

Limiting similarity among coexisting species

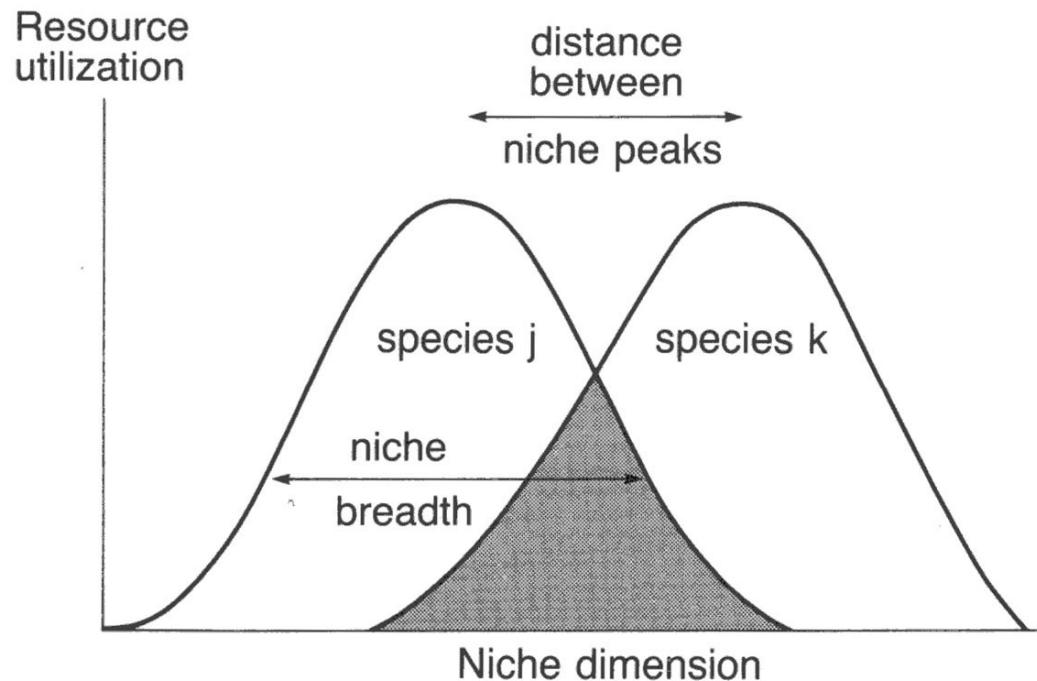
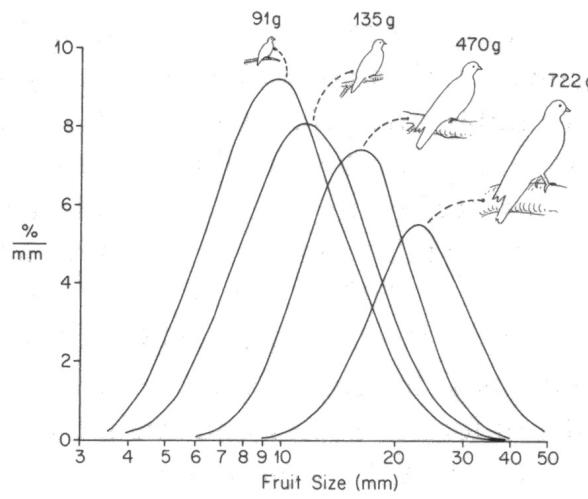
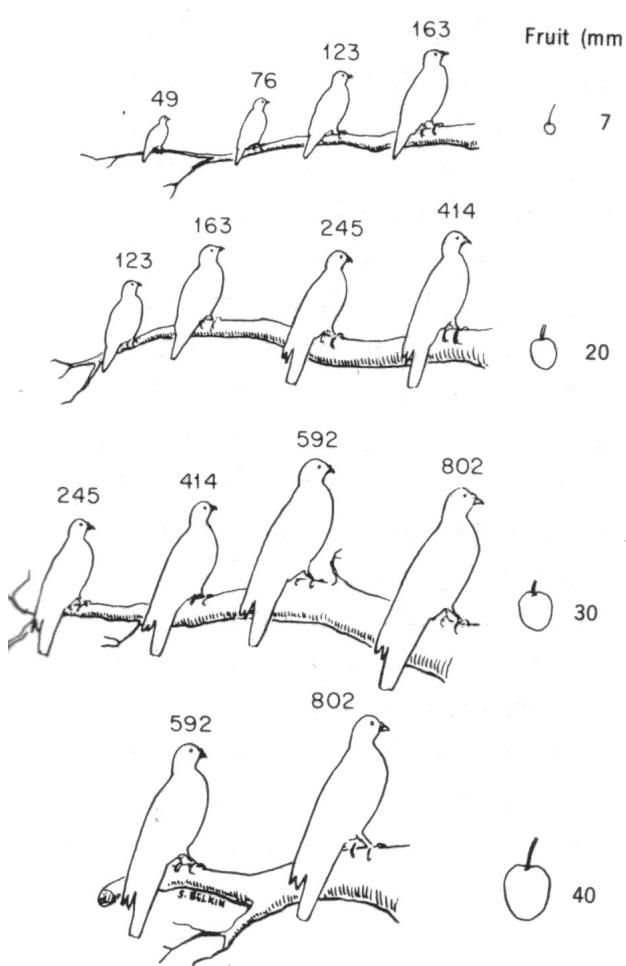


Figure 35–2

Activity curves of two species along a single resource dimension showing niche breadth, the distance between the centers of the niches, and niche overlap.

Body size ratios: the ‘1.3 rule’

(Hutchinson, 1959)



hypothesized patterns:

- 1) minimum size ratios
- 2) constant size ratios across an entire assemblage

Diamond 1975

Limits to similarity among coexisting competitors

Nature, 270: 660-661, 1977

from Henry S. Horn and Robert M. May

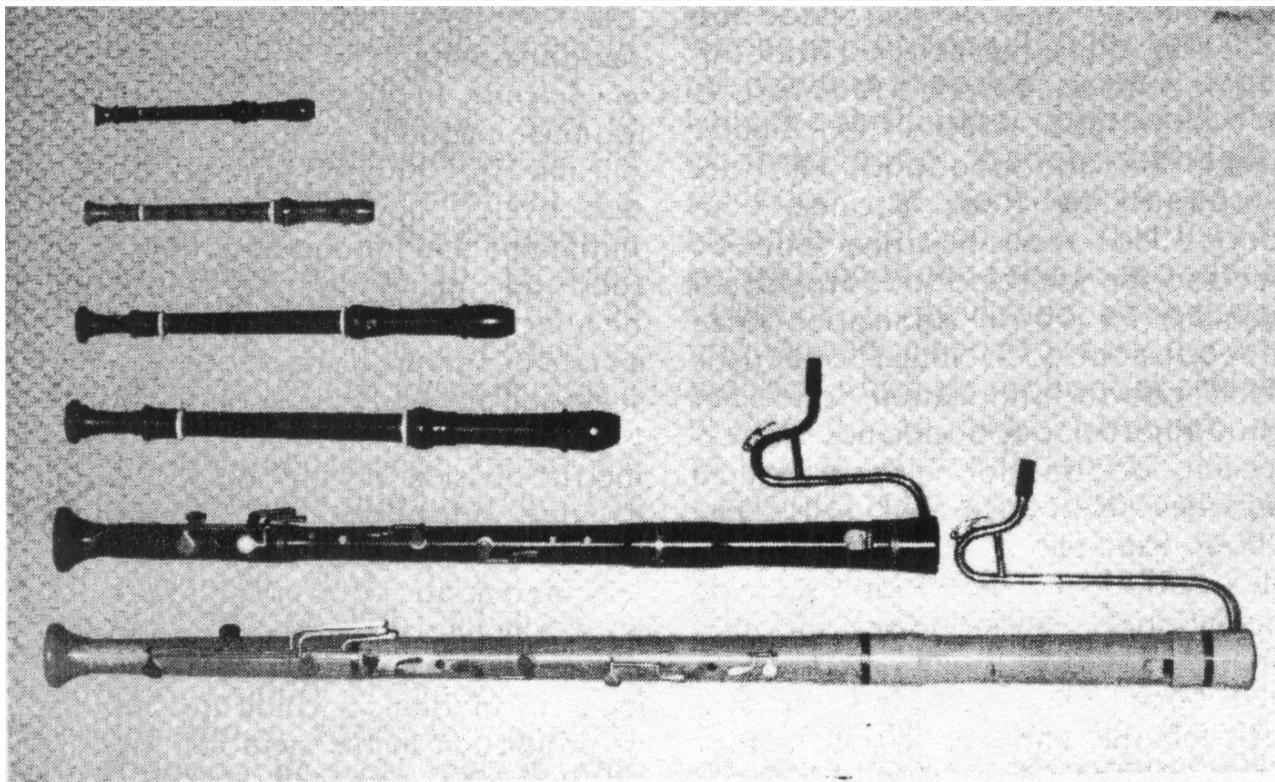
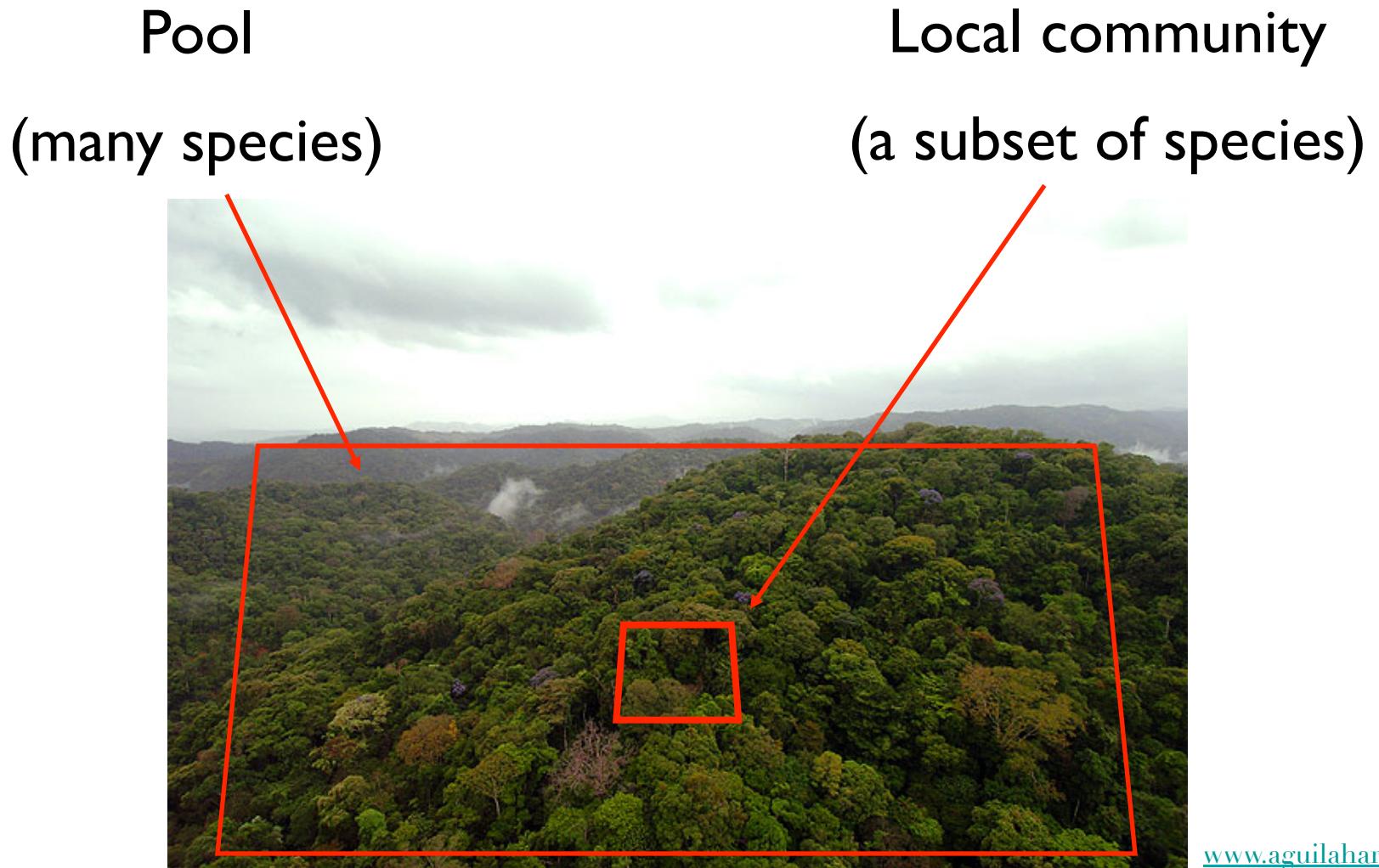
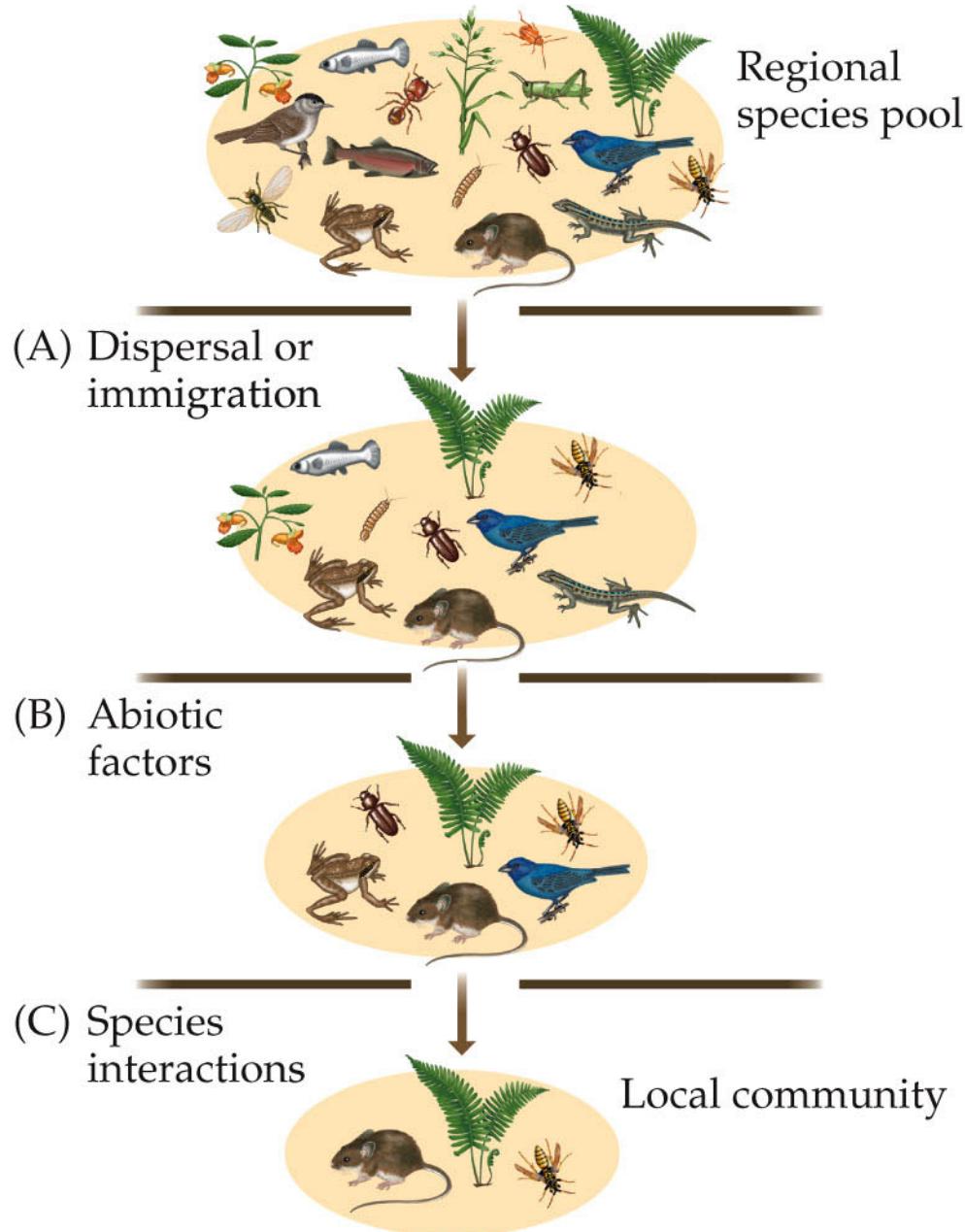


