Center for Community-Based Resource Management (CBRM)

Natural Resources Institute, University of Manitoba

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Date:	**30/Nov/2014**	**Entry Number:**	**1345**
Case Study Name:	**Species-area and species-individual relationships for tropical trees: a comparison of three 50-ha plots**		
Authors:	Richard Condit; Stephen P. Hubbell; James V. Lafrankie; R. Sukumar; N. Manokaran; Robin B. Foster; Peter S. Ashton		
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Region:	Central America		
Country:	Malaysia, Panama, India		
Ecosystem Type:	Tropical Forest		
Social Characteristics:	Urban communities		
Scale of Study:	Ecosystem		
Resource Type:	Forestry		
Type of Initiative:	Research driven-project		
Community-Based Work:	Ecosystem assessment		

Keywords:	Panama, Malaysia, India, Species-accumulation, Specie-area, Species-individual, Woody plants, Tropical forests, Diversity, Extinction, Species preservation.

Summary:

1 Species-accumulation curves for woody plants were calculated in three tropical forests, based on fully mapped 50-ha plots in wet, old-growth forest in Peninsular Malaysia, in moist, old-growth forest in central Panama, and in dry, previously logged forest in southern India. A total of 610000 stems were identified to species and mapped to < l m accuracy. Mean species number and stem number were calculated in quadrats as small as 5 m x 5 m to as large as 1000 m x 500 m, for a variety of stem sizes above 10 mm in diameter. Species-area curves were generated by plotting species number as a function of quadrat size; species-individual curves were generated from the same data, but using stem number as the independent variable rather than area.

2 Species-area curves had different forms for stems of different diameters, but species-individual curves were nearly independent of diameter class. With < lo4 stems, species-individual curves were concave downward on log-log plots, with curves from different forests diverging, but beyond about 10^4 stems, the log-log curves became nearly linear, with all three sites having a similar slope. This indicates an asymptotic difference in richness between forests: the Malaysian site had 2.7 times as many species as Panama, which in turn was 3.3 times as rich as India.

3 Other details of the species-accumulation relationship were remarkably similar between the three sites. Rectangular quadrats had 5-27% more species than square quadrats of the same area, with longer and narrower quadrats increasingly diverse. Random samples of stems drawn from the entire 50 ha had 10-30% more species than square quadrats with the same number of stems. At both Pasoh and BCI, but not Mudumalai, species richness was slightly higher among intermediate-sized stems (50-100mm in diameter) than in either smaller or larger sizes. These patterns reflect aggregated distributions of individual species, plus weak density-dependent forces that tend to smooth the species abundance distribution and 'loosen' aggregations as stems grow.

4 The results provide support for the view that within each tree community, many species have their abundance and distribution guided more by random drift than deterministic interactions. The drift model predicts that the species-accumulation curve will have a declining slope on a log-log plot, reaching a slope of 0.1 in about 50 ha. No other model of community structure can make such a precise prediction.

5 The results demonstrate that diversity studies based on different stem diameters can be compared by sampling identical numbers of stems. Moreover, they indicate that stem counts < 1000 in tropical forests will underestimate the percentage difference in species richness between two diverse sites. Fortunately, standard diversity indices (Fisher's a, Shannon-Wiener) captured diversity differences in small stem samples more effectively than raw species richness, but both

	were sample size dependent. Two nonparametric richness estimators (Chao, jackknife) performed poorly, greatly underestimating true species richness.