	-	-
Original	14	2881.3	2947	-1426.6	2853.3	10.184	6	0.1171
Pseudotsuga menziesii **Original Model: *Seed Predation ~ Predation Type + Habitat + Aggregation* + (1|Plot)**								
Model Term	***df***	**AIC**			**LRT**		**Pr(>χ)**	
None	-	1013.2			-		-	
Habitat	4	1024.3			19.08		**7.582e-4**	
Predation Type	5	1356.3			353.10		**<2.2e-16**	

Table S4. Outputs from the simplified (*P. contorta*) and original (*Ps. menziesii*) mixed effects zero-inflated poisson regression models. Significant terms are displayed in bold.

***Pinus contorta* (Simplified)**				
Coefficient	***Estimate***	***Standard Error***	***z-value***	***Pr(>|z|)***
Intercept	1.8678	0.1272	14.680	**< 2e-16**
Damaged Seed	-0.7988	0.1415	-5.646	**1.64e-08**
Hollow Seed	-0.3151	0.1384	-2.276	**2.285e-03**
Missing Seed	1.0373	0.1154	8.988	**< 2e-16**
Sheep Damage	0.5339	0.1903	2.807	**5.01e-03**
Stick Damage	-1.0566	0.1549	-6.822	**9.00e-12**
***Pseudotsuga menziesii* (Original)**				
Coefficient	***Estimate***	***Standard Error***	***z-value***	***Pr(>|z|)***
Intercept	3.5159	0.3720	9.452	**< 2e-16**
ACCF	-0.5501	0.4047	-1.359	0.174
GCCA	-0.5018	0.3819	-1.314	0.189
Pasture	-1.5430	0.3863	-3.994	**6.50e-05**
Tussock	-1.6681	0.3851	-4.332	**1.48e-05**
Damaged Seed	-1.5950	0.2311	-6.903	**5.10e-12**
Hollow Seed	-1.5657	0.2361	-6.632	**3.32e-11**
Missing Seed	-0.2896	0.2183	-1.326	0.185
Sheep Damage	1.3484	0.3351	4.024	**5.71e-05**
Stick Damage	-1.5755	0.2577	-6.114	9.73e-10

Table S5. Pairwise comparisons of seed predation compared between damage categories. All values represent *p*-values which, if bolded, are significant, and if in italics, are marginal. Values in the lower left half of the table relate to *Pinus contorta* whereas values in the upper right half relate to *Pseudotsuga menziesii*.

Damage Category	Seed Missing	Cattle Damage	Sheep Damage	Hollowed Seed	Seed Damaged	Stick Damaged
Seed Missing		0.771	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Cattle Damage	**<0.001**		**<0.001**	**<0.001**	**<0.001**	**<0.001**
Sheep Damage	**0.012**	*0.056*		**<0.001**	**<0.001**	**<0.001**
Hollowed Seed	**<0.001**	0.204	**<0.001**		1.000	1.000
Seed Damaged	**<0.001**	**<0.001**	**<0.001**	**<0.001**		1.000
Stick Damaged	**<0.001**	**<0.001**	**<0.001**	**<0.001**	0.363	