Fig. 1 The conventional ensemble of recorders, whose lengths roughly obey the '1 : 3 ratio rule'.

Community Assembly





ECOLOGY, Figure 18.4

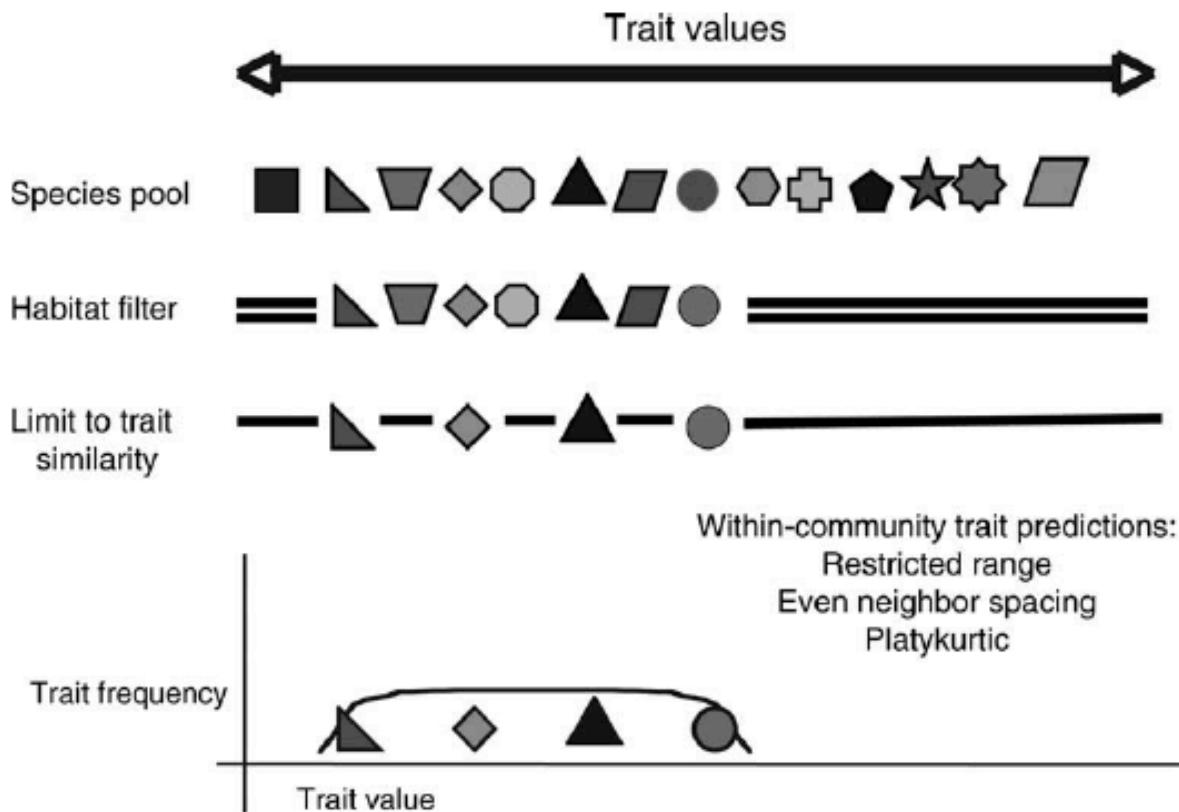
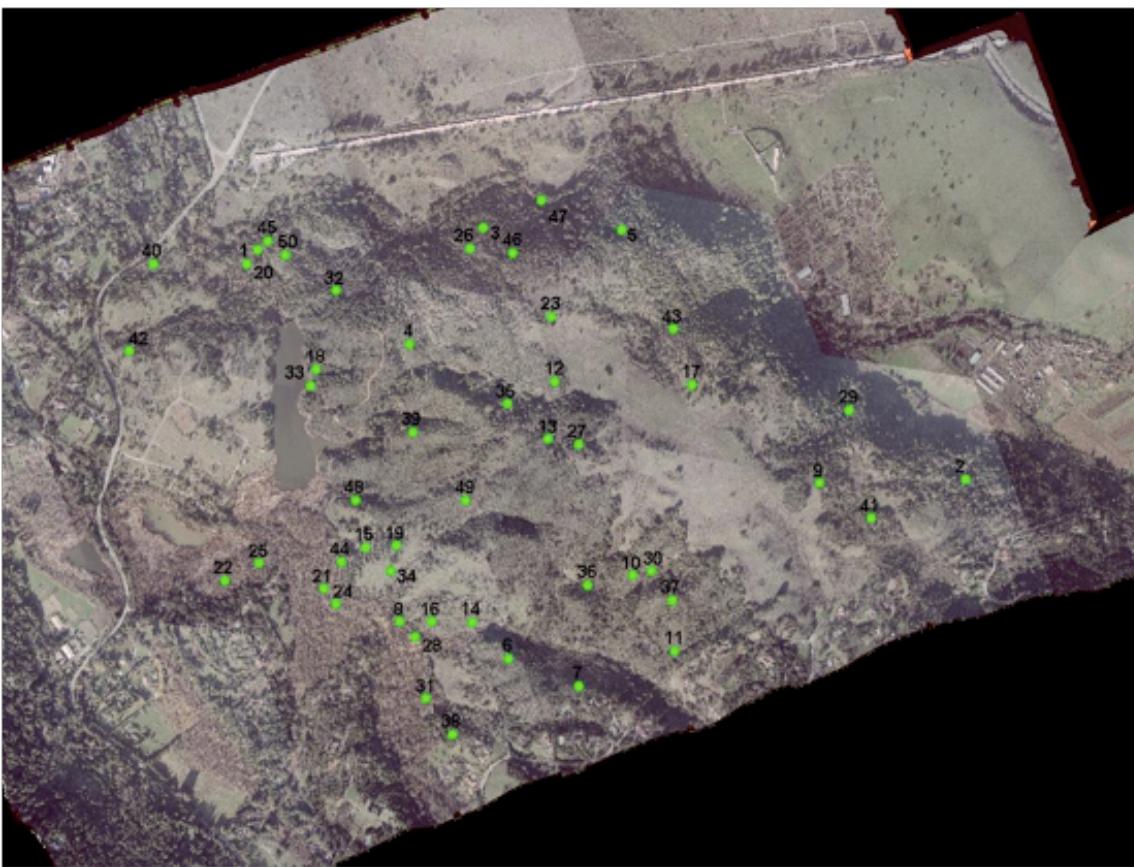


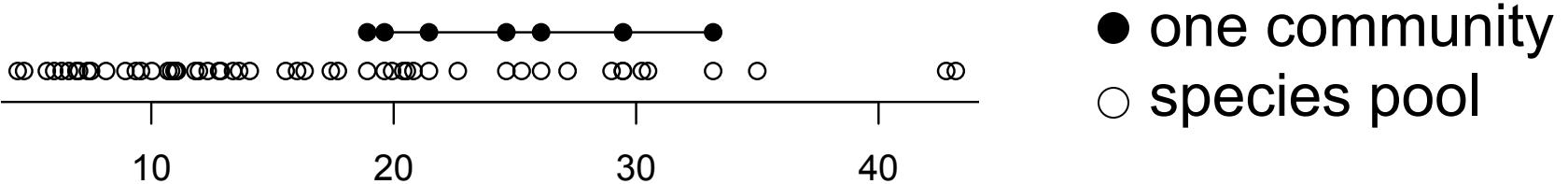
FIG. 1. A hypothesis for assembly effects on within-community trait distribution (following Diaz et al. 1998, Weiher et al. 1998). The strength of the habitat filter and limiting similarity is expected to depend on the identity of the trait in combination with the particular abiotic conditions at a site. Note that habitat filtering is hypothesized to affect the range of trait values; limiting similarity will affect the spacing and lead to a platykurtic (that is, flat-topped) distribution.

Woody plant communities at Jasper Ridge Biological Preserve



- 44 - 20 x 20 m plots
- 54 native woody plant species
- median plot species richness of 12
- chaparral to broadleaf forest

Community trait statistics



- Given a set of trait values for a community, and a larger set of values for the regional species pool:
- What statistic could you use to ask whether the species in the community were more similar to each other overall, compared to a randomly assembled community?
- What statistic could you use to ask whether the species were evenly spaced along a trait axis, compared to a randomly assembled community?

