Supporting Information (online only)

For

Disturbance-dependent variation in functional redundancy drives the species versus functional diversity relationship across spatial scales and vegetation layers

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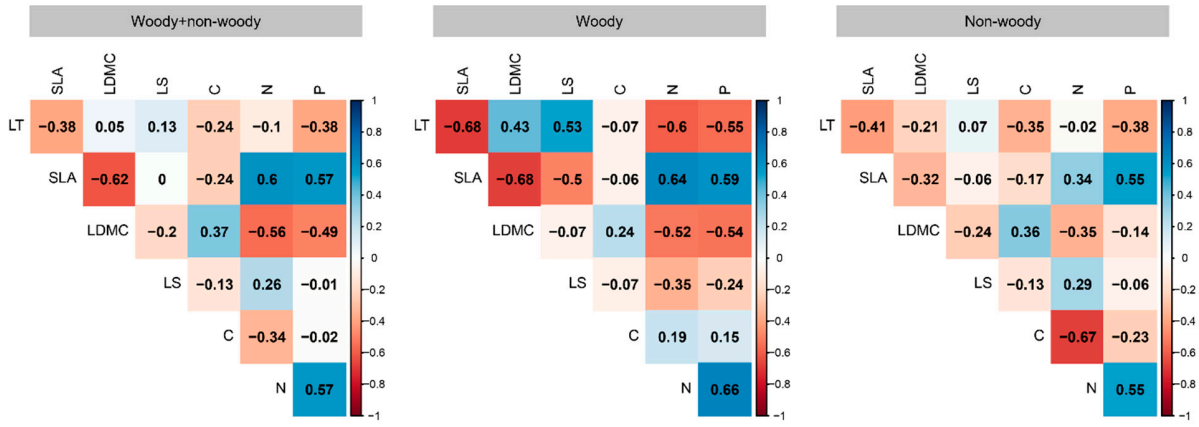

Figure S1. Trait-trait correlations among the measured traits in this study.

