Fewer berries and more pods: losers and winners of chronic disturbance in an Ecuadorian tropical dry forest

Oecologia

Carlos Iván Espinosa[1,5], Andrea Jara-Guerrero[1], Judith Castillo-Escobar[2], Jorge Cueva-Ortiz[3], Elizabeth Gusmán-Montalván[1], Bernd Stimm[3], Patrick Hildebrandt[3], Adrián Escudero[4].

[1] EcoSs_Lab, Departamento de Ciencias Biológicas y Agropecuarias, Universidad Técnica Particular de Loja, Loja, Ecuador.

[2] Maestría de Biología de la Conservación y Ecología Tropical, Departamento de Ciencias Biológicas y Agropecuarias, Universidad Técnica Particular de Loja, Loja, Ecuador.

[3] Department of Life Science Systems, Technical University of Munich, Freising, Germany

[4] Instituto de Investigación en Cambio Global IICG-URJC, Área de Biodiversidad y Conservación. Dep. de Biología, Geología y Física Aplicada. ESCET URJC, Móstoles, Madrid, Spain.

[5] Corresponding author: ciespinosa@utpl.edu.ec

Table S4. Output of the generalized linear models for plant traits associated with seed dispersal. We used three explanatory variables; chronic disturbance (CDI), elevation and interaction of these two variables (CDI:E). We adjusted three models for each measured trait: i) complete model; it is a model with CDI, elevation and CDI:E, ii) model without interaction; CDI and elevation, and iii) reduced model; only CDI. For qualitative variables (a-c) we used binomial error distribution, while for quantitative variables we used four error distribution structures; gamma error distribution with three link functions and the gaussian error distribution (d-g). The summary of the models is showed as estimate [low confidence, high confidence]. The table includes the results of the best models and error distribution structure as *error distribution (link function)*.

a. Fruit type

	Achene	Berry	Capsule	Drupe	Pods	Samara	Syconium
Trees							
Intercept	-3.32 ***	-1.80 ***	0.10	-1.38 ***	-2.28 ***	-0.49 *	-2.98
	[-4.12, -2.53]	[-2.77, -0.82]	[-0.17, 0.37]	[-1.66, -1.10]	[-2.58, -1.98]	[-0.93, -0.04]	[-6.14, 0.17]
CDI	-0.51	-6.77 ***	-1.47 ***	-1.01 ***	3.82 ***	-3.88 ***	-9.95 *
	[-2.24, 1.21]	[-9.30, -4.24]	[-2.06, -0.88]	[-1.52, -0.49]	[3.18, 4.47]	[-4.93, -2.83]	[-18.18, -1.73]
Elevation	-2.52 **	-1.85 *	-0.50 *	-0.21	1.12 ***	-2.00 ***	-4.45
	[-4.05, -0.98]	[-3.40, -0.29]	[-0.95, -0.06]	[-0.55, 0.13]	[0.61, 1.64]	[-2.74, -1.26]	[-9.72, 0.82]
CDI:E	9.70 ***	12.07 ***	1.70 **		-6.90 ***	8.24 ***	21.63 **
	[5.77, 13.63]	[7.45, 16.69]	[0.43, 2.97]		[-8.36, -5.44]	[6.11, 10.38]	[6.89, 36.36]
N	72	72	72	72	72	72	72
AIC	493.65	429.90	1087.35	873.32	1002.07	1675.56	99.75
BIC	502.76	439.01	1096.45	880.15	1011.17	1684.66	108.86
Pseudo R2	0.58	0.79	0.46	0.22	0.99	0.76	0.33
Trees and shrubs							
Intercept	-3.44 ***	-2.88 ***	1.03 ***	-2.36 ***	-2.55 ***	-1.70 ***	-4.12 ***
	[-3.73, -3.15]	[-3.14, -2.61]	[0.90, 1.16]	[-2.57, -2.14]	[-2.70, -2.39]	[-1.95, -1.46]	[-5.95, -2.29]
CDI	-0.18	-0.50	-2.04 ***	0.25	3.23 ***	-2.11 ***	-8.52 ***