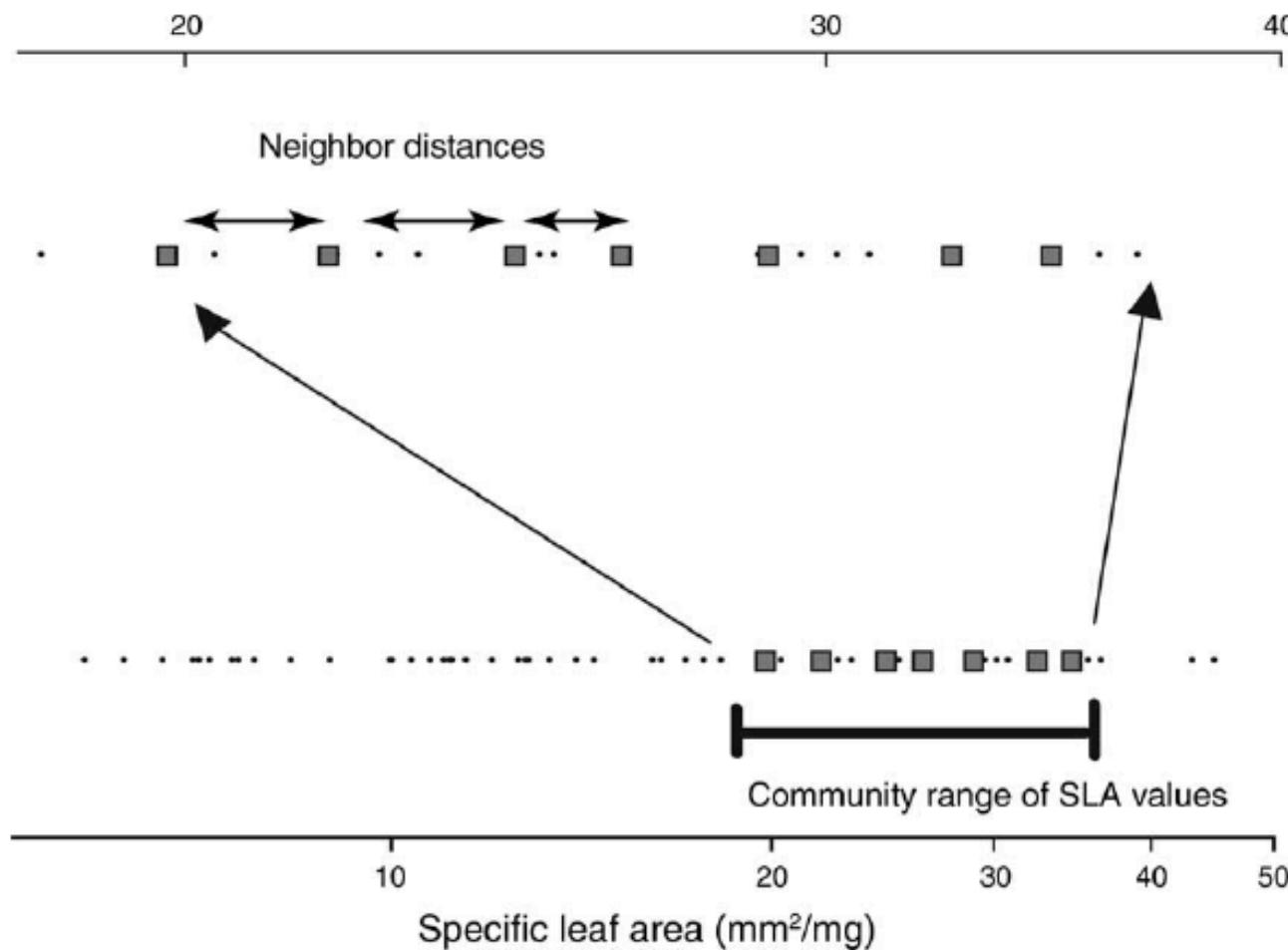
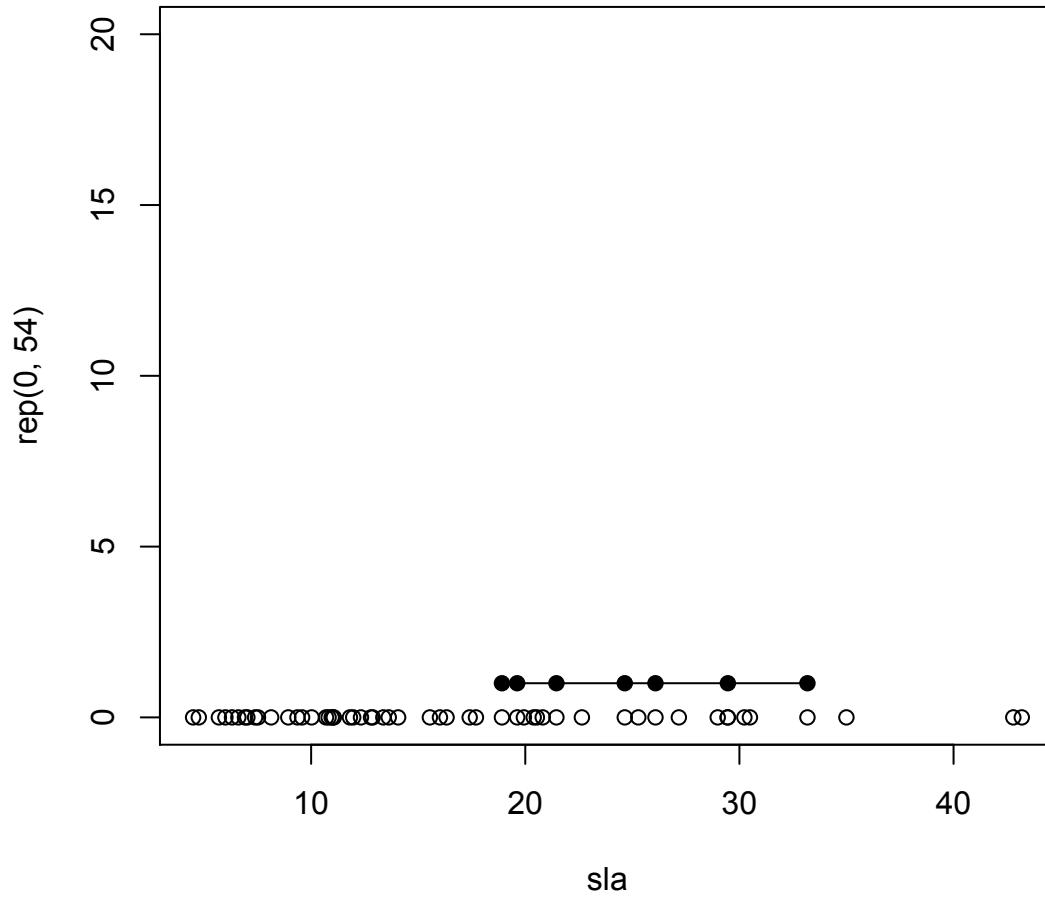
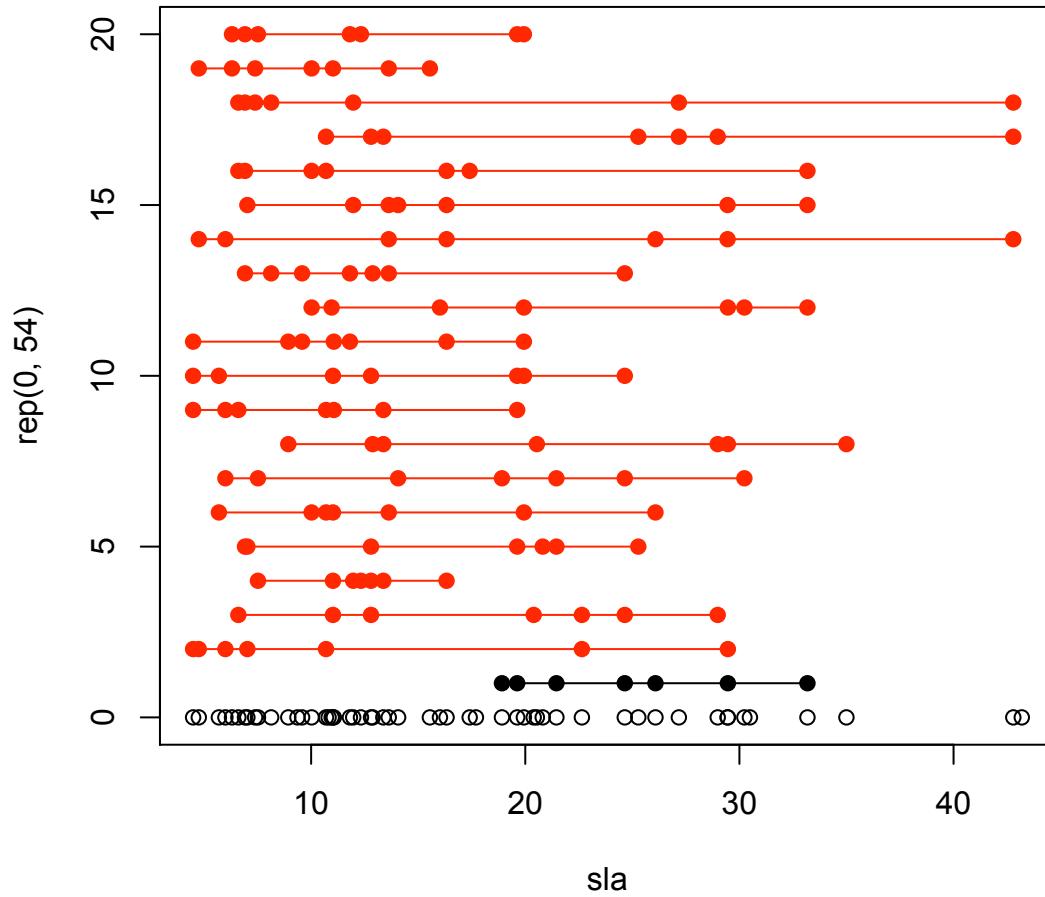
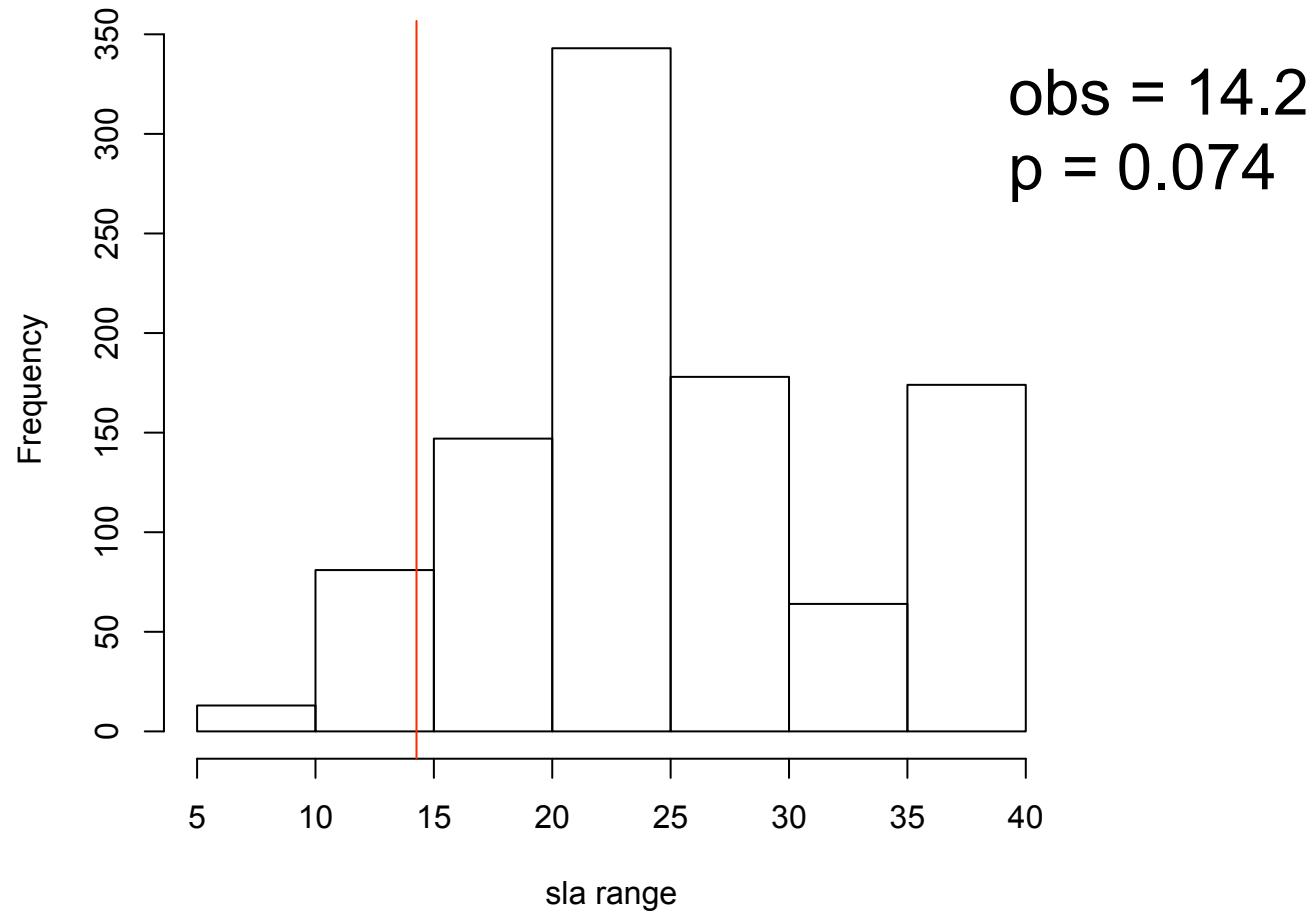


FIG. 6. Range in SLA values (log scale). Larger squares show SLA values from the species found in plot 31, a plot with relatively high soil water. Small circles show the species found at Jasper Ridge but absent from plot 31. The bottom panel shows the entire range for SLA values at Jasper Ridge; the upper panel narrows the extent of data presented to examine the spacing of trait values for coexisting species in more detail.





results of null



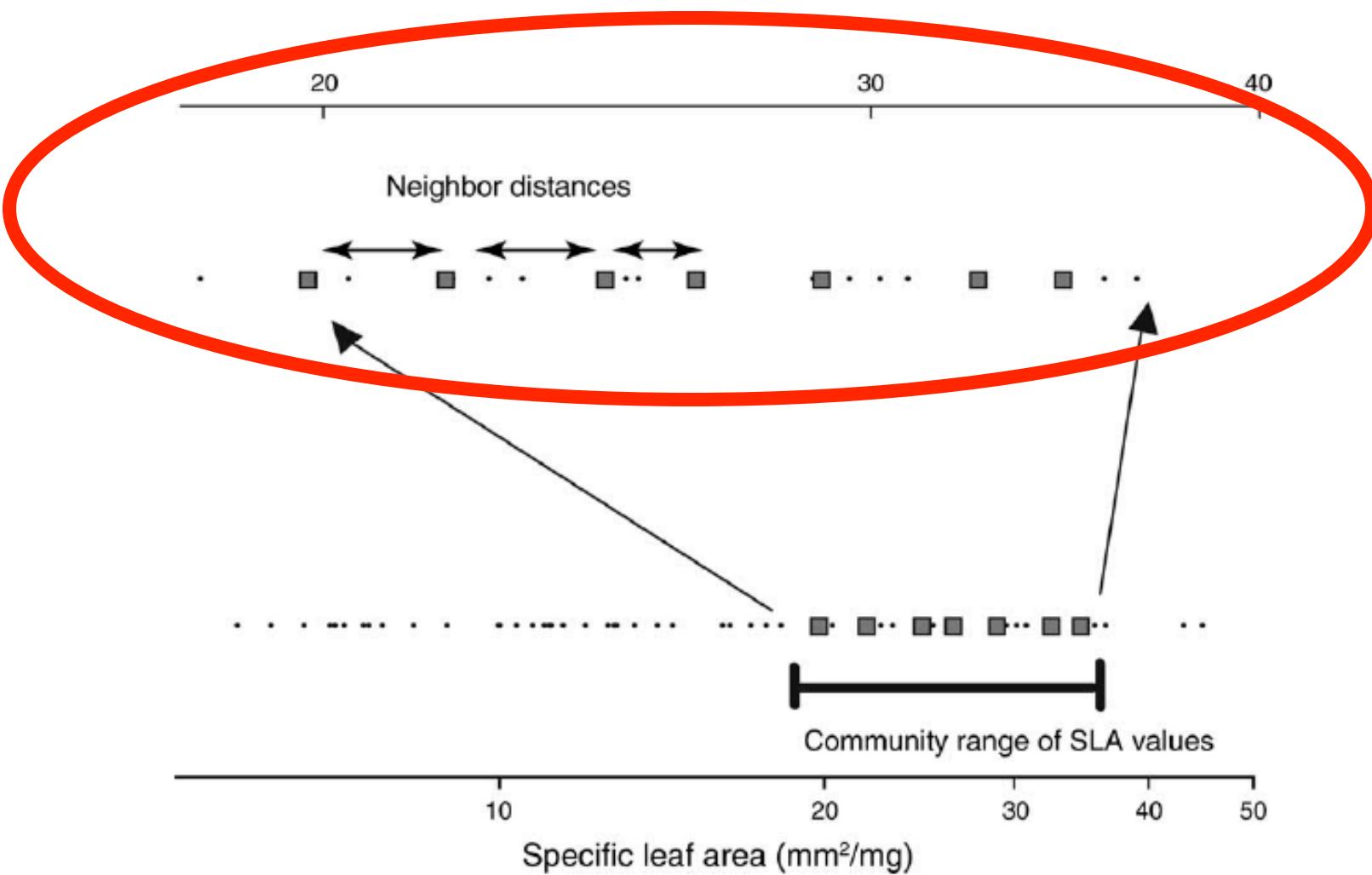


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SLA had significant even spacing – evidence of non-random ecological differentiation

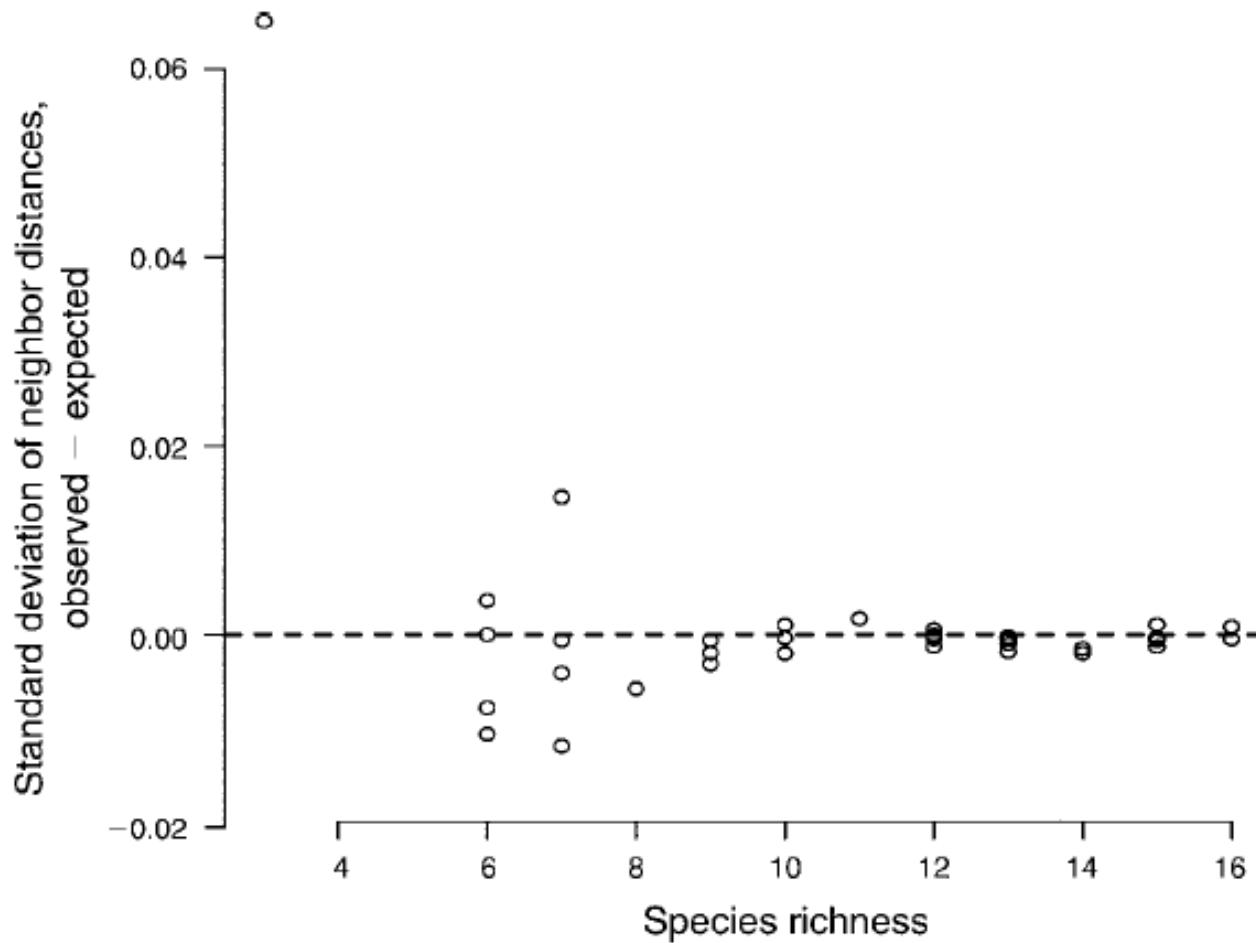
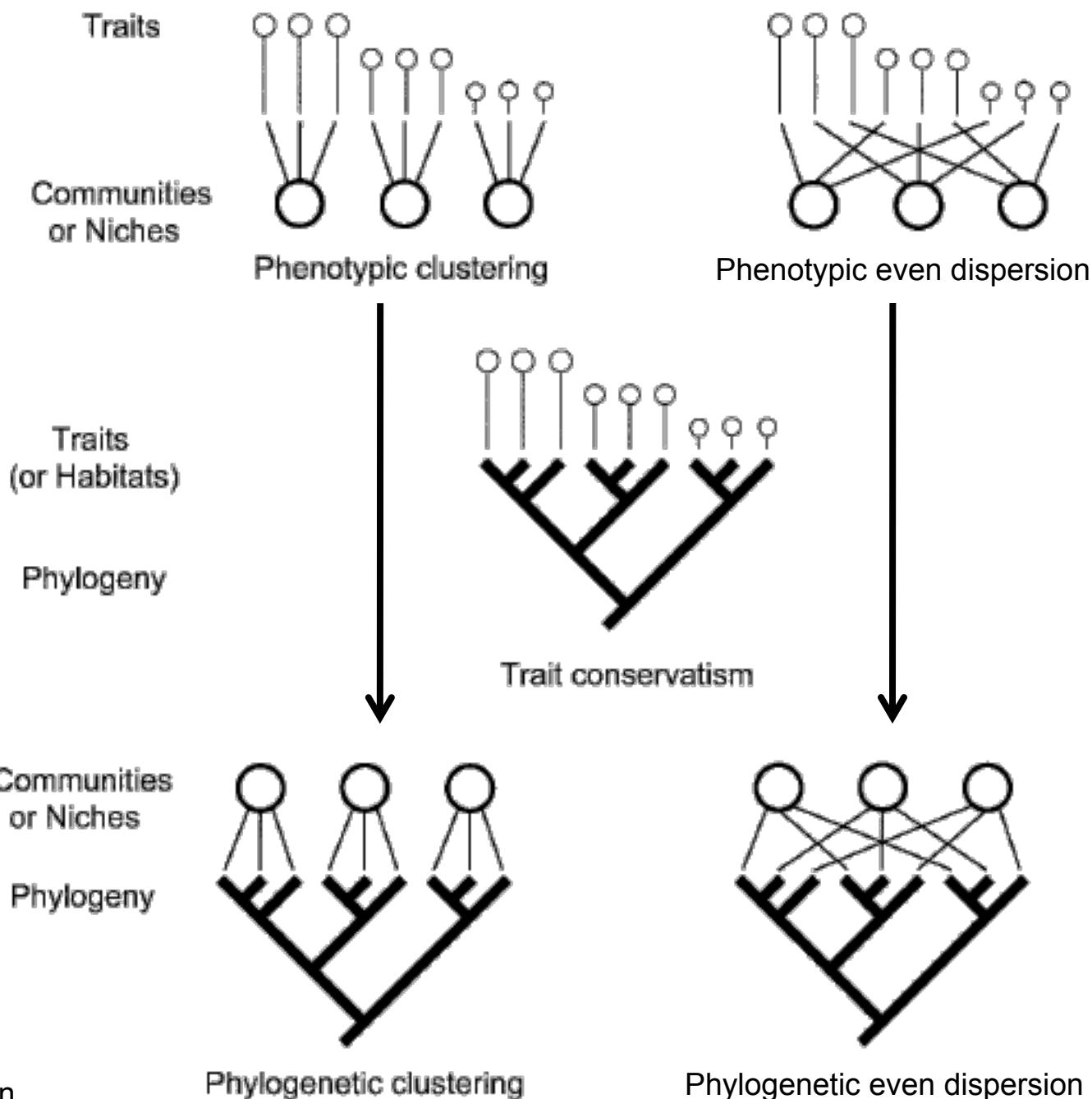


FIG. 5. Results of the more restrictive null model (see also Fig. 2). Each point represents the deviation from the null expectation for the spacing of SLA values within one plot. Values below the dashed line are indicative of even spacing relative to the null expectation. The distribution of plot values was significantly less than the expectation ($P < 0.05$).

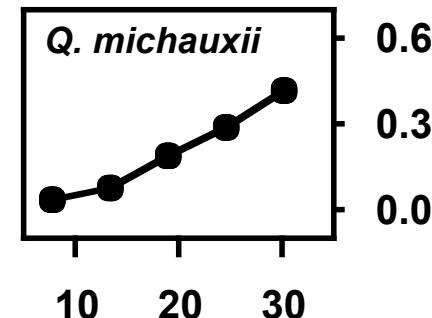
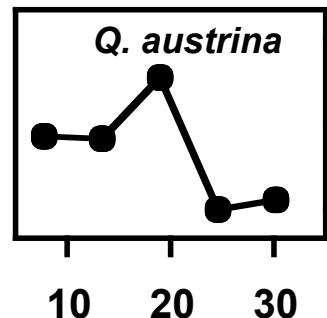
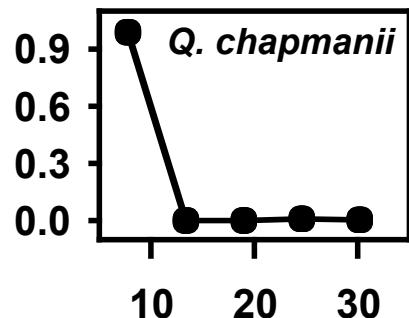


modified from Cavender-Bares et al. 2004 American Naturalist

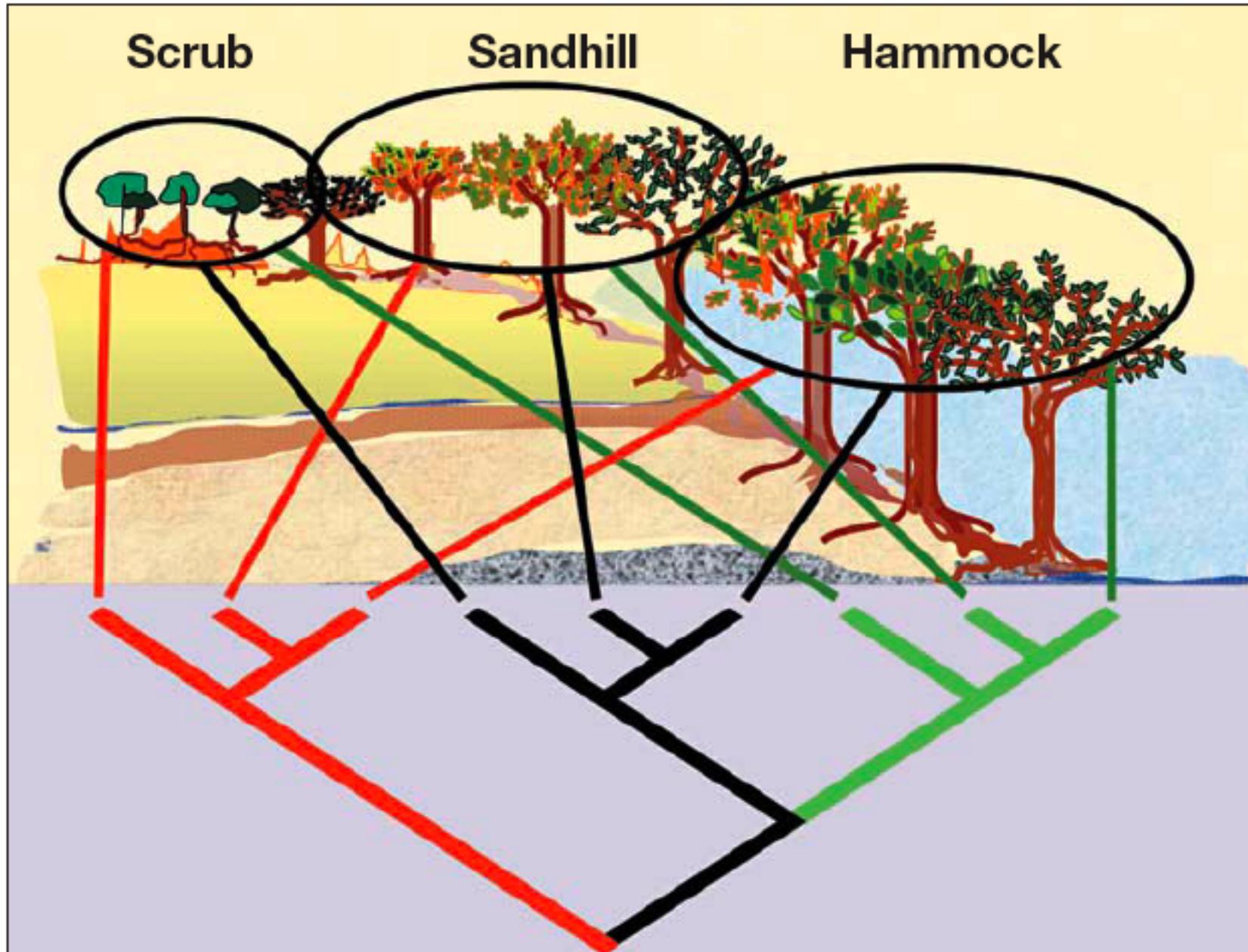


Oaks of northern Florida

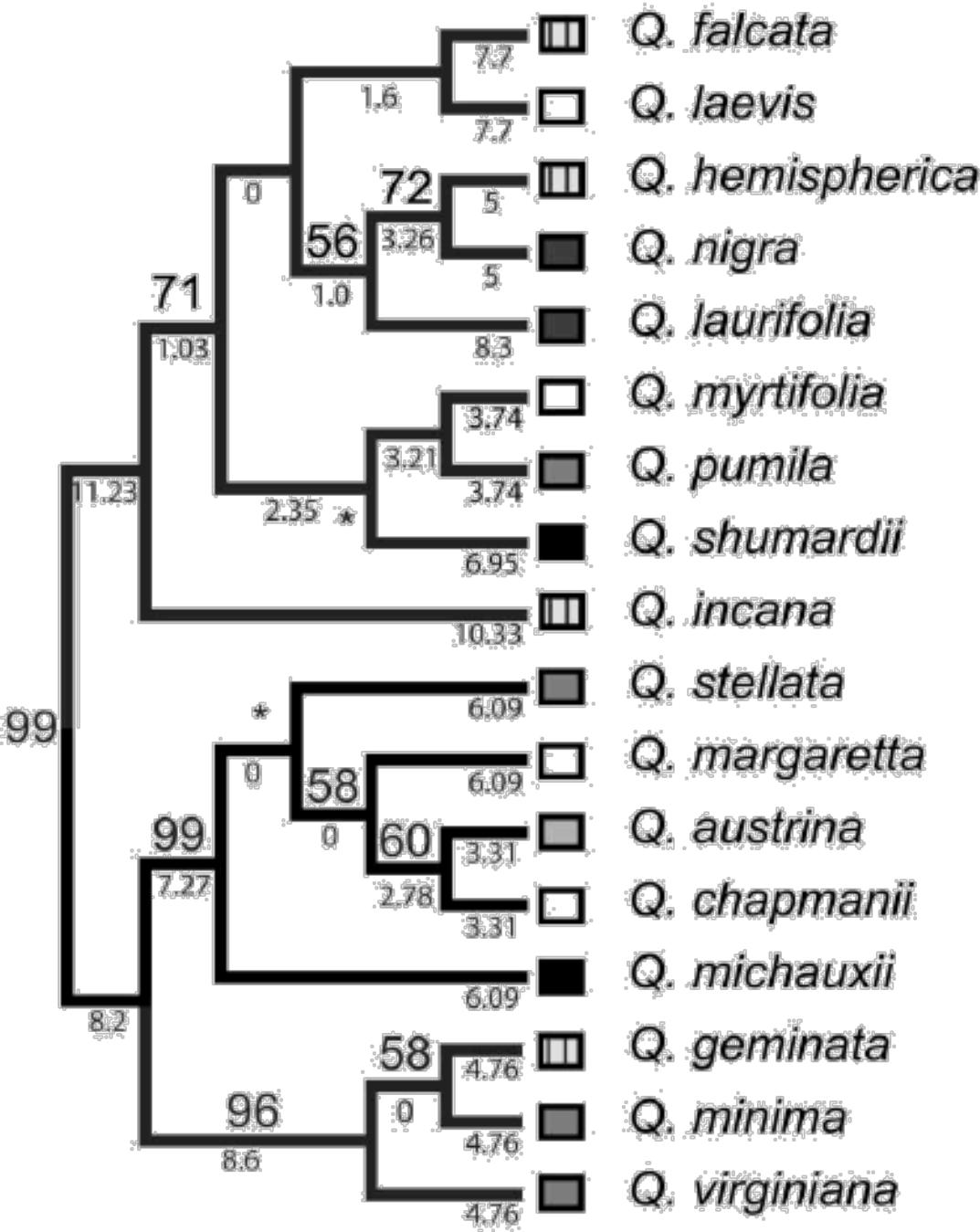
(J. Cavender-Bares et al.
2004a, Amer. Nat.;
2004b Ecol. Monogr.)