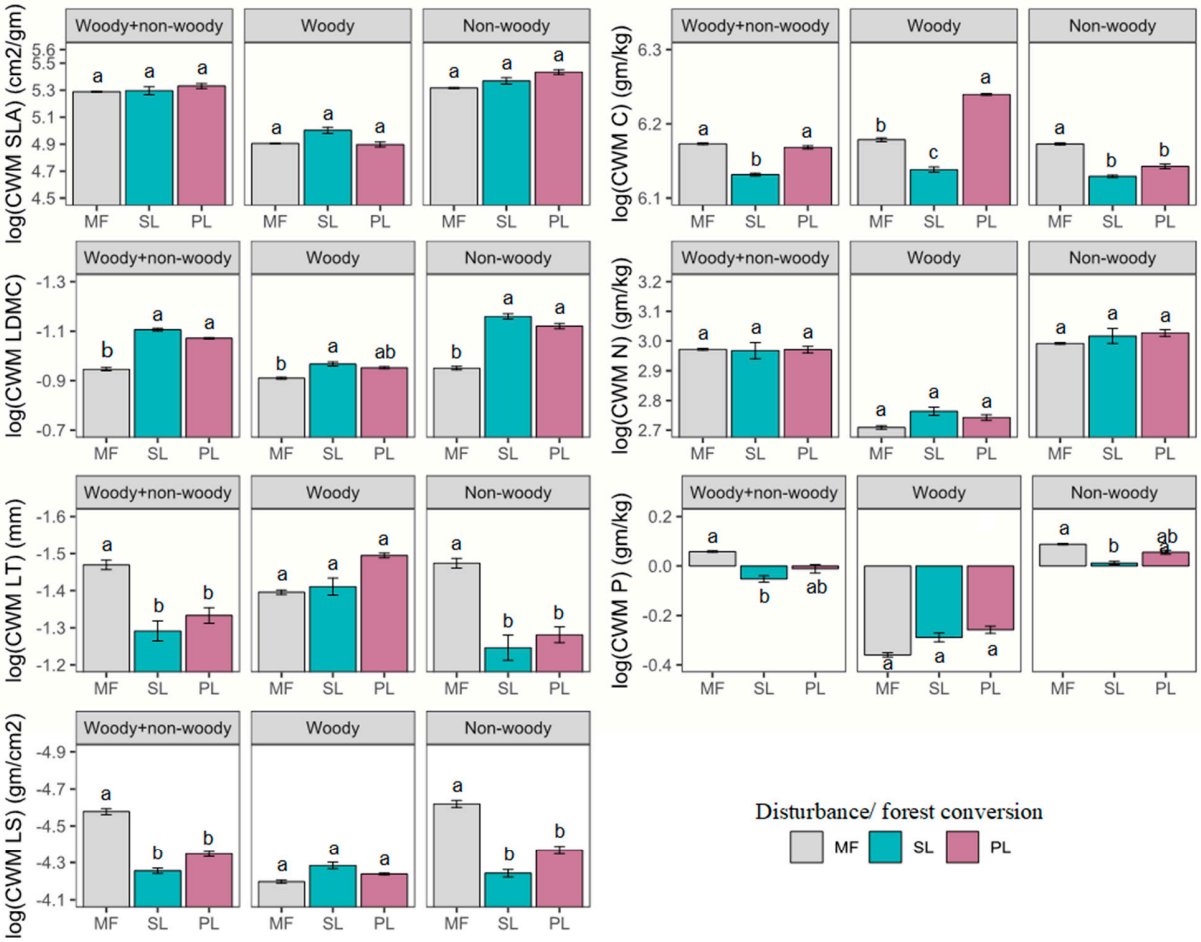

Figure S2: Variations in functional composition (community-weighted mean of individual traits) concerning disturbance and vegetation layers. Shown in the figures are mean ±1se. Bars marked with the same letters do not differ significantly at α = 0.05, as identified by Tukey's posthoc test.