	[-0.84, 0.48]	[-1.10, 0.10]	[-2.32, -1.76]	[-0.21, 0.70]	[2.91, 3.55]	[-2.68, -1.54]	[-13.30, -3.74]
Elevation	1.21 ***	0.70 **	-1.98 ***	0.91 ***	1.29 ***	-0.64 **	-3.21 *
	[0.73, 1.68]	[0.26, 1.14]	[-2.20, -1.75]	[0.55, 1.27]	[1.01, 1.56]	[-1.07, -0.22]	[-6.35, -0.07]
CDI:E	2.85 ***	1.86 **	4.75 ***	-5.05 ***	-6.39 ***	3.07 ***	18.24 ***
	[1.54, 4.17]	[0.62, 3.09]	[4.13, 5.37]	[-6.08, -4.02]	[-7.12, -5.65]	[1.86, 4.28]	[9.37, 27.11]
N	72	72	72	72	72	72	72
AIC	2963.81	5162.80	6779.10	2050.48	5063.59	3979.61	219.34
BIC	2972.91	5171.91	6788.21	2059.59	5072.70	3988.72	228.45
Pseudo R2	1.00	0.94	0.99	0.93	1.00	0.85	0.55

*** p < 0.001; ** p < 0.01; * p < 0.05.

b. Fruit color

	Black	Blue	Brown	Green	Orange	Red	White	Yellow
Trees								
Intercept	-3.11 ***	-7.42	1.04 ***	-2.42 ***	-8.25 ***	-1.09 *	-0.68	0.01
	[-4.43, -1.78]	[-15.15, 0.30]	[0.71, 1.37]	[-2.77, -2.08]	[-12.13, -4.38]	[-2.09, -0.10]	[-3.18, 1.83]	[-0.88, 0.90]
CDI	-2.74	-5.1	1.47 ***	0.64	-1.02	-5.83 ***	-13.32 ***	-11.66 ***
	[-5.80, 0.33]	[-21.10, 10.89]	[0.72, 2.22]	[-0.11, 1.39]	[-8.11, 6.08]	[-8.25, -3.42]	[-20.42, -6.22]	[-14.16, -9.15]
Elevation	-3.69 **	0.16	-0.79 **	2.19 ***	2.58	-5.72 ***	-5.87 **	-3.87 ***
	[-6.27, -1.11]	[-9.51, 9.84]	[-1.32, -0.26]	[1.65, 2.74]	[-1.63, 6.79]	[-7.69, -3.75]	[-10.27, -1.47]	[-5.32, -2.41]
CDI:E	10.90 **		-2.01 **	-2.73 ***		17.05 ***	17.33 *	18.84 ***
	[4.01, 17.80]		[-3.54, -0.49]	[-4.29, -1.17]		[11.69, 22.41]	[3.27, 31.40]	[14.34, 23.35]
N	72	72	72	72	72	72	72	72
AIC	281.95	14.94	762.57	776.8	37.83	401.56	145.94	387.69
BIC	291.06	21.77	771.67	785.9	44.66	410.67	155.04	396.8
Pseudo R2	0.21	0.09	0.98	0.93	0.11	0.54	0.35	0.96
Trees and Shrubs								
Intercept	-3.75 ***	-0.22	2.06 ***	-3.43 ***	-7.95 ***	-2.20 ***	-2.07 **	-1.53 ***
	[-4.54, -2.96]	[-13.78, 13.35]	[1.90, 2.22]	[-3.63, -3.23]	[-8.42, -7.48]	[-2.50, -1.90]	[-3.55, -0.60]	[-2.05, -1.00]
CDI	-2.14 *	-29.87	-0.50 **	1.81 ***	4.26 ***	-1.17 ***	-10.62 ***	-9.11 ***
	[-3.94, -0.34]	[-71.45, 11.70]	[-0.85, -0.15]	[1.39, 2.23]	[3.54, 4.98]	[-1.83, -0.51]	[-14.76, -6.48]	[-10.57, -7.65]
Elevation	-3.22 ***	-13.67	-2.06 ***	3.27 ***	4.45 ***	-1.60 ***	-4.08 **	-2.03 ***
	[-4.82, -1.62]	[-39.08, 11.73]	[-2.32, -1.79]	[2.96, 3.59]	[4.01, 4.89]	[-2.17, -1.04]	[-6.69, -1.46]	[-2.89, -1.16]
CDI:E	7.87 ***	47.98	3.30 ***	-7.14 ***		1.60 *	10.20 *	13.05 ***
	[3.63, 12.11]	[-28.04, 123.99]	[2.56, 4.05]	[-8.03, -6.24]		[0.07, 3.14]	[1.69, 18.71]	[10.36, 15.73]
N	72	72	72	72	72	72	72	72