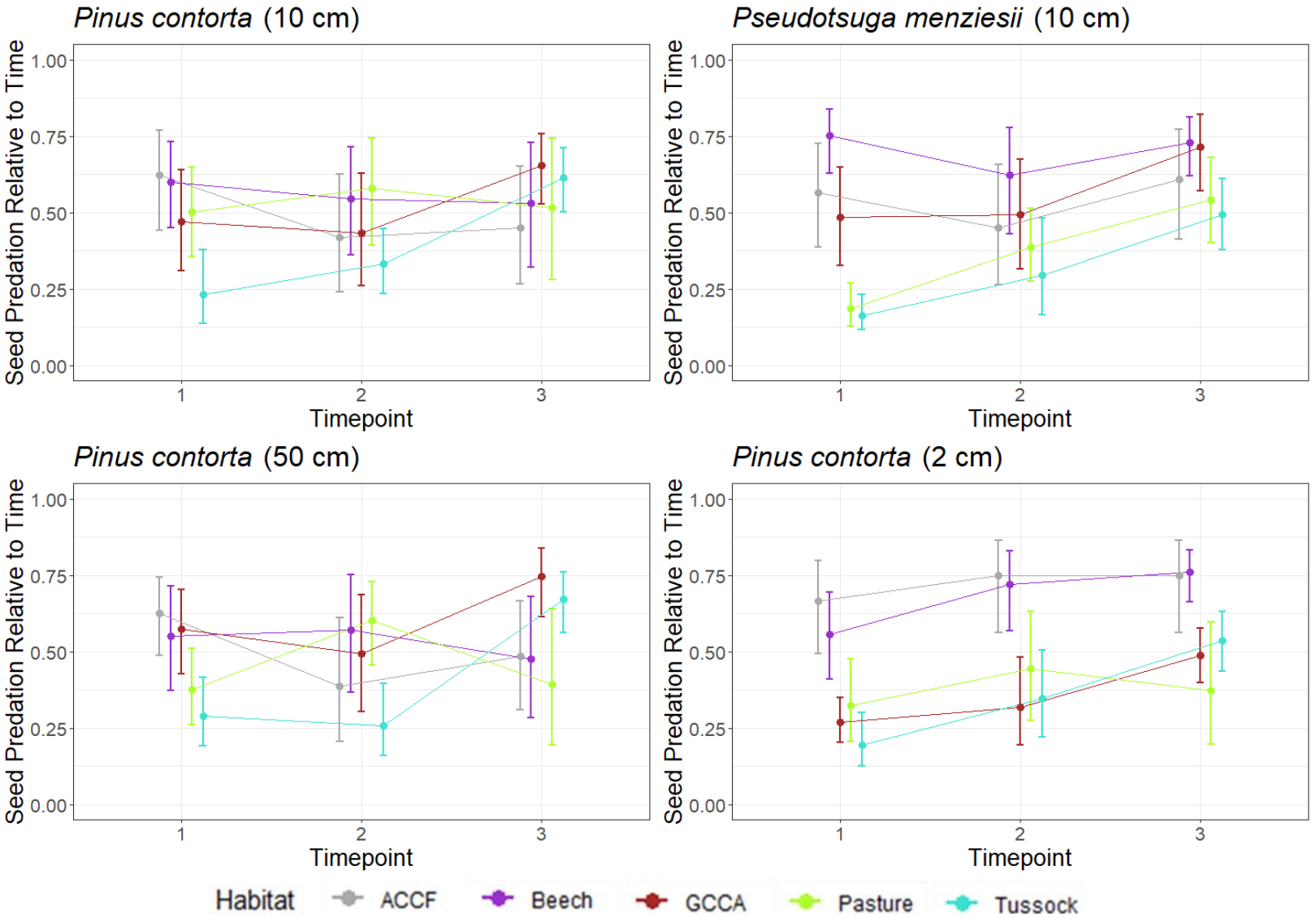

Figure S3. Seed predation relative to each timepoint. This provides an indication of whether the level of seed predation changes the longer the seed is in the environment, as opposed to showing absolute values of seed predation like in Figure 4. Aerially-controlled conifer forest and ground-controlled conifer areas are abbreviated to ACCF and GCCA respectively. Error bars show ± standard error.

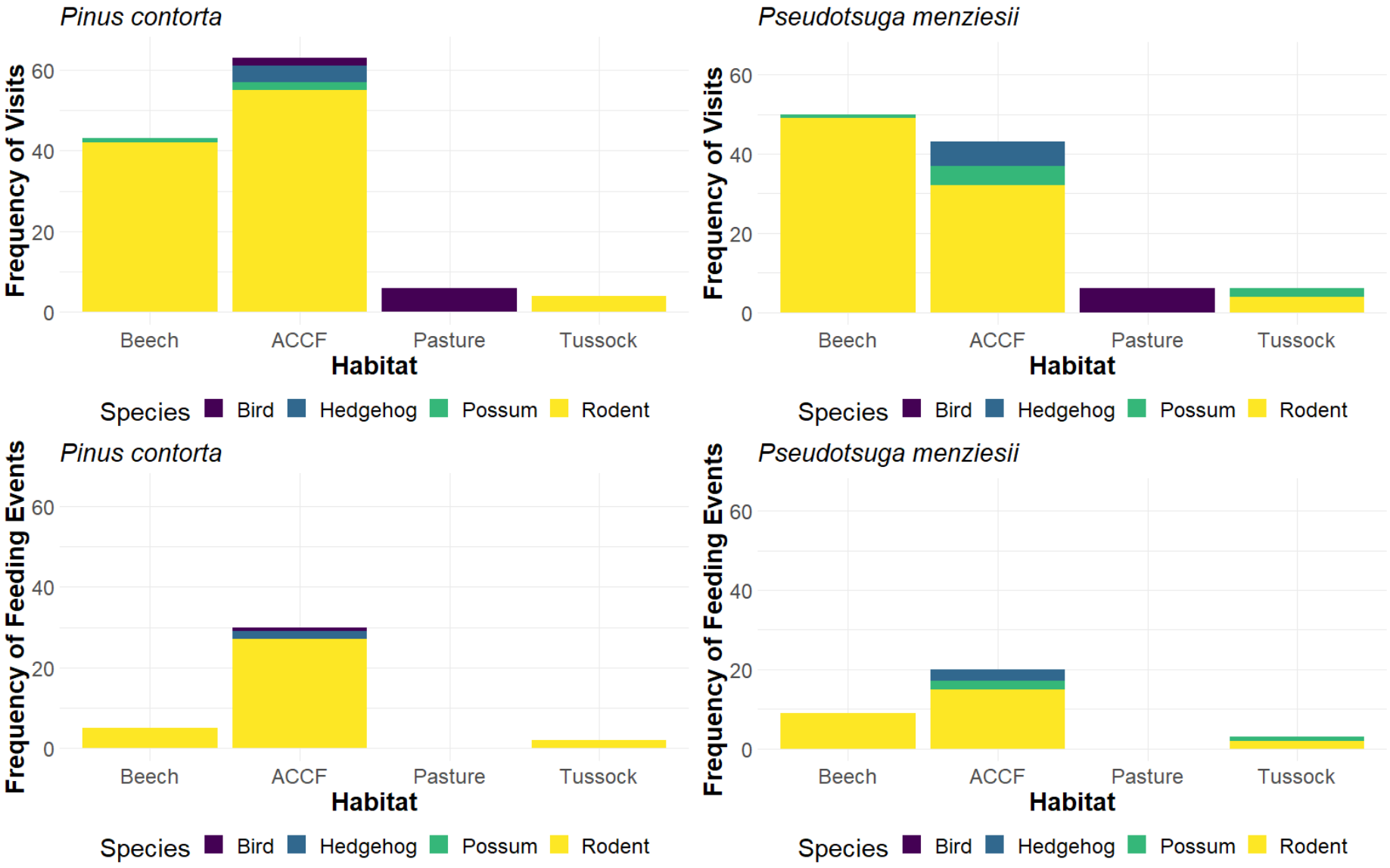

Figure S4. Stacked barcharts showing the total number of visits (top row) or feeding events (bottom row) for different seed predator species. Left plots show *Pinus contorta*, right plots show *Pseudotsuga menziesii*. These data are from camera traps facing feeding stations as per Figure 1 in main text.