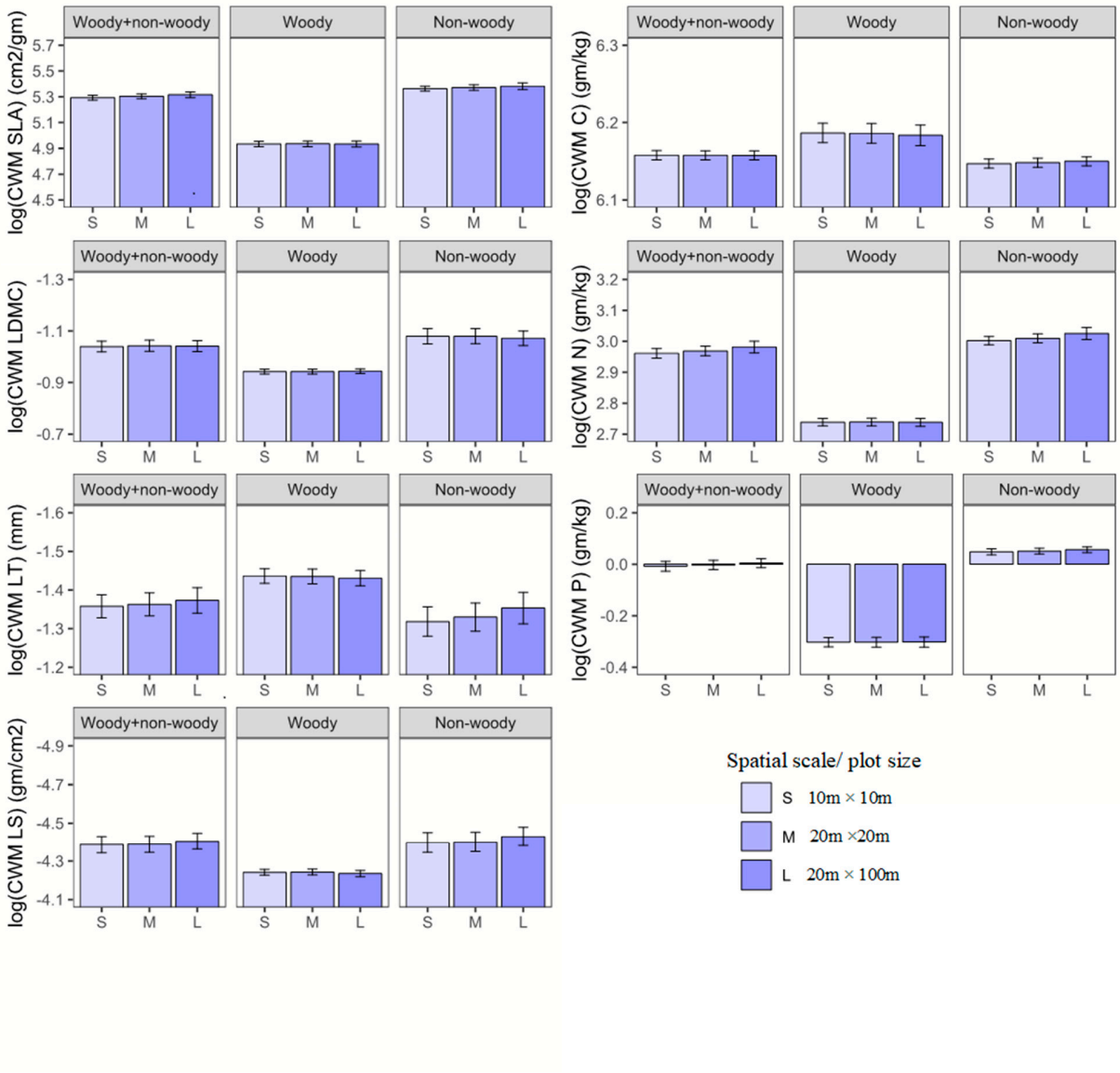

Figure S3: Variations in functional composition (community-weighted mean of individual traits) concerning spatial scale and vegetation layers. Shown in the figures are mean ±1se.

Table S1: List of species found in this study

Chinese name	Scientific name	Life form
三角槭	*Acer buergerianum*	Woody species
秀丽槭	*Acer elegantulum*	Woody species
毛脉槭	*Acer pubinerve*	Woody species
杨桐	*Adinandra millettii*	Woody species
合欢	*Albizia julibrissin*	Woody species
山槐	*Albizia kalkora*	Woody species
拟赤扬	*Alniphyllum fortunei*	Woody species
毛柄连蕊茶	*Camellia fraterna*	Woody species
油茶	*Camellia oleifera*	Woody species
雷公鹅耳枥	*Carpinus viminea*	Woody species
米槠	*Castanopsis carlesii*	Woody species
栲	*Castanopsis fargesii*	Woody species
苦槠	*Castanopsis scerophylla*	Woody species
朴树	*Celtis sinensis*	Woody species
迎春樱桃	*Cerasus discoidea*	Woody species
大叶早樱	*Cerasus subhirtella*	Woody species
南酸枣	*Choerospondias axillaris*	Woody species
香樟	*Cinnamomum camphora*	Woody species
细叶香桂	*Cinnamomum subavenium*	Woody species
大青	*Clerodendrum cyrtophyllum*	Woody species
赤皮青冈	*Cyclobalanopsis gilva*	Woody species
小叶青冈	*Cyclobalanopsis myrsinifolia*	Woody species
云山青冈	*Cyclobalanopsis sessilifolia*	Woody species
褐叶青冈	*Cyclobalanopsis stewardiana*	Woody species
黄檀	*Dalbergia hupeana*	Woody species
虎皮楠	*Daphniphyllum oldhami*	Woody species
柿子	*Diospyros kaki*	Woody species
浙江柿	*Diospyros montana*	Woody species
罗浮柿	*Diospyros morrisiana*	Woody species
油柿	*Diospyros oleifera*	Woody species
杨梅叶蚊母树	*Distylium myricoides*	Woody species
厚壳树	*Ehretia thyrsiflora*	Woody species
日本杜英	*Elaeocarpus japonicus*	Woody species
铁海棠	*Euphorbia milii*	Woody species
细枝柃	*Eurya loquaiana*	Woody species
格药柃	*Eurya muricata*	Woody species