AIC	640.94	26.91	2515.37	2013.91	1384.25	2188.46	351.43	858.41
BIC	650.05	36.02	2524.47	2023.01	1391.08	2197.56	360.54	867.51
Pseudo R2	0.32	0.26	1	1	0.99	0.62	0.63	1

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

c. Dispersal syndrome

	Anemochory	Autochory	Zoochory

Trees			
Intercept	1.20 ***	-3.41 ***	-1.23 ***
	[0.92, 1.48]	[-3.83, -2.99]	[-1.59, -0.88]
CDI	0.1	1.51 ***	-1.30 **
	[-0.51, 0.71]	[0.65, 2.37]	[-2.09, -0.50]
Elevation	-0.85 ***	1.51 ***	0.4
	[-1.31, -0.39]	[0.86, 2.17]	[-0.16, 0.97]
CDI:E	-2.69 ***	2.19 *	0.84
	[-3.99, -1.39]	[0.43, 3.95]	[-0.80, 2.48]
N	72	72	72
AIC	979.43	694	858.01
BIC	988.53	703.1	867.12
Pseudo R2	0.95	0.88	0.77
Trees and shurbs			
Intercept	1.52 ***	-3.15 ***	-1.94 ***
	[1.38, 1.66]	[-3.40, -2.90]	[-2.10, -1.78]
CDI	-0.29	-0.26	0.47 **
	[-0.60, 0.02]	[-0.83, 0.31]	[0.12, 0.82]
Elevation	-1.24 ***	0.96 ***	1.35 ***
	[-1.49, -1.00]	[0.54, 1.38]	[1.07, 1.62]
CDI:E	-0.88 **	4.89 ***	-2.91 ***
	[-1.55, -0.22]	[3.74, 6.04]	[-3.67, -2.14]
N	72	72	72
AIC	5902.35	3583.29	4125.32
BIC	5911.45	3592.39	4134.43
Pseudo R2	1	1	0.96

*** p < 0.001; ** p < 0.01; * p < 0.05.

d. Fruit traits

	Fruit area	Fruit weight	N. seeds
Trees			
CDI	0.5	-2.15 *	-9.13 ***
	[-0.44, 1.44]	[-4.16, -0.14]	[-13.64, -4.61]
Elevation	0.28	-0.17	-12.29 ***
	[-0.48, 1.05]	[-2.31, 1.97]	[-15.84, -8.73]
CDI:E	-1.7	4.61	22.00 ***
	[-3.74, 0.33]	[-1.06, 10.28]	[12.51, 31.48]
N	72	72	72
AIC	1079.59	456.4	725.32
BIC	1090.97	467.78	736.71
Pseudo R2	0.07	0.18	0.2
Error distribution structure	Gamma(Log)	Gamma(Sqrt)	Gamma(Sqrt)
Trees and shrubs			
CDI	-2.33	-4.64 ***	-7.38 ***
	[-19.36, 14.71]	[-6.46, -2.82]	[-11.22, -3.54]
Elevation	-1.79	-3.92 ***	-10.24 ***
	[-12.80, 9.23]	[-5.70, -2.13]	[-13.16, -7.31]
CDI:E		9.47 ***	15.82 ***
		[4.76, 14.19]	[8.12, 23.52]
N	72	72	72
AIC	1123.91	538.99	678.99
BIC	1133.02	550.37	690.37
Pseudo R2	0	0.1	0.35
Error distribution structure	Gamma(Sqrt)	Gamma(Sqrt)	Gamma(Sqrt)