Soil Moisture



Courtesy of J Cavender-Bares

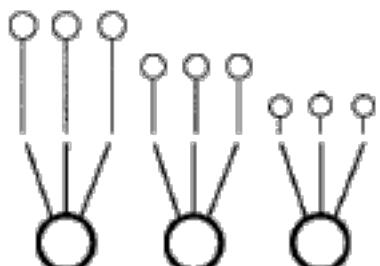


Species habitat preferences

Mean soil moisture
Vol. H₂O [Vol. soil]⁻¹

- < 7 %
- 7 - 12 %
- 12 - 17 %
- 17 - 22 %
- 22 - 27 %
- 27 - 32 %
- > 32 %

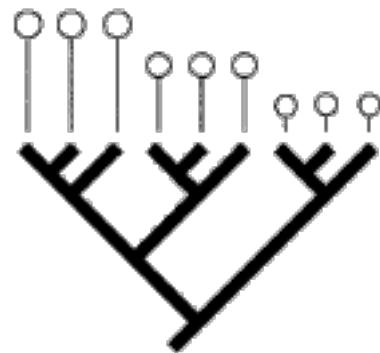
Traits



Communities
or Niches

Phenotypic clustering

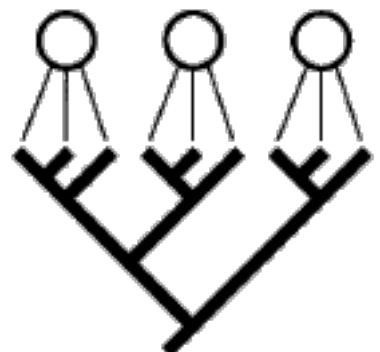
Traits
(or Habitats)



Phylogeny

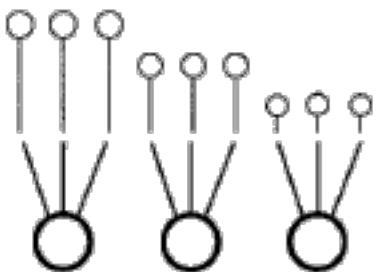
Trait conservatism

Communities
or Niches

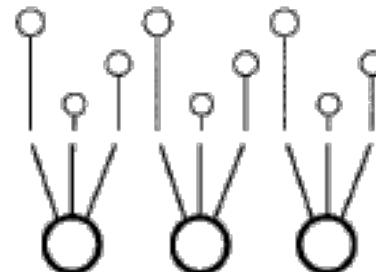


Phylogeny

Phylogenetic clustering

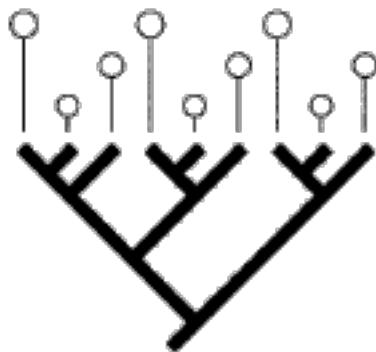


Phenotypic clustering



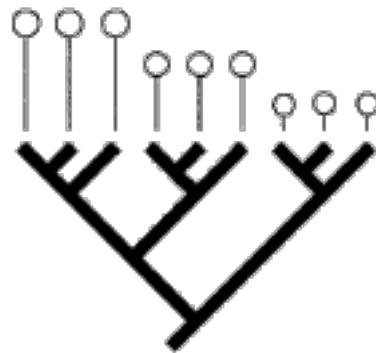
Phenotypic overdispersion

+

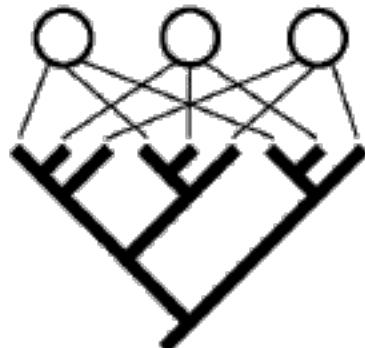


Trait convergence

+

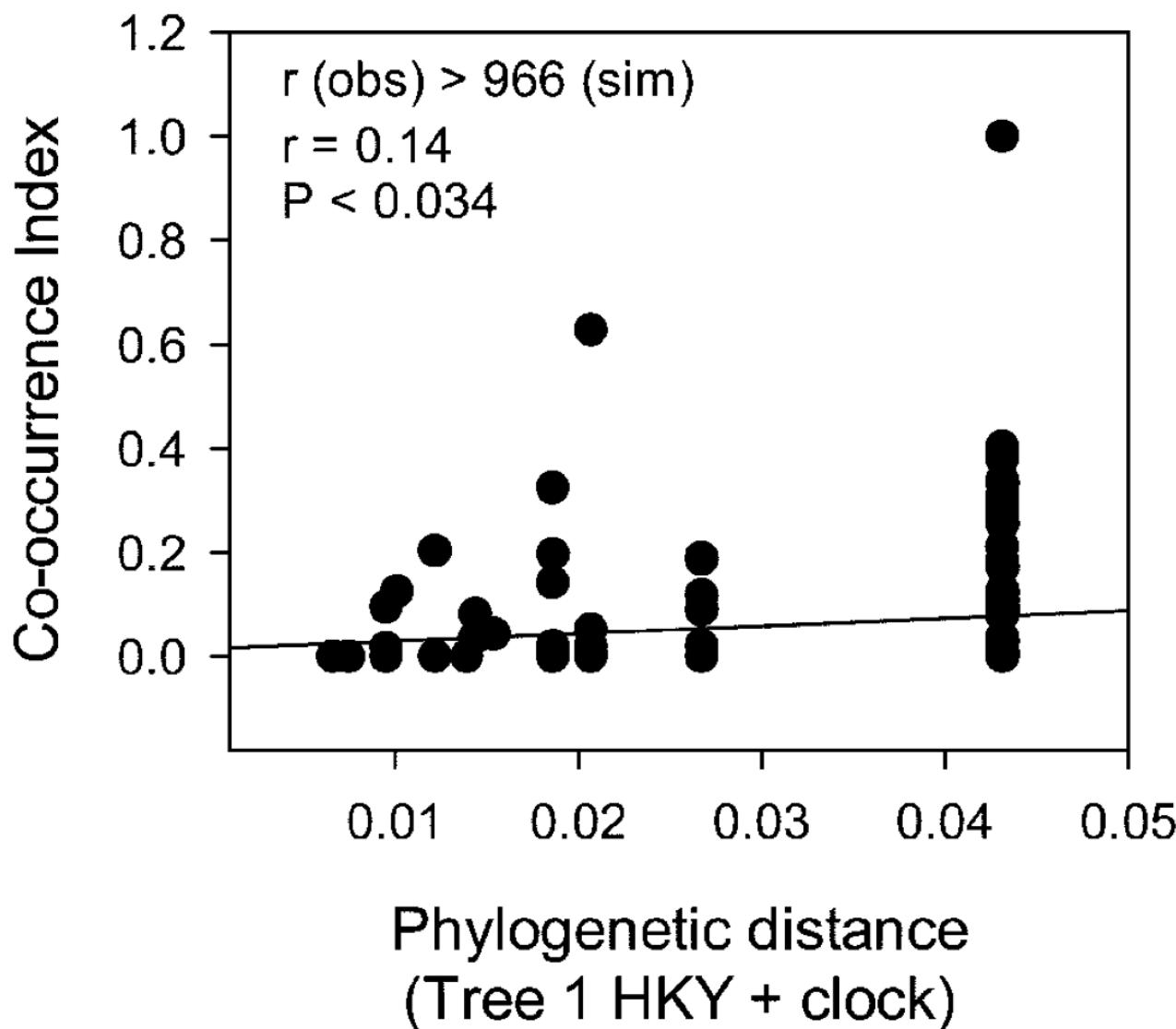


Trait conservatism



Phylogenetic even dispersion

Co-occurrence v. Phylogenetic Distance



Trait evolution

Trait similarity within communities

Clustering of traits

Overdispersion of traits

(driven by environmental filtering)

(driven by competitive interactions)

