

Data on diversity, abundance, per-capita recruitment, and conspecific and heterospecific negative density dependence of CTFS-ForestGEO plots

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Bunyavejchewin, L. Chang, J. Chiang, G. B. Chuyong, K. Clay, R. Condit, S. Cordell, S. J. Davies, T. J. Furniss, C. P. Giardina, I. A. U. N. Gunatilleke, C. V. S. Gunatilleke, F. He, R. W. Howe, S. P. Hubbell, C. Hsieh, F. M. Inman-Narahari, D. Janík, D. J. Johnson, D. Kenfack, L. Korte, K. Král, A. J. Larson, J. A. Lutz, S. M. McMahon, W. J. McShea, H. R. Memiaghe, A. Nathalang, V. Novotny, P. S. Ong, D. A. Orwig, R. Ostertag, G. G. Parker, R. P. Phillips, L. Sack, I. Sun, J. S. Tello, D. W. Thomas, B. L. Turner, D. M. Vela Díaz, T. Vrška, G. D. Weiblen, A. Wolf, S. Yap, and J. A. Myers, Plant diversity increases with the strength of negative density dependence at the global scale. *Science* 356:1389-1392 (2017).

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Dataset description:

To evaluate the extent to which changes in conspecific negative density dependence (CNDD) and heterospecific negative density dependence (HNDD) contribute to global patterns of tree species diversity, we calculated forest-wide species richness (the total number of species in a forest plot), forest-wide rarefied species richness (rarefied to the number of individuals in the forest plot with the lowest abundance, i.e. Yosemite with 7,083 live individuals), forest-wide species diversity (Shannon diversity index), mean species richness per 20×20 m quadrat, mean rarefied species richness per 20×20 m quadrat (rarefied to 20 individuals per quadrat because 95% of all quadrats across plots contained ≥ 20 individuals; observed species richness was used for those quadrats with < 20 individuals), and mean local species diversity (Shannon diversity index) per 20×20 m quadrat using the package ‘vegan’ in R (R Core Team 2015, Oksanen *et al.* 2015). Data were used from the most recent census of all live individuals in each forest plot (census number used in our analyses can be found in Table S20 of the supplementary material for LaManna *et al.* 2017). We calculated per-capita recruitment (saplings/conspecific adult) and the strength of CNDD and HNDD for each species at both the 10×10 m and 20×20 m scale using

both Ricker and power equations (Bolker 2008, LaManna *et al.* 2017). We then calculated the median and weighted (by the inverse of each estimate's SE) mean values of CNDD and HNDD across species for each forest plot. We also calculated the intercept and slope of the relationship between species abundance (m²/ha) and the strength of CNDD across species for each CTFS-ForestGEO plot. We also calculated the values of CNDD, HNDD, and the slope between species abundance and CNDD expected from neutral population dynamics using neutral simulation models (LaManna *et al.* 2017). These data can be used to reproduce statistical analyses and figures in LaManna *et al.* (2017). Copies of R scripts used in the above calculations are available in the supplementary material for LaManna *et al.* (2017).

Data files:

LaManna_et_al_2017_Science_data.csv

Data file contents:

Column	Description
Forest plot	Smithsonian Center for Tropical Forest Science-ForestGEO (CTFS-ForestGEO) plot
Latitude	Latitude of CTFS-ForestGEO plot
Longitude	Longitude of CTFS-ForestGEO plot
Plot size (ha)	Size of CTFS-ForestGEO plot (ha)
Total individuals in plot	Number of individual live trees (> 1 cm dbh) in entire CTFS-ForestGEO plot
Plot species richness	Number of species of live trees in entire CTFS-ForestGEO plot
Plot rarefied richness	Rarefied species richness of live trees in entire CTFS-ForestGEO plot
Plot Shannon diversity	Shannon species diversity of live trees in entire CTFS-ForestGEO plot
Mean-local richness	Mean number of species of live trees in 20x20 m quadrats within CTFS-ForestGEO plot
Mean-local rarefied richness	Mean rarefied species richness of live trees in 20x20 m quadrats within CTFS-ForestGEO plot
Mean-local Shannon diversity	Mean Shannon species diversity of live trees in 20x20 m quadrats within CTFS-ForestGEO plot
Median CNDD (Ricker 10x10)	Median value of CNDD measured with the Ricker model at the 10x10 m scale
Mean CNDD (Ricker 10x10)	Mean value of CNDD measured with the Ricker model at the 10x10 m scale
Mean CNDD (Ricker 10x10) CI	Confidence interval for the mean value of CNDD measured with the Ricker model at the 10x10 m scale

Median adult HNDD (Ricker 10x10)	Median value of HNDD from heterospecific adults measured with the Ricker model at the 10x10 m scale
Mean adult HNDD (Ricker 10x10)	Mean value of HNDD from heterospecific adults measured with the Ricker model at the 10x10 m scale
Mean adult HDD (Ricker 10x10) CI	Confidence interval for the mean value of HNDD from heterospecific adults measured with the Ricker model at the 10x10 m scale
Median sapling HNDD (Ricker 10x10)	Median value of HNDD from heterospecific saplings measured with the Ricker model at the 10x10 m scale
Mean sapling HNDD (Ricker 10x10)	Mean value of HNDD from heterospecific saplings measured with the Ricker model at the 10x10 m scale
Mean sapling HNDD (Ricker 10x10) CI	Confidence interval for the mean value of HNDD from heterospecific saplings measured with the Ricker model at the 10x10 m scale
Median r (Ricker 10x10)	Median value of per-capita recruitment (r) measured with the Ricker model at the 10x10 m scale
Mean r (Ricker 10x10)	Mean value of per-capita recruitment (r) measured with the Ricker model at the 10x10 m scale
Mean r (Ricker 10x10) CI	Confidence interval for the mean value of per-capita recruitment (r) measured with the Ricker model at the 10x10 m scale
Median CNDD rare species (10x10)	Median value of CNDD across rare species (all species in a plot with abundance < 0.1 m ² /ha) measured with the Ricker model at the 10x10 m scale
Median CNDD (Ricker 20x20)	Median value of CNDD measured with the Ricker model at the 20x20 m scale
Mean CNDD (Ricker 20x20)	Mean value of CNDD measured with the Ricker model at the 20x20 m scale
Mean CNDD (Ricker 20x20) CI	Confidence interval for the mean value of CNDD measured with the Ricker model at the 20x20 m scale
Median adult HNDD (Ricker 20x20)	Median value of HNDD from heterospecific adults measured with the Ricker model at the 20x20 m scale
Mean adult HNDD (Ricker 20x20)	Mean value of HNDD from heterospecific adults measured with the Ricker model at the 20x20 m scale
Mean adult HNDD (Ricker 20x20) CI	Confidence interval for the mean value of HNDD from heterospecific adults measured with the Ricker model at the 20x20 m scale
Median sapling HNDD (Ricker 20x20)	Median value of HNDD from heterospecific saplings measured with the Ricker model at the 20x20 m scale
Mean sapling HNDD (Ricker 20x20)	Mean value of HNDD from heterospecific saplings measured with the Ricker model at the 20x20 m scale
Mean sapling HNDD (Ricker 20x20) CI	Confidence interval for the mean value of HNDD from heterospecific saplings measured with the Ricker model at the 20x20 m scale
Median r (Ricker 20x20)	Median value of per-capita recruitment (r) