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Dispersal limitation of soil seed banks in tropical montane forest secondary growth in the Yungas, Bolivia

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Introduction

A permanent disturbed or destroyed tropical forest ecosystem results in unknown local to global, ecological and economic consequences for the nature and the native people in these regions. The anthropogenic forest clearance by fire, commonly used in South America to produce arable land and pastures, destroys and fragmentizes apparently not only the current vegetation, but changes also the subsequent vegetation by influencing the seeds in the soil. Some recent studies revealed that the soil seed banks are exactly the key factor of the natural regeneration ability of tropical forests.[1,2,3,4]

Thus determines the heterogenity, more precisely the density, diversity and compostion of the soil seeds a possible new etablishment of forest species in cleared areas. It was shown that especially the transition and the distance from a forest remnant to open fields can lead to dispersal limitation or edge effects that influence the local soil seed banks (SSB).[1,2,3]

It was investigated in this study if distances or site conditions from remnant forests to cleared fields with forest secondary growth and edge positions can affect, for instance by dispersal limitation, the heterogenity of SSB.

Material and methods

Study area

- Six sites in a secondary tropical mountain forest remnant with smooth transition to fire cleared, now savanna-like areas in the bolivian South Yungas

Sampling

- Five distances to forest border: 160 m (forest= control) and 20 m inside (edge), 5 m, 20 m and 80 m outside (savanna)
- Collection of compound soils samples (V= 1000 cm³, depth = 5 cm) in a grid of marked points (2 m x 2 m; 100m²)
- Fractioning of 500 m³ per sample to produce 3 fractions (large: < 2 mm, medium: <1 mm, small: <0.63 mm, leftover discarded)
- Count of seed density and classification into morphospecies ("seed species" by morphological differentiation) per fraction

Data analysis (with *R*)

- One-factorial ANOVAs (linear models) to analyse effects of distance on seed density, species richness of all seeds and for the three sizes of the seeds
- Bray- Curtis Dissimilarity between the SSB compositions of the distances to demonstrate a possible gradual seed compostion shift with a increasing distance to the forest

Results

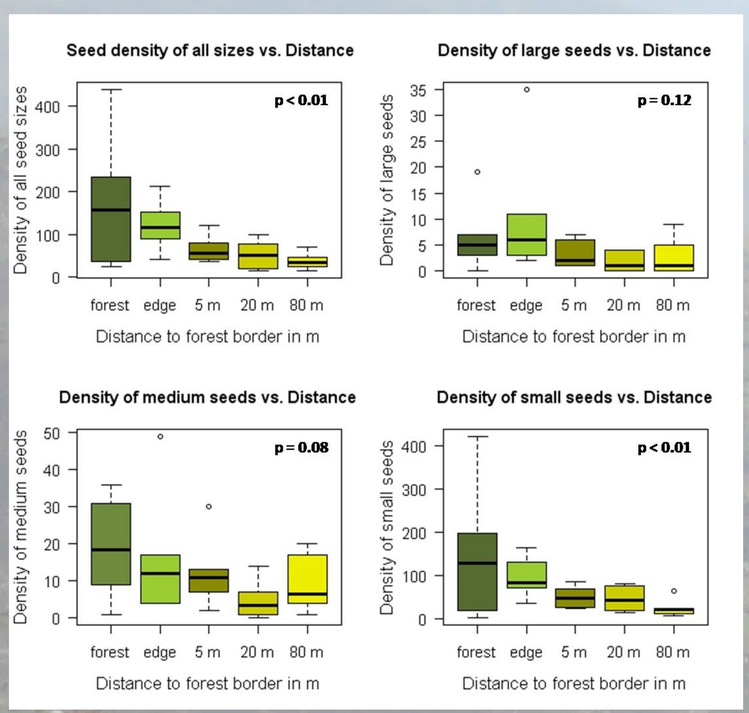

Fig. 1- Effect of distance to forest border on seed density of SSB, for all seeds and for small, medium and large seeds