Chinese name	Scientific name	Life form
窄基红褐柃	*Eurya rubiginosa*	Woody species
野鸦椿	*Euscaphis japonica*	Woody species
青桐	*Firmiana platanifolia*	Woody species
牛鼻栓	*Fortunearia sinensis*	Woody species
苦枥木	*Fraxinus insularis*	Woody species
栀子花	*Gardenia jasminoides*	Woody species
小果山龙眼	*Helicia cochinchinensis*	Woody species
短梗冬青	*Ilex buergeri*	Woody species
冬青	*Ilex chinensis*	Woody species
毛枝冬青	*Ilex dasyclada*	Woody species
皱柄冬青	*Ilex kengii*	Woody species
小果冬青	*Ilex micrococca*	Woody species
铁冬青	*Ilex rotunda*	Woody species
披针叶茴香	*Illicium lanceolatum*	Woody species
刺楸	*Kalopanax septemlobus*	Woody species
刺叶桂樱	*Laurocerasus spinulosa*	Woody species
水腊	*Ligustrum obtusifolium*	Woody species
山胡椒	*Lindera glauca*	Woody species
红脉钓樟	*Lindera rubronervia Gamble*	Woody species
枫香树	*Liquidambar formosana*	Woody species
石栎	*Lithocarpus glaber*	Woody species
东南石栎	*Lithocarpus harlandii*	Woody species
山鸡椒	*Litsea cubeba*	Woody species
黄丹木姜子	*Litsea elongata*	Woody species
檵木	*Loropetalum chinense*	Woody species
红楠	*Machilus thunbergii*	Woody species
野桐	*Mallotus japonicus*	Woody species
深山含笑	*Michelia maudiae*	Woody species
杨梅	*Myrica rubra*	Woody species
浙江新木姜子	*Neolitsea aurata*	Woody species
宁波木犀	*Osmanthus cooperi*	Woody species
桂花	*Osmanthus fragrans*	Woody species
光叶石楠	*Photinia glabra*	Woody species
小叶石楠	*Photinia parvifolia*	Woody species
海金子	*Pittosporum illicioides*	Woody species
化香	*Platycarya strobilacea*	Woody species
豆腐柴	*Premna microphylla*	Woody species
桂樱	*Prunus laurocerasus*	Woody species
麻栎	*Quercus acutissima*	Woody species

Chinese name	Scientific name	Life form
小叶栎	*Quercus chenii*	Woody species
白栎	*Quercus fabri*	Woody species
青冈	*Quercus glauca*	Woody species
苦栎	*Quercus laevis*	Woody species
石斑木	*Rhaphiolepis indica*	Woody species
马银花	*Rhododendron ovatum*	Woody species
杜鹃花	*Rhododendron simsii*	Woody species
盐肤木	*Rhus chinensis*	Woody species
檫木	*Sassafras tzumu*	Woody species
木荷	*Schima superba*	Woody species
赛山梅	*Styrax confusus*	Woody species
薄叶山矾	*Symplocos anomala*	Woody species
倒披针叶山矾	*Symplocos oblanceolata*	Woody species
白檀	*Symplocos paniculata*	Woody species
老鼠矢	*Symplocos stellaris*	Woody species
山矾	*Symplocos sumuntia*	Woody species
赤楠	*Syzygium buxifolium*	Woody species
白花苦灯笼	*Tarenna mollissima*	Woody species
漆树	*Toxicodendron vernicifluum*	Woody species
南烛	*Vaccinium bracteatum*	Woody species
黄背越桔	*Vaccinium iteophyllum*	Woody species
江南越橘	*Vaccinium mandarinorum*	Woody species
油桐	*Vernicia fordii*	Woody species
宜昌荚蒾	*Viburnum erosum*	Woody species
花椒	*Zanthoxylum bungeanum*	Woody species
木通	*Akebia quinata*	Non-woody species
山葡萄	*Ampelopsis brevipedunculata*	Non-woody species
蛇葡萄	*Ampelopsis sinica*	Non-woody species
紫金牛	*Ardisia japonica*	Non-woody species
勾儿茶	*Berchemia sinica Schneid*	Non-woody species
葡蟠	*Broussonetia kaempferi*	Non-woody species
过山枫	*Celastrus aculeatus*	Non-woody species
单叶双盖蕨	*Deparia lancea*	Non-woody species
芒萁	*Dicranopteris dichotoma*	Non-woody species
里白	*Diplopterygium glaucum*	Non-woody species
红盖鳞毛蕨	*Dryopteris erythrosora*	Non-woody species
丽江鳞毛蕨	*Dryopteris montigena*	Non-woody species
蛇莓	*Duchesnea indica*	Non-woody species
大吴风草	*Farfugium japonicum*	Non-woody species

