FITTING SPECIES ABUNDANCE MODELS IN TREE STRATA IN A CLOUD FOREST

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Abstract

Species-abundance models can be used to detect forest disturbance in ecosystems that had been logged. With the aim of knowing the impact of the selective logging on the distribution of tree species abundance, we analyzed the forest disturbance and successional stage of two experimental plots with different historical of management. Four species-abundance models were fitted in the tree strata of two stands with different historical of management in "El Cielo" cloud forest, Tamaulipas, Mexico. Two sampling schemes were tested to evaluate its efficiency in collecting the data needed to fit species-abundance models, quadrants and transects. The log-normal distribution fitted well the data in the unlogged plot, while for the logged plot none of the abundance models shows a significant fit, however, the species distribution of this plot is developing to a log-normal. The geometric series and the broken stick model did not fit well the abundance data in none of analyzed plots. The results indicate that both stands show an intermediate succesional grade, between the pionner and climax stages, where the species with middle abundance are the most dominant. The transects were found to be better to collect the data needed to fit species-abundance models in the tree strata of this forest. We found significant evidence that the stand that had been selectively logged is currently in an earlier succesional stage compared to the unlogged stand, due to the latter fitted a log-normal distribution, whereas the data for former did not. Contrary to some studies that claim that species-abundance are nor good to detect forest disturbance in sites that had been logged, this study shows that these models can be used appropriately to evaluate whether or not a forest is disturbed.

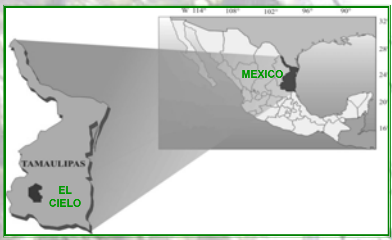

Figure 1. Study Area

Fitted models

Model	Equation
Geometric series	$N_i = NC_k k(1-k)^{i-1}$
Log series	$\alpha x, \alpha x^2/2, \alpha x^3/3, \ldots \alpha x^n/n$
Log normal	$S(R) = S_0 \exp\left(-a^2R^2\right)$
Broken stick	$S(n) = (S(S-1)/N)(1-n/N)^{s-2}$

N_i = the total number of individuals in the *i*th species; N = the total number of individuals; $C_k = (1-(1-k)s)-1$, is a constant that insures that $\Sigma n_i = N$; k = the proportion of the remaining niche space occupied by each succesively colonizing species (k is a constant); αx = the number of species predicted to have one individual, $\alpha x^2/2$ those with two, and so on; $S(R)$ = the number of species in the *R*th octave (i.e., class) to the right, and to the left, of the symmetric curve; S_0= the number of species in the modal octave; $a=(2\sigma^2)^{-1/2}$ = the inverse width of the distribution; n_i = the abundance of the *i*th species; N = the total number of individuals; and S = the total number of species.

Results

Table 1. Found species in Plot 1 and Plot 2

		Plot 1		Plot 2	
Code	**Species**	**N/ha**	**G (m^2ha^{-1})**	**N/ha**	**G (m^2ha^{-1})**
1	*Liquidambar styraciflua*	38	0.87	410	18.37
2	*Ostrya virginiana*	178	2.40	226	2.71
3	*Quercus sartorii*	149	7.50	128	7.3
4	*Carya ovata*	174	2.56	80	0.95
5	*Podocarpus reichei*	140	2.59	80	1.24
6	*Ternstroemia sylvatica*	25	0.07	80	0.26
7	*Clethra pringlei*	13	0.22	54	0.47
8	*Mirandaceltis monoica*	38	0.21	46	0.47
9	*Rapaena myricoides*	25	0.21	36	0.25
10	*Quercus germana*	45	3.18	36	0.97
11	*Quercus xalapensis*	76	0.95	24	1.49
12	*Pinus montezumae*	10	1.34	24	3.59
13	*Carpinus caroliniana*	-	-	10	0.04
14	*Magnolia shiedeana*	51	2.62	8	0.33
15	*Unknown 1*	6	0.03	2	0.04
16	*Carya myristicaeformis*	10	0.36	-	-
17	*Acer shutchii*	4	0.59	6	0.18
18	*Nectandra sanguinea*	3	0.42	6	0.03
19	*Zanthoxylon aff. Carib.*	19	0.21	6	0.11
20	*Cercis canadensis*	3	0.44	4	0.11
21	*Senecio lanicaulis*	6	0.02	4	0.01
22	*Columbrina elliptica*	-	-	4	0.31
23	*Eugenia capuli*	-	-	4	0.28
24	*Witherringia mexicana*	-	-	4	0.04
25	*Unknown 2*	-	-	4	0.23
26	*Prunus serotina*	-	-	4	0.03
27	*Abies vejari*	-	-	2	0.23
28	*Bernardia inerterrupta*	-	-	2	0.21
29	*Pinus patula*	-	-	2	0.23
30	*Celtis iguanea*	-	-	2	0.18
31	*Tilia houghii*	10	0.82	-	-
32	*Berberis hartwegii*	3	0.49	-	-
	TOTAL	1026	28.10	1298	40.66

Table 2. Fitting of the species abundance models in quadrants.

Plot	Quadrant (m)	Geometric Series	Log series	Log normal	Broken stick
1	100	1	1	0	0
1	225	1	1	0	0
1	400	1	1	0	0
1	625	1	1	0	0
1	900	1	1	0	0
1	1225	1	1	0	0
1	1400	1	1	0	0
2	100	1	1	0	0
2	225	1	1	0	0
2	400	1	1	0	0
2	625	1	1	0	1
2	900	1	1	0	1
2	1225	1	1	1	1
2	1400	1	1	1	1

0 = null hypothesis (the data fit to this type of distribution); 1 = alternative hypothesis (the data do not fit to this type of distribution).

Table 2. Fitting of the species abundance models in transects.

Plot	Transect (m2)	Geometric Series	Log series	Log normal	Broken stick
1	120	1	1	0	0
1	200	1	1	0	0
1	280	1	1	0	0
1	360	1	1	0	0
1	400	1	1	0	1
2	120	1	1	0	0
2	200	1	1	0	0
2	280	1	1	0	0
2	360	1	1	0	0
2	400	1	1	0	0

0 = null hypothesis (the data fit to this type of distribution); 1 = alternative hypothesis (the data do not fit to this type of distribution).

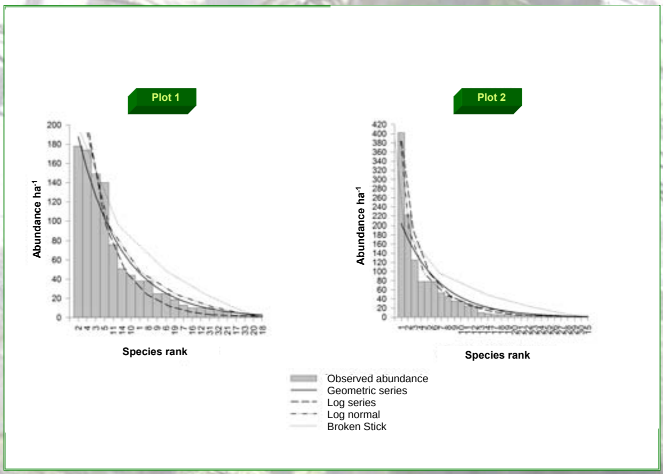

Figure 2. Fitting of four models of diversity and abundance to the total surface of two Plots in the cloud forest "EL Cielo", in Tamaulipas, Mexico. The key of the species is defined in Table 1.

Acknowlegement

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