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

e. Seed traits

	Seed area	Seed weight

Trees		
CDI	-1.17	-2.28
	[-2.43, 0.09]	[-5.37, 0.81]
Elevation	-1.82 ***	-2.13
	[-2.84, -0.80]	[-4.64, 0.37]
CDI:E	3.66 *	4.9
	[0.94, 6.38]	[-1.78, 11.59]
N	72	72
AIC	734.1	47.94
BIC	745.49	59.33
Pseudo R2	0.2	0.15
Error distribution structure	Gamma(Log)	Gamma(Inv)
Trees and shrubs		
CDI	-1.41 **	-0.43
	[-2.42, -0.41]	[-0.99, 0.14]
Elevation	-2.15 ***	-0.32
	[-2.96, -1.33]	[-0.67, 0.04]
CDI:E	4.10 ***	
	[1.93, 6.27]	
N	72	72
AIC	739.24	-2.58
BIC	750.63	6.52
Pseudo R2	0.3	-0.59
Error distribution structure	Gamma(Log)	Gamma(Sqrt)

*** p < 0.001; ** p < 0.01; * p < 0.05.

f. Functional diversity of fruit traits

Fruit area	Fruit weight	Seed number per fruit

	Functional richness	Functional evenness	Functional divergence	Functional richness	Functional evenness	functional divergence	Functional richness	Functional evenness	functional divergence
Trees									
CDI	-0.82 *	0	-0.23	-0.77	0	-2.26	-0.34	-0.20 **	-0.25 ***
	[-1.48, -0.15]	[-0.09, 0.08]	[-0.46, -0.00]	[-2.52, 0.98]	[-0.07, 0.06]	[-4.71, 0.20]	[-1.07, 0.38]	[-0.34, -0.06]	[-0.35, -0.14]
Elevation	0	-0.00 *	0	0		0	0	-0.00 *	-0.00 ***
	[-0.00, 0.00]	[-0.00, -0.00]	[-0.00, 0.00]	[-0.01, 0.00]		[-0.01, 0.00]	[-0.00, 0.00]	[-0.00, -0.00]	[-0.00, -0.00]
CDI:E	0					0	0	0.00 *	0.00 ***
	[-0.00, 0.00]					[-0.00, 0.01]	[-0.00, 0.00]	[0.00, 0.00]	[0.00, 0.00]
N	72	72	72	72 E8	72	72	72	72	72
AIC	162.63	-79.38	-99.93	7.7	-90.78	-352.32	24.61	-134.76	-197.44
BIC	174.01	-70.27	-90.83	16.8	-83.95	-340.93	35.99	-123.38	-186.06
Pseudo R2	0.23		-0.02	1.05		0	0.45		-0.02
R2		0.12			0			0.12	
Error distribution structure	Gamma(Log)	Gaussian	Gamma(Log)	Gamma(Log)	Gaussian	Gamma(Log)	Gamma(Sqrt)	Gaussian	Gamma(Sqrt)
Trees and shrubs									
CDI	-1.03 **	0.12	-0.06	-2.96	0.14	-0.29	-0.36	-0.20 **	-0.18 **
	[-1.63, -0.43]	[-0.06, 0.31]	[-0.19, 0.08]	[-6.51, 0.59]	[-0.30, 0.57]	[-1.12, 0.54]	[-1.13, 0.40]	[-0.34, -0.06]	[-0.29, -0.06]
Elevation	0	0	0	-0.01 *	0	-0.00 *	0	-0.00 *	-0.00 ***
	[-0.00, 0.00]	[-0.00, 0.00]	[-0.00, 0.00]	[-0.01, -0.00]	[-0.00, 0.00]	[-0.00, -0.00]	[-0.00, 0.00]	[-0.00, -0.00]	[-0.00, -0.00]
CDI:E	0.00 **	0		0			0	0	0.00 **
	[0.00, 0.00]	[-0.00, 0.00]		[-0.00, 0.01]			[-0.00, 0.00]	[-0.00, 0.00]	[0.00, 0.00]
N	72	72	72	72	72	72	72	72	72