Chinese name	Scientific name	Life form
绞股蓝	*Gynostemma pentaphyllum*	Non-woody species
箬竹	*Indocalamus tessellatus*	Non-woody species
南五味子	*Kadsura logipedunculata*	Non-woody species
金银花	*Lonicera japonica*	Non-woody species
淡竹叶	*Lophatherum gracile*	Non-woody species
海金沙	*Lygodium japonicum*	Non-woody species
杜茎山	*Maesa japonica*	Non-woody species
沿阶草	*Ophiopogon bodinieri*	Non-woody species
紫萁	*Osmunda japonica*	Non-woody species
鸡矢藤	*Paederia scandens*	Non-woody species
Species	Latin name	Life form
水竹	*Phyllostachys heteroclada*	Non-woody species
菝葜	*Smilax china*	Non-woody species
千金藤	*Stephania japonica*	Non-woody species
络石	*Trachelospermum jasminoides*	Non-woody species
油点草	*Tricyrtis macropoda*	Non-woody species
紫藤	*Wisteria sinensis*	Non-woody species
狗脊	*Woodwardia japonica*	Non-woody species

Table S2: Results of mixed-effect models showing the effects of habitat disturbance and spatial scale on species and functional diversity relationships for woody, non-woody and woody + non-woody layers. Bold font represents statistical significance (α = 0.05).

Model relevant to hypotheses					*Fitted model*				
(a) Species richness-functional richness relationship in woody layers									
Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	p-value
(Intercept)	1	13	1414.192	**<0.0001**	(Intercept)	1	17	1982.321	**<0.0001**
log(richness)	1	13	1020.05	**<0.0001**	log(richness)	1	17	1255.07	**<0.0001**
Disturbance	2	9	32.1886	**0.0001**	Disturbance	2	9	40.4604	**<0.0001**
Spatial scale	2	13	4.9972	**0.0246**	Spatial scale	2	17	6.5888	**0.0076**
log(richness):Disturbance	2	13	16.7719	**0.0003**	log(richness):Disturbance	2	17	16.843	**0.0001**
log(richness):Spatial scale	2	13	7.3977	**0.0072**	log(richness):Spatial scale	2	17	7.8019	**0.0039**
Disturbnace:Spatial scale	4	13	0.3014	0.8719					
Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.1311205 (intercept)					site: 0.1036881 (intercept)				
Spatial scale %in% site: 0.121159 (intercept); 0.05260605 (res)					Spatial scale %in% site: 0.120545 (intercept); 0.04957394 (res)				
AIC: 25.39789; BIC: 43.94561; logLik: 4.301055					AIC: 17.67429; BIC: 34.02954; logLik: 4.162857				
(b) Species evenness-functional evenness relationship in woody layers									
Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	p-value
(Intercept)	1	13	423.9203	**<0.0001**	(Intercept)	1	19	638.185	**<0.0001**
log(Evar)	1	13	93.6597	**<0.0001**	log(Evar)	1	19	130.897	**<0.0001**

Disturbance	2	9	0.3175	0.7358	Spatial scale	2	19	0.8746	0.4331
Spatial scale	2	13	0.8098	0.4662	log(Evar):Spatial scale	2	19	6.233	**0.0083**
log(Evar):Disturbance	2	13	0.7145	0.5077					
log(Evar):Spatial scale	2	13	6.5433	**0.0108**					
Disturbance:Spatial scale	4	13	0.5794	0.6828					
Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.06657712 (intercept)					site: 0.0325984 (intercept)				
Spatial scale %in% site: 0.1176006 (intercept); 0.0438779 (res)					Spatial scale %in% site: 0.121604 (intercept); 0.0363736 (res)				
AIC: 25.95032; BIC: 44.49804; logLik: 4.024841					AIC: -2.907229; BIC: 9.703548; logLik: 10.45361				