Conserved

Phylogenetic clustering

Phylogenetic overdispersion

Convergent

Phylogenetic overdispersion

Phylogenetic clustering or
random dispersion

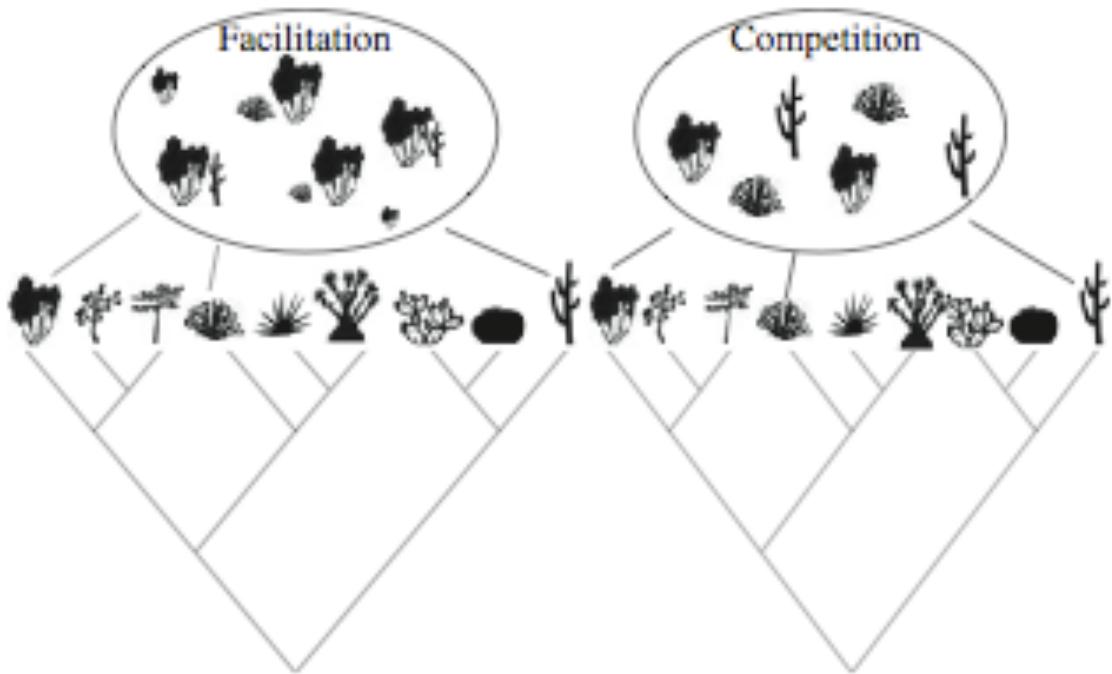
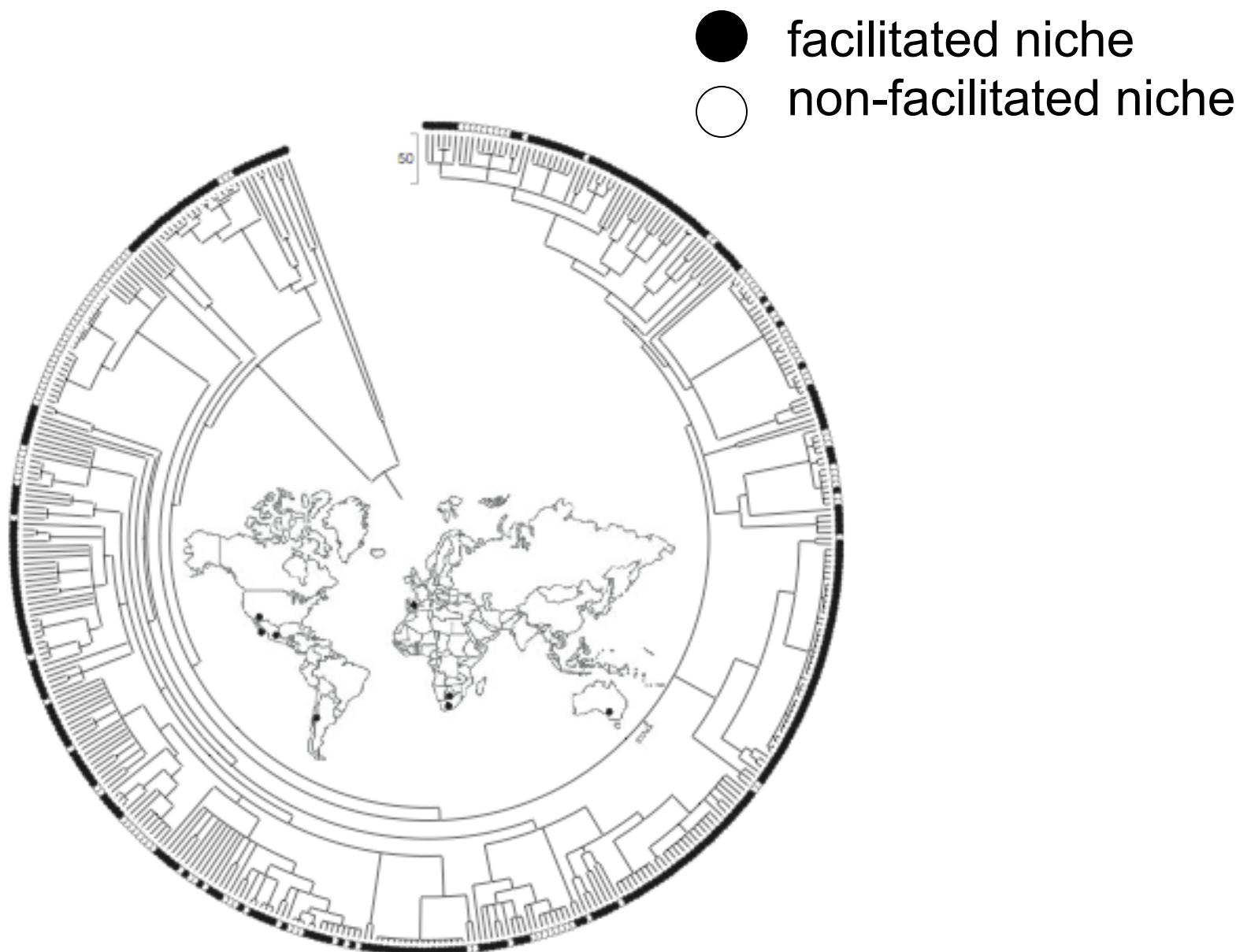
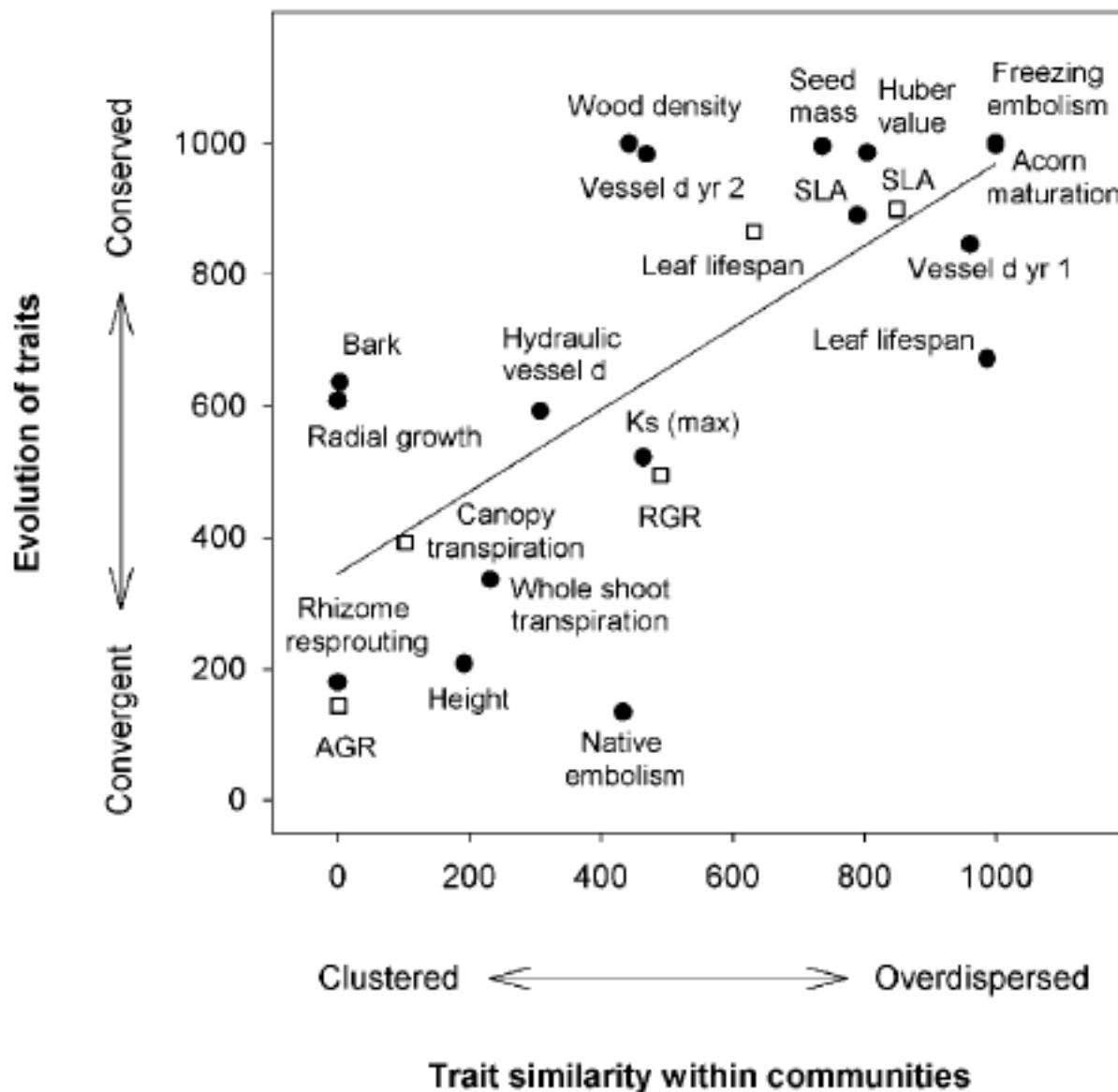


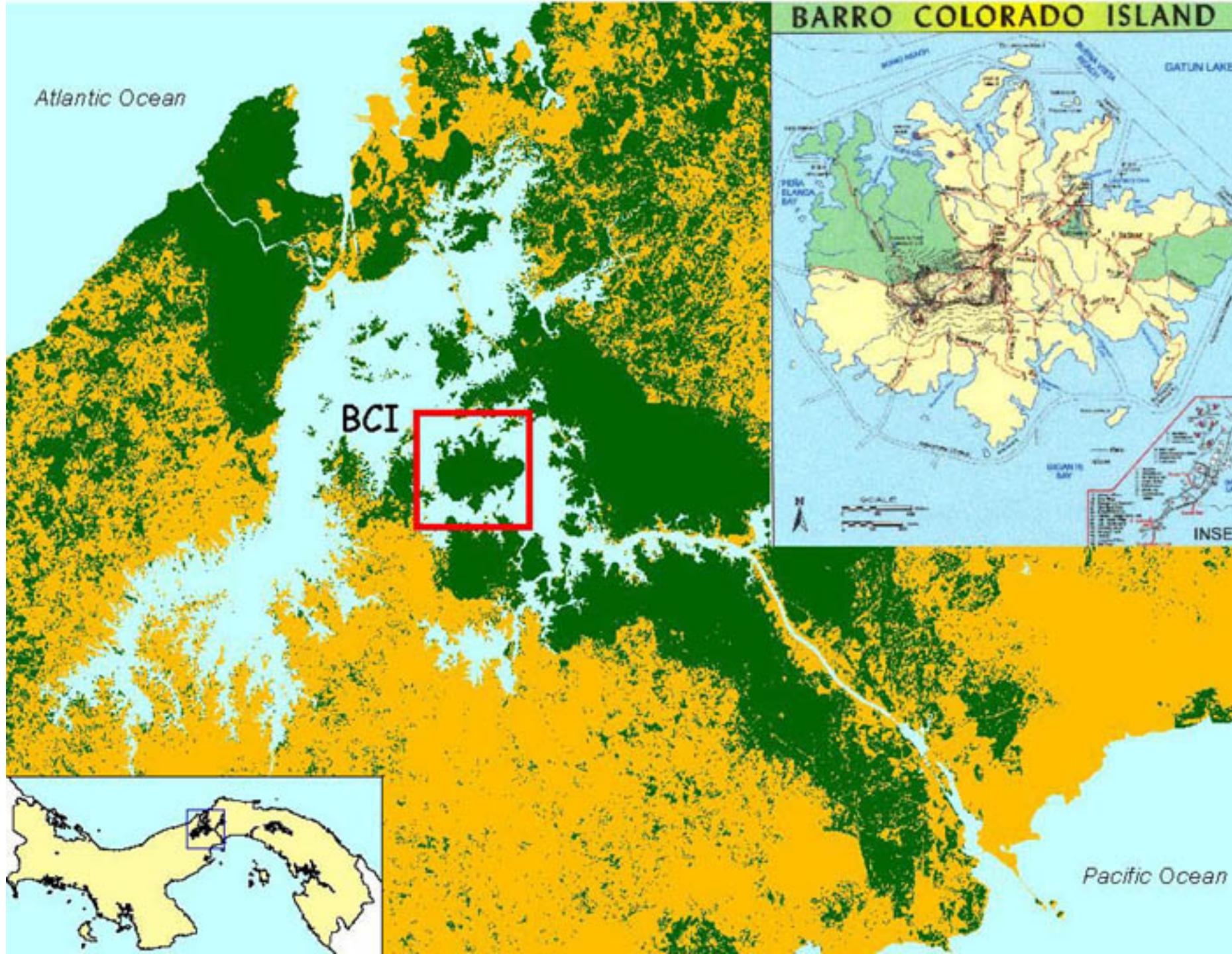
Figure 1 Two different ways how phylogenetic overdispersion in communities can be produced. In the case of competition, overdispersion is achieved by the exclusion of close-related species producing a checkerboard spatial pattern. In the case of facilitation, overdispersion is achieved because nurses add distant-related species to the community producing a clumped association pattern among species.