AIC	159.85	-94.68	-42.32	45.87	-69.37	-328.1	37.7	-131.08	-231.48
BIC	171.23	-83.29	-33.22	57.25	-60.27	-319	49.08	-119.69	-220.1
Pseudo R2	0.36		-0.09	0.3	0	0	0.34		-0.01
R2		0.21						0.12	
Error distribution structure	Gamma(Log)	Gaussian	Gamma(Sqrt)	Gamma(Log)	Gamma(Log)	Gamma(Log)	Gamma(Sqrt)	Gaussian	Gamma(Sqrt)

*** p < 0.001; ** p < 0.01; * p < 0.05.

g. Functional diversity of seed traits

	SA_FRic	SA_FEve	SA_FDis	SW_FRic	SW_FEve	SW_FDis
Trees						
CDI	-0.16	-0.19	-1.04 *	-1	-0.25 **	-0.13
	[-1.29, 0.97]	[-0.39, 0.00]	[-2.01, -0.07]	[-2.47, 0.47]	[-0.41, -0.09]	[-0.28, 0.02]
Elevation	-0.00 *	-0.00 *	-0.00 **	0	0	-0.00 *
	[-0.00, -0.00]	[-0.00, -0.00]	[-0.00, -0.00]	[-0.00, 0.00]	[-0.00, 0.00]	[-0.00, -0.00]
CDI:E		0.00 *	0.00 *		0.00 *	0
		[0.00, 0.00]	[0.00, 0.00]		[0.00, 0.00]	[-0.00, 0.00]
N	72	72	72	72	72	72
R2	0.11	0.1				
AIC	287.02	-84.52	49.61	8.25	-80.81	-333.17
BIC	296.12	-73.14	61	17.36	-69.42	-321.79
Pseudo R2			0.36	0.95	-0.08	0
Error distribution structure	Gaussian	Gaussian	Gamma(Log)	Gamma(Log)	Gamma(Sqrt)	Gamma(Sqrt)
Trees and shrubs						
CDI	-0.09	-0.21 *	-0.88 *	-1.42	-0.22 **	-0.07

	[-1.26, 1.07]	[-0.40, -0.03]	[-1.68, -0.07]	[-4.80, 1.96]	[-0.38, -0.07]	[-0.15, 0.01]
Elevation	-0.00 *	-0.00 *	-0.00 ***	0	0	-0.00 *
	[-0.01, -0.00]	[-0.00, -0.00]	[-0.00, -0.00]	[-0.01, 0.00]	[-0.00, 0.00]	[-0.00, -0.00]
CDI:E		0.00 **	0.00 *	0	0	
		[0.00, 0.00]	[0.00, 0.00]	[-0.00, 0.01]	[-0.00, 0.00]	
N	72	72	72	72	72	72
R2	0.11	0.12				
AIC	290.56	-96.42	32.5	25.3	-94.14	-363.08
BIC	299.67	-85.03	43.88	36.68	-82.76	-353.97
Pseudo R2			0.5	0.28	-0.06	0
Error distribution structure	Gaussian	Gaussian	Gamma(Log)	Gamma(Log)	Gamma(Inv)	Gamma(Sqrt)

*** p < 0.001; ** p < 0.01; * p < 0.05.