(c) Species diversity-functional diversity relationship in woody layers

Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	p-value
(Intercept)	1	13	80.7735	**<0.0001**	(Intercept)	1	23	81.13703	**<0.0001**
log(Species diversity)	1	13	286.0755	**<0.0001**	log(Species diversity)	1	23	108.8915	**<0.0001**
Disturbance	2	9	0.65001	0.5449					
Spatial scale	2	13	36.654	**<0.0001**					
log(Species diversity):Disturbance	2	13	5.56667	**0.0179**					
log(Species diversity): Spatial scale	2	13	4.03662	**0.0433**					
Disturbance: Spatial scale	4	13	1.38476	0.2929					
Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.3599029 (intercept)					site: 0.3510388 (intercept)				
Spatial scale %in% site: 0.05406032 (intercept); 0.03935568 (res)					Spatial scale %in% site: 0.1274053 (intercept); 0.07337433 (res)				

AIC: 16.24265; BIC: 34.79037; logLik: 8.878677					AIC: 12.48434; 20.11614; logLik: -1.242169				
(d) Species richness-functional richness relationship in non-woody layers									
Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	p-value
(Intercept)	1	13	373.7536	**<0.0001**	(Intercept)	1	23	515.8541	**<0.0001**
log(richness)	1	13	436.6051	**<0.0001**	log(richness)	1	23	452.9774	**<0.0001**
Disturbance	2	9	0.1281	0.8814					
Spatial scale	2	13	0.525	0.6036					
log(richness): Spatial scale	2	13	0.6221	0.552					
log(richness): Spatial scale	2	13	2.0944	0.1627					
Disturbance: Spatial scale	4	13	0.4311	0.7838					
Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.3058164 (intercept)					site: 0.2554895 (intercept)				
Spatial scale %in% site: 0.1527584 (intercept); 0.07838734 (res)					Spatial scale %in% site: 0.1521594 (intercept); 0.07526573 (res)				
AIC: 41.19177; BIC: 59.7395; logLik: -3.595887					AIC: 13.83727; BIC: 21.46908; logLik: -1.918637				
(e) Species evenness-functional evenness relationship in non-woody layers									
Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	p-value
(Intercept)	1	13	129.15	**<0.0001**	(Intercept)	1	23	126.0473	**<0.0001**
log(Evar)	1	13	0.0033	0.9551	log(Evar)	1	23	0.22188	0.642
Disturbance	2	9	2.07233	0.1819					
Spatial scale	2	13	7.79113	**0.006**					
log(Evar):Disturbance	2	13	1.47053	0.2656					
log(Evar): Spatial scale	2	13	0.85597	0.4475					
Disturbance: Spatial scale	4	13	3.10082	0.0536					

Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.1962443 (intercept)					site: 0.1531631 (intercept)				
Spatial scale %in% site: 0.1997083 (intercept); 0.08477458 (res)					Spatial scale %in% site: 0.2912275 (intercept); 0.1068549 (res)				
AIC: 49.2826; BIC: 67.83032; logLik: -7.641298					AIC: 38.40402; BIC: 46.03582; logLik: -14.20201				
(f) Species diversity-functional diversity relationship in non-woody layers									
Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	p-value
(Intercept)	1	13	75.51696	**<0.0001**	(Intercept)	1	23	90.83944	**<0.0001**
log(Species diversity)	1	13	144.3509	**<0.0001**	log(Species diversity)	1	23	143.127	**<0.0001**
Disturbance	2	9	0.45626	0.6475					
Spatial scale	2	13	1.02649	0.3856					
log(Species diversity):Disturbance	2	13	0.9193	0.4232					
log(Species diversity): Spatial scale	2	13	2.74641	0.1012					
Disturbance: Spatial scale	4	13	0.15483	0.9574					
Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.2097169 (intercept)					site: 0.190901 (intercept)				
Spatial scale %in% site: 0.03441179 (intercept); 0.02432411 (res)					Spatial scale %in% site: 0.03454414 (intercept); 0.02532032 (res)				
AIC: -6.314668; 12.23305: logLik: 20.15733					AIC: -59.07616; BIC: -51.44436; logLik: 34.53808				
(g) Species richness-functional richness relationship in woody and non-woody layers combined									
Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	**p-value**
(Intercept)	1	13	647.4161	**<0.0001**	(Intercept)	1	21	616.2284	**<0.0001**
log(richness)	1	13	258.4929	**<0.0001**	log(richness)	1	21	270.1342	**<0.0001**