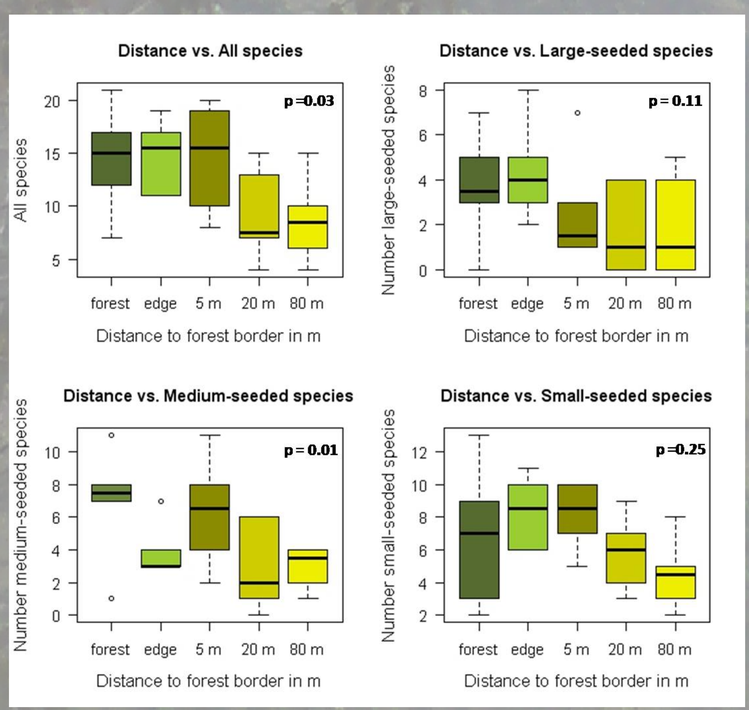

Fig. 2.- Effect of distance to forest border on speciesnumber of SSB, for all seeds and for small, medium and large seeds

Tab. 1 - Overview of all identified seeds and the number of classified morphospecies with their proportion of the total of seeds

Seed size	Number of seeds per fraction	Proportion of total %	Number of morpho-species per fraction	Proportion of total %
Large	145	5.35	43	28.29
Medium	372	13.73	59	38.82
Small	2193	80.92	50	32.89
Total:	**2710**	**100.00**	**152**	**100.00**

Tab. 2 - Bray- Curtis Dissimilarity between the soil seed compositions of the distances, for all, large, medium and small seeds

Dissimilarity of →	All seeds	Large seeds	Medium seeds	Small seeds
Comparison of distances ↓	Mean ± Sd	Mean ± Sd	Mean ± Sd	Mean ± Sd
Forest vs. Edge	0.66 ± 0.03	0.98 ± 0.00	0.73 ± 0.02	0.69 ± 0.05
Forest vs. Savanna (5 m)	0.78 ± 0.04	0.99 ± 0.00	0.90 ± 0.01	0.76 ± 0.08
Forest vs. Savanna (20 m)	0.80 ± 0.03	1.00 ± 0.00	0.93 ± 0.02	0.78 ± 0.03
Forest vs. Savanna (80 m)	0.83 ± 0.04	1.00 ± 0.13	0.95 ± 0.01	0.83 ± 0.04

Overview of identified all seeds and number of classified morphospecies (Tab. 1)

- Large seeds with a 5,4% proportion of all seeds, but approximately a third of all species
- Domination of small seeds in the totality of all seeds
- Medium seeds with the highest proportion of species

Boxplots, integrated ANOVA p-values (Fig. 1,2)

- General decrease of the seed density with the distance to the forest border; a significant dependence of all and small seeds on the distance
- General more species inside and near to the forest border than in the more external savanna; a significant dependence of all and medium-seeded species on the distance

Bray-Curtis Dissimilarty tests (Tab. 2)

- Gradual increase of the dissimilarity of the seed compositions with the distance to the forest border
- General "jump" between edge to savanna (5 m) ; highest within the medium seeds
- Large seed composition with the highest general dissimilarity

Conclusions

It was revealed, that the general proportions of the seed density show a estimated small seed domination and a suprisingly high proportion of large seeded species. Furthermore affirmes the study that the distance from the forest to adjacent cleared, savanna-like areas influences the heterogenity of SSB. The density and the species richness decrease with a increasing distance. It was supposed for instance, that especially the often animal-dispersed larger seeds, as sign of dispersal limitation, are stronger located inside the forest. But the large seeds were distributed relatively even across all distances. Nevertheless seems the increasing dissimilarity of the seed compositions as a potential evidence of a dispersal limitation or an edge effect, especially the "jump" between edge and savanna numbers and the relative high amount of species in the savanna related to the forest. The in other studies described effects of dispersal limitation or edge positions could not definitely argued. But they are still possible.

References

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