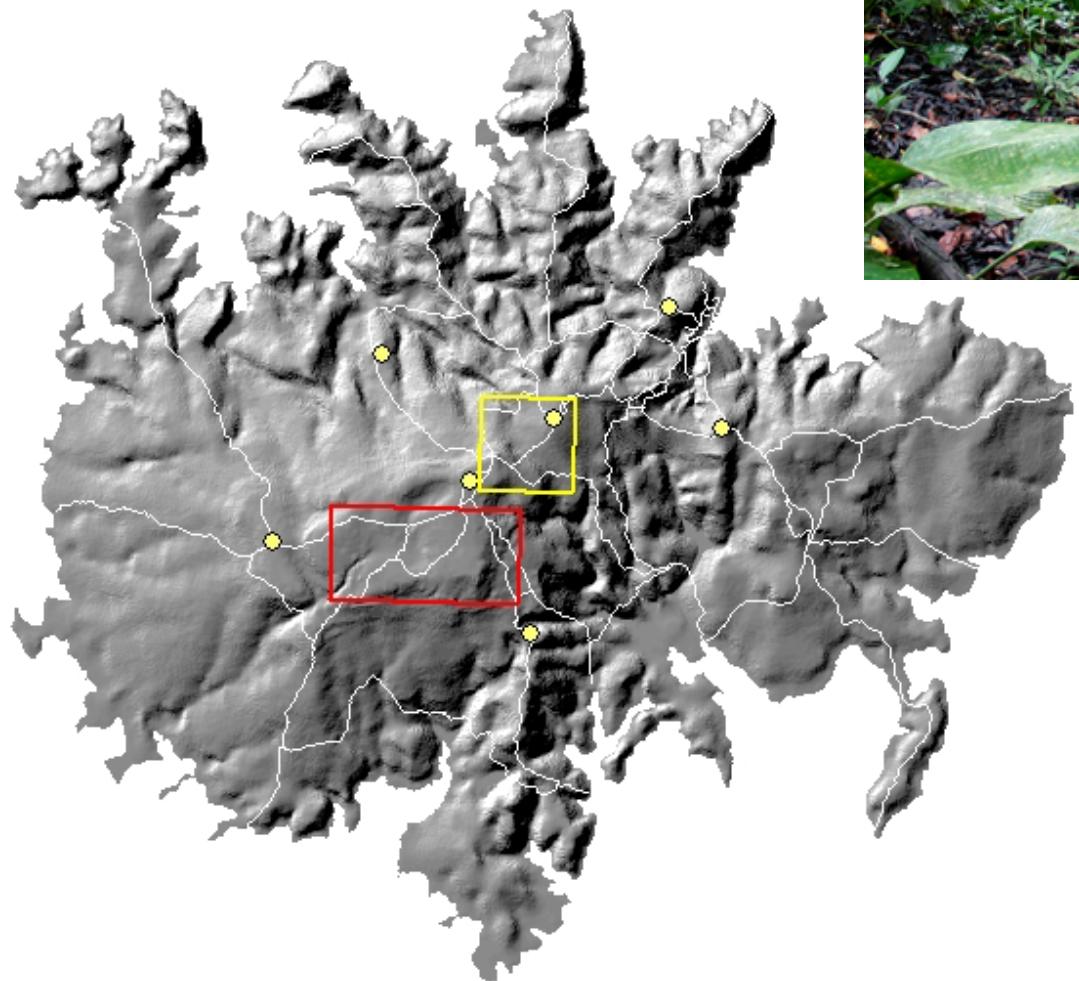
BARRO COLORADO ISLAND



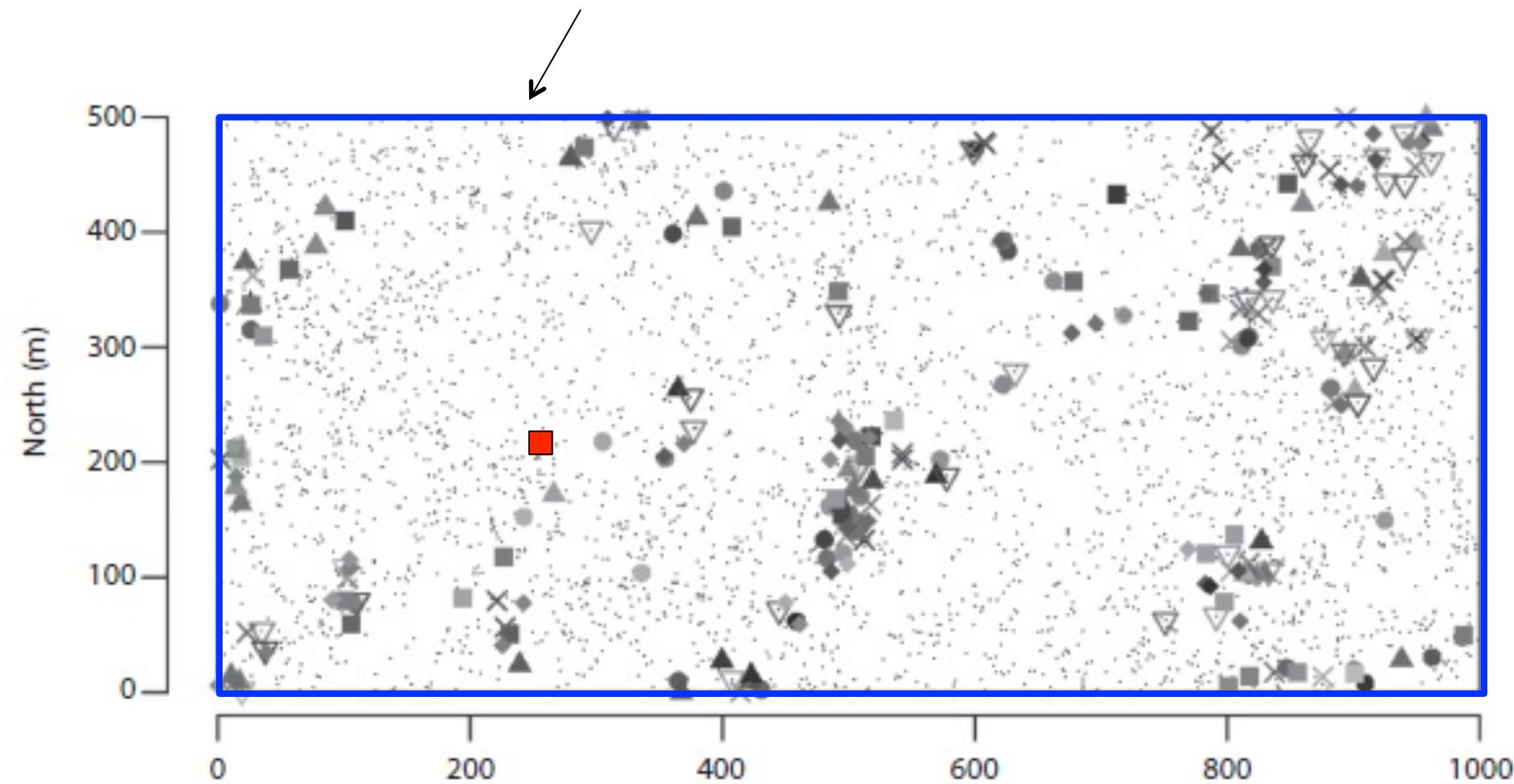
Atlantic Ocean

Pacific Ocean





■ 20 x 20 m subplot
50 ha ‘pool’ (entire plot)



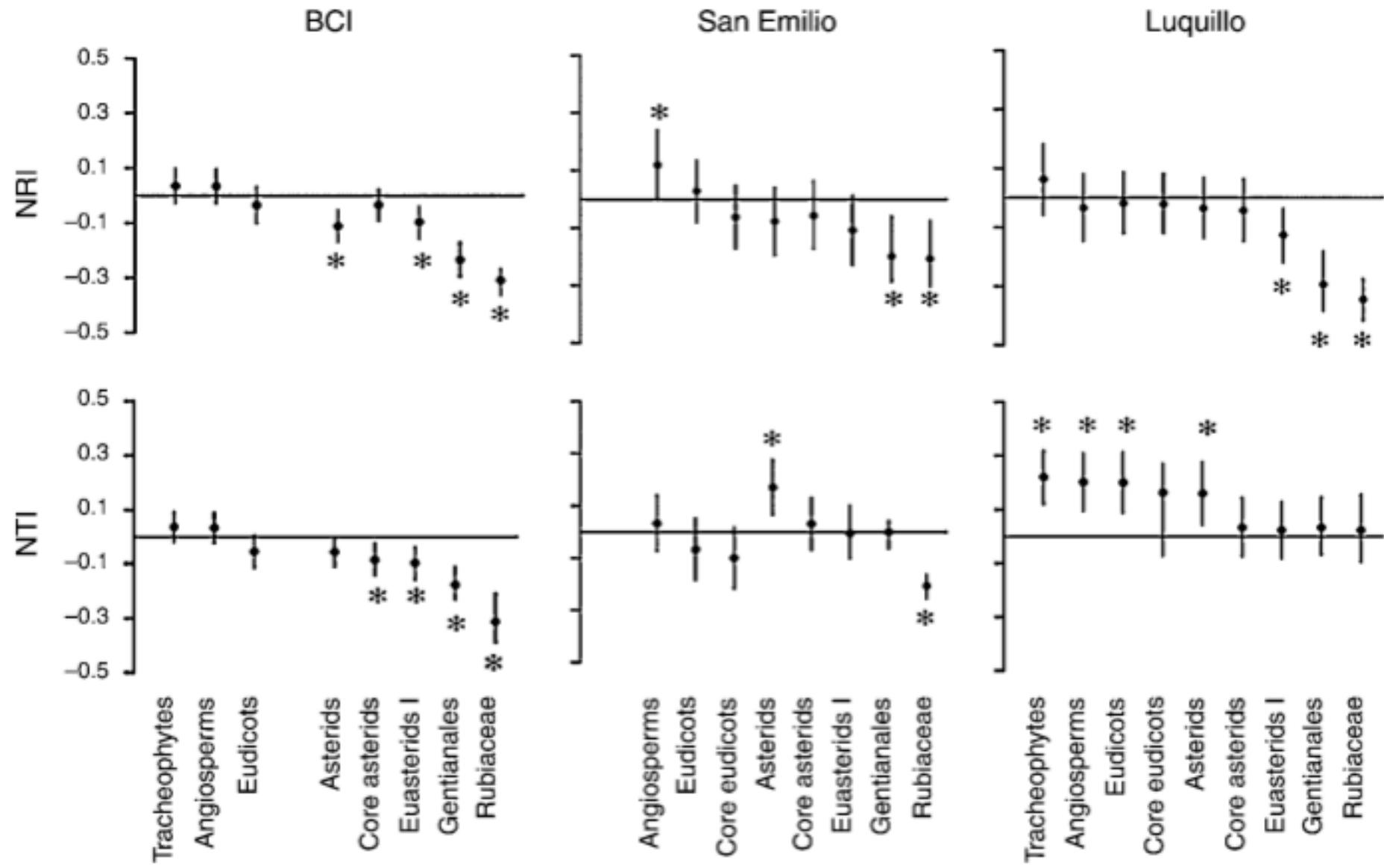
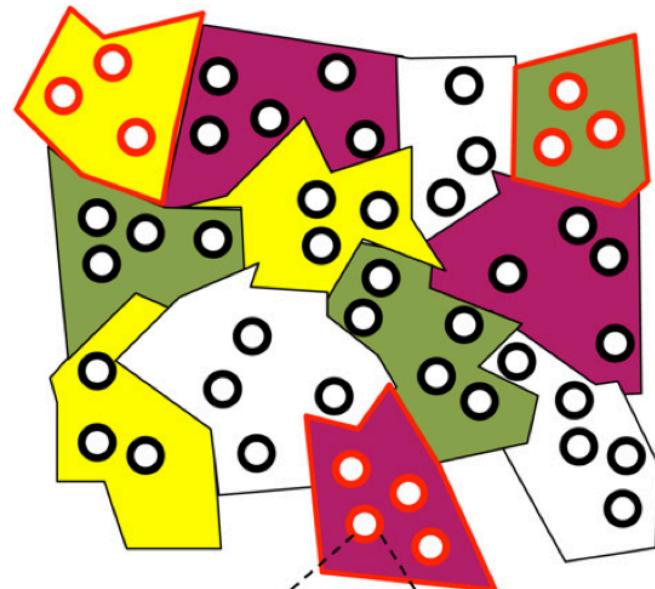


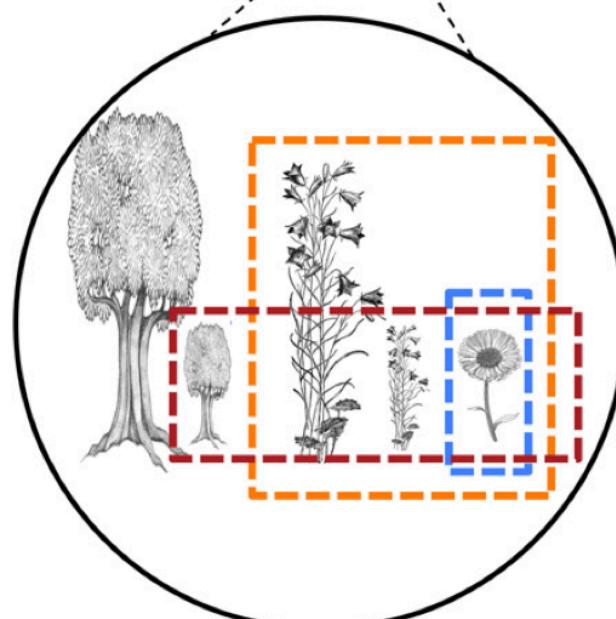
FIG. 1. The median net relatedness index (NRI) and nearest taxon index (NTI) scores for Barro Colorado Island (BCI), San Emilio, and Luquillo forest dynamics plots (FDPs) using eight or nine different taxonomic scales. Positive values indicate phylogenetic clustering, and negative values indicate phylogenetic overdispersion. The bars represent 95% confidence intervals.

* $P < 0.05$ (Wilcoxon test).

CHOICES OF SCALES



Choice of spatial and
environm. extents
(which polygons?)



Choice of organismic
scales
(which organisms?)

ANALYSES

Species pool level

- APD_O and APD_A
- species pool diversity

Null model
distributions

Focal community plot level

- α -diversities
- α -diversity ranks

LEGEND

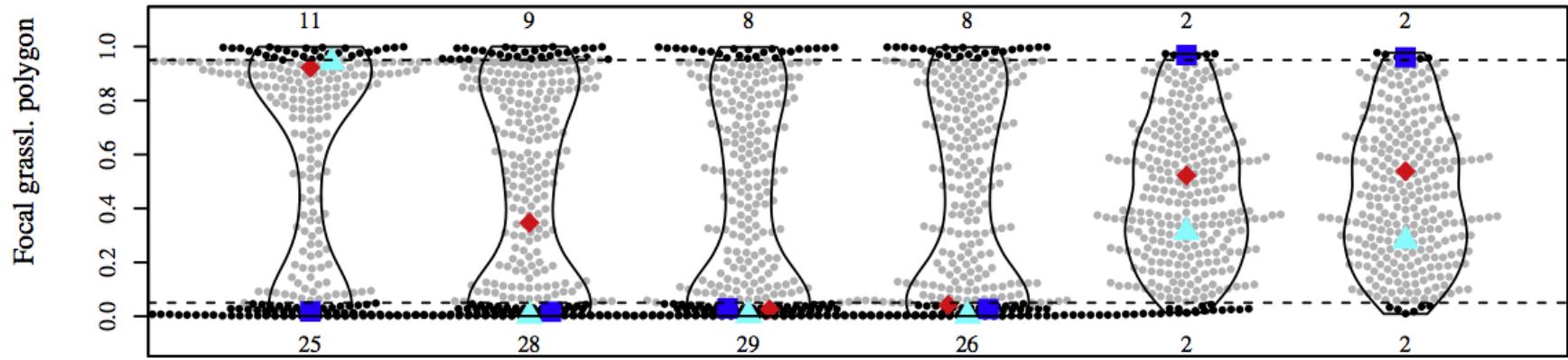
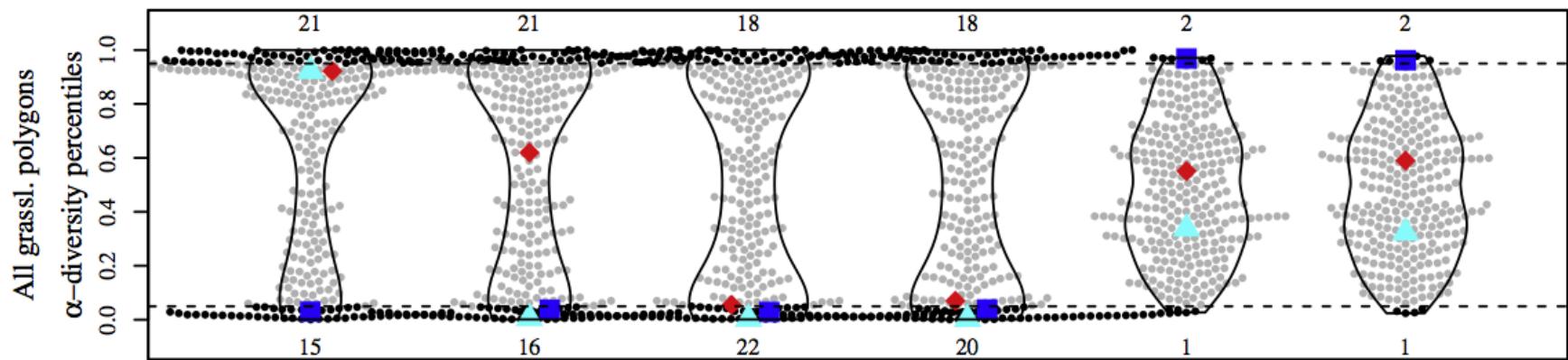
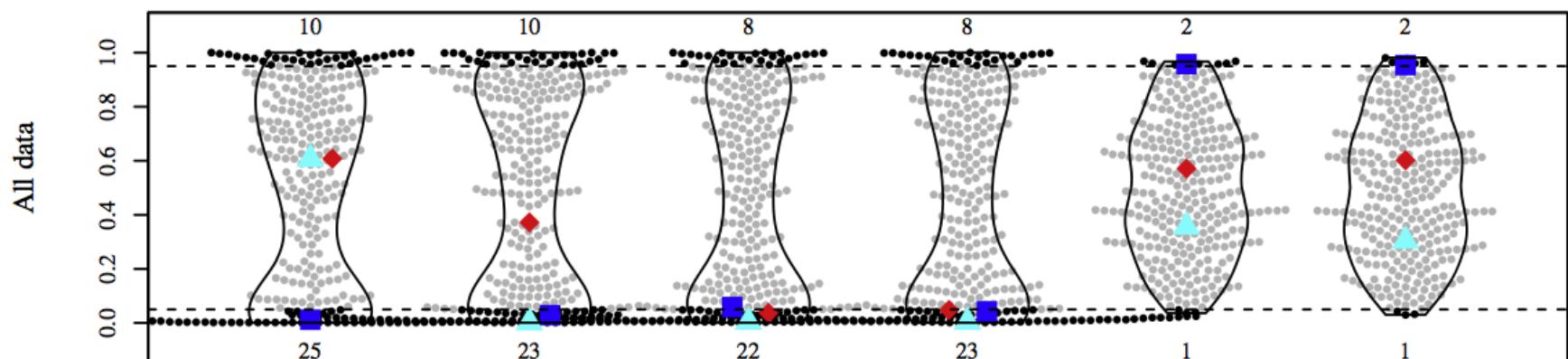
- community plot
- focal community plot
- ◀ land cover type polygon
- ◀ focal land cover type polygon

Organismic scales

- lowest stratum
- herbaceous species
- Asteraceae

Land cover type classification

- grassland
- sparsely vegetated area
- bare-rock vegetation
- others (forest, ...)



Strata:

Species:

all

all

lowest

all

all

herbaceous

lowest

herbaceous

all

Asteraceae

lowest

Asteraceae

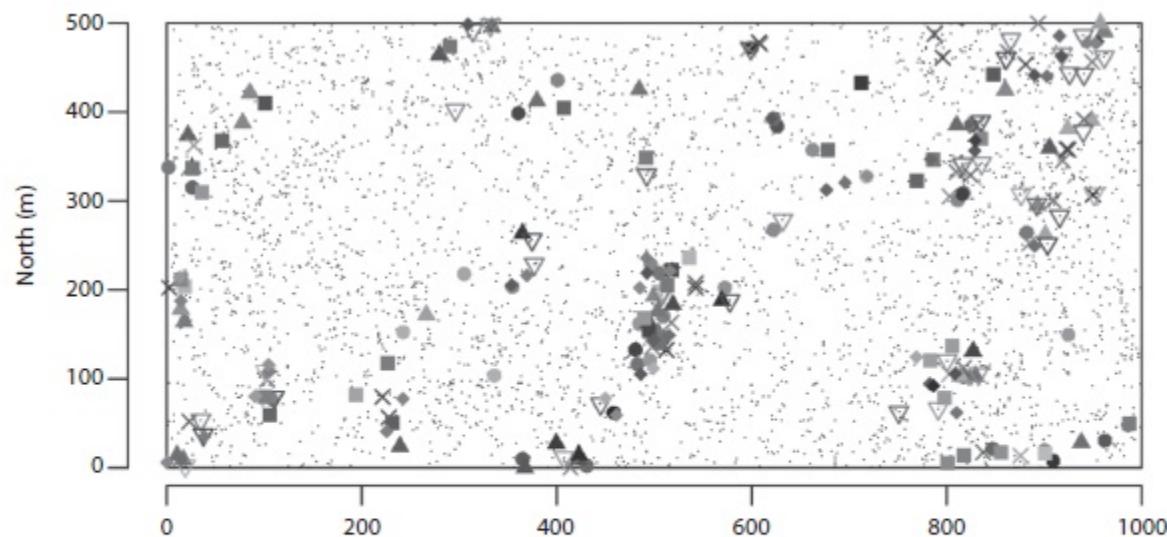


TABLE 1. The number of species in pools (*n*) at each scale utilized and the forest types included in the pool.

Location	0.36 ha		1 ha		FDP		Region		Country		Multiple countries	
	<i>n</i>	Forest types	<i>n</i>	Forest types	<i>n</i>	Forest types						
BCI†	118–144	moist	157–181	moist	301	moist	1270	dry, moist, wet forests	2446	cloud, dry, moist, wet forests	3435	cloud, dry, moist, wet forests
San Emilio	55–74	dry	85–88	dry	173	dry	197	dry forest	2261	cloud, dry, moist, wet forests	3435	cloud, dry, moist, wet forests
Luquillo	49–70	moist	71–87	moist	151	moist	281	cloud, moist, wet forests	738	cloud, dry, moist, wet forests	779	cloud, dry, moist, wet forests

† Barro Colorado Island.

■ 20 x 20 m subplot
■ 0.36 ha ‘pool’
■ 1 ha ‘pool’
■ 50 ha ‘pool’ (entire plot)

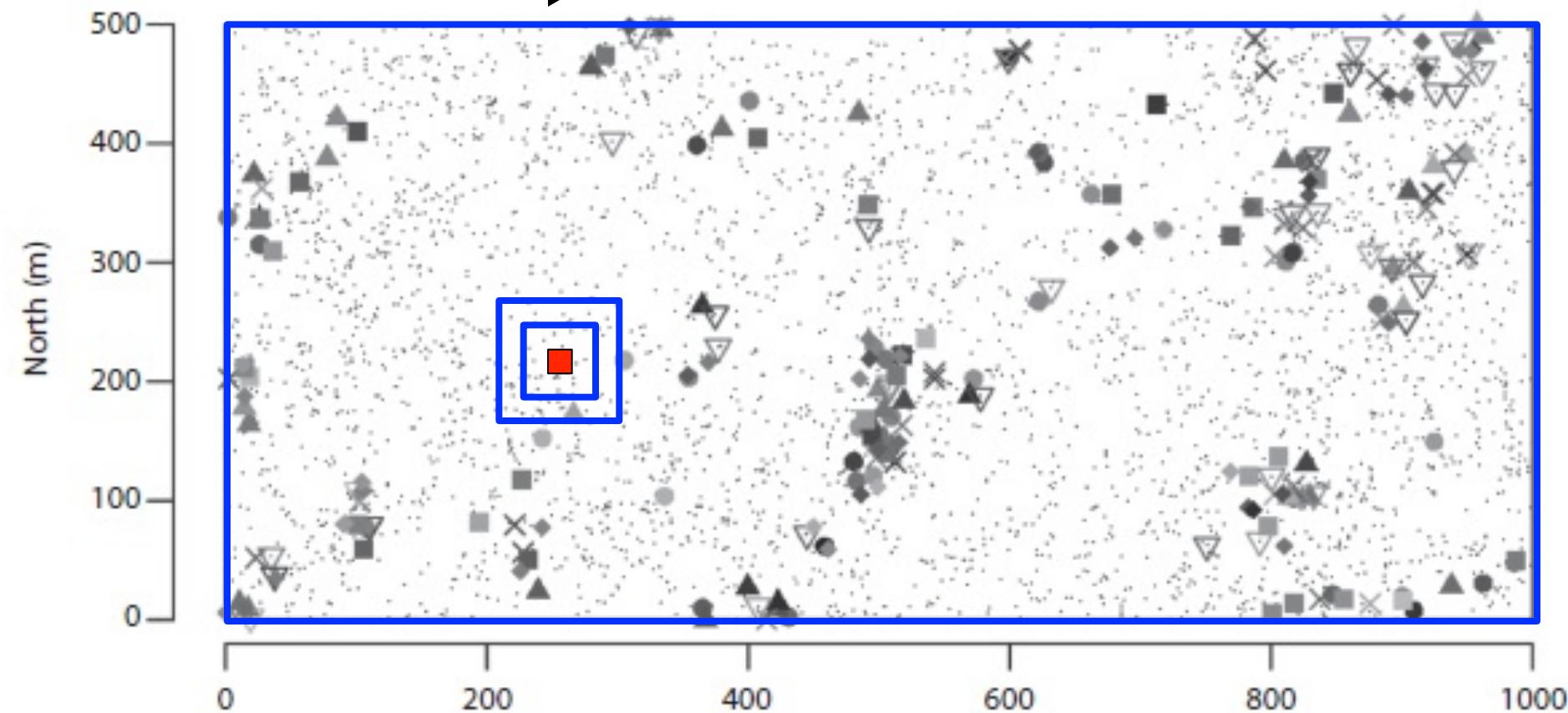


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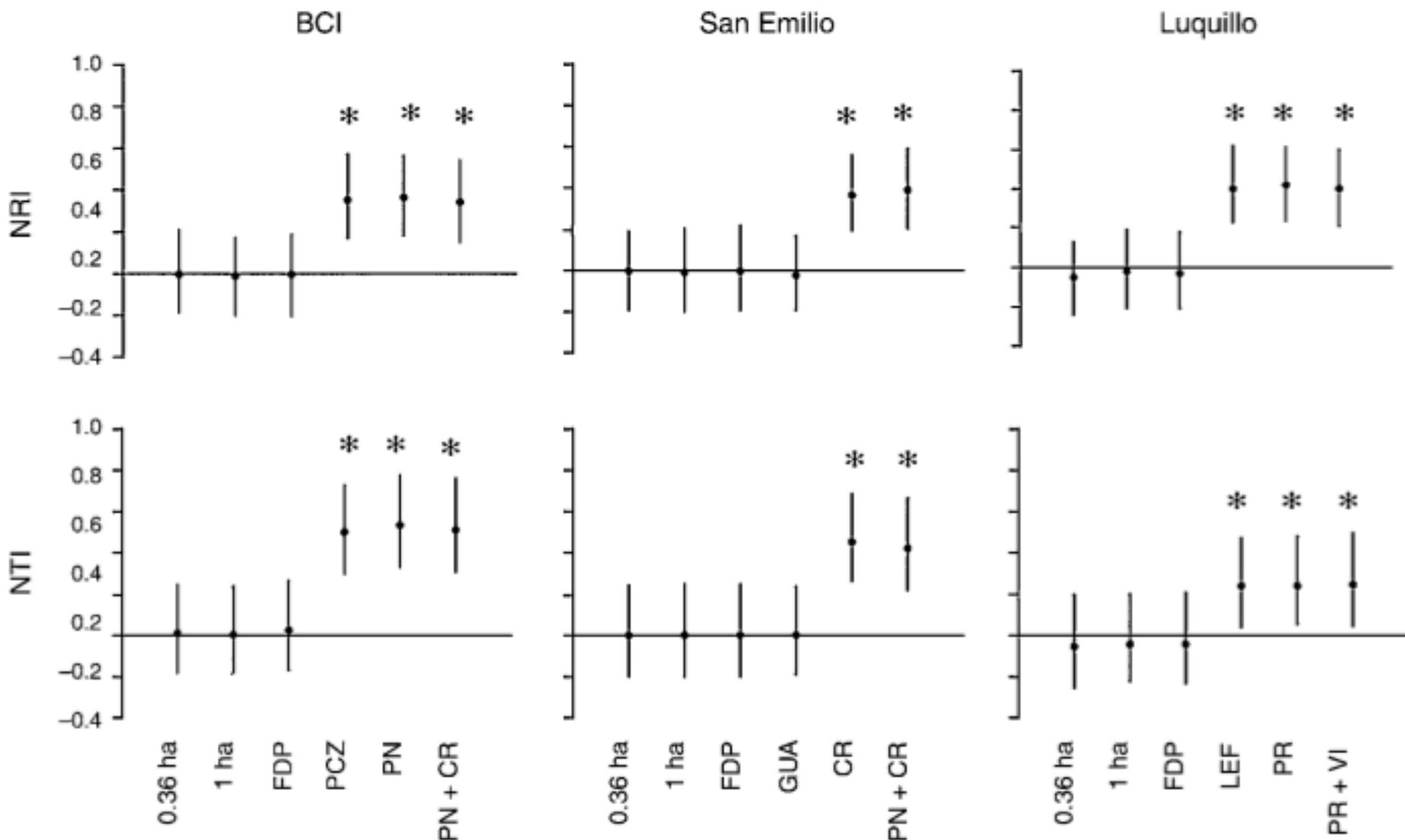
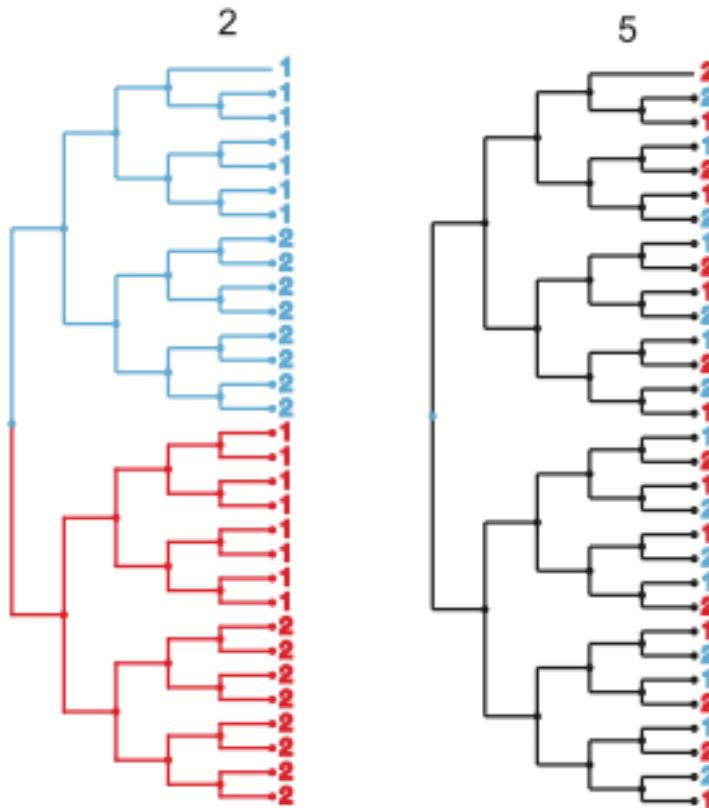


FIG. 2. The median NRI and NTI scores for BCI, San Emilio, and Luquillo FDPs using six different species pool sizes. Positive values indicate phylogenetic clustering, and negative values indicate phylogenetic overdispersion. The bars represent 95% confidence intervals. Key to abbreviations: FDP, forest dynamics plot; PCZ, Panama Canal Zone; PN, Panama; PN + CR, Panama and Costa Rica; LEF, Luquillo Experimental Forest; PR, Puerto Rico; PR + VI, Puerto Rico and the Virgin Islands; GUA, Santa Rosa and Palo Verde National Parks; CR, Costa Rica.

* $P < 0.05$ (Wilcoxon test).

Two communities that share no species



High Low

Phylobetadiversity