Disturbance	2	9	5.6448	**0.0258**	Disturbance	2	9	5.3819	**0.029**
Spatial scale	2	13	0.1644	0.8502	log(S): Disturbance	2	21	5.0523	**0.0162**
log(richness):Disturbance	2	13	4.6932	**0.0292**					
log(richness): Spatial scale	2	13	1.921	0.1858					
Disturbance: Spatial scale	4	13	0.8993	0.4923					
Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.1809013 (intercept)					site: 0.187327 (intercept)				
Spatial scale %in% site: 0.1336633 (intercept); 0.06126598 (res)					Spatial scale %in% site: 0.1298101 (intercept); 0.06110076 (res)				
AIC: 29.58537; BIC: 48.13309; logLik: 2.207314					AIC: 13.69687; BIC: 26.30765; logLik: 2.151564				
(h) Species evenness-functional evenness relationship in woody and non-woody layers combined									
Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	p-value
(Intercept)	1	13	964.2905	**<0.0001**	(Intercept)	1	19	724.2672	**<0.0001**
log(Evar)	1	13	4.6619	0.0501	log(Evar)	1	19	2.3757	0.1397
Disturbance	2	9	2.5813	0.13	Spatial scale	2	19	32.4973	**<.0001**
Spatial scale	2	13	33.4699	**<0.0001**	log(Evar): Spatial scale	2	19	7.7021	**0.0036**
log(Evar): Disturbance	2	13	1.4474	0.2707					
log(Evar): Spatial scale	2	13	7.6	**0.0065**					
Disturbance: Spatial scale	4	13	0.6513	0.6361					
Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.02661224 (intercept)					site: 0.04831632 (intercept)				
Spatial scale %in% site: 0.1081581 (intercept); 0.03059314 (res)					Spatial scale %in% site: 0.1060043 (intercept); 0.03754336 (res)				
AIC: 14.34219; BIC: 32.88991; logLik: 9.828905					AIC: -10.29944; BIC: 2.311338; logLik: 14.14972				
(i) Species diversity-functional diversity relationship in woody and non-woody layers combined									

Fixed effects	numDF	denDF	F-value	p-value	*Fixed effects*	numDF	denDF	F-value	p-value
(Intercept)	1	13	329.4658	**<0.0001**	(Intercept)	1	19	372.0936	**<0.0001**
log(Species diversity)	1	13	135.9715	**<0.0001**	log(Species diversity)	1	19	117.4201	**<0.0001**
Disturbance	2	9	3.7399	0.0657	Spatial scale	2	19	4.5029	**0.0251**
Spatial scale	2	13	2.4623	0.1239	log(Species diversity): Spatial scale	2	19	4.0223	**0.0349**
log(Species diversity):Disturbance	2	13	2.1254	0.159					
log(Species diversity):Spatial scale	2	13	6.1319	**0.0133**					
Disturbance:Spatial scale	4	13	0.4001	0.8052					
Random effects (StdDev)					*Random effects (StdDev)*				
site: 0.1891207 (intercept)					site: 0.1775943 (intercept)				
Spatial scale %in% site: 0.02747623 (intercept); 0.01954483 (res)					Spatial scale %in% site: 0.0300881 (intercept); 0.02212692 (res)				
AIC: -17.30541; BIC: 1.242307; logLik: 25.65271					AIC: -43.35325; BIC: -30.74248; logLik: 30.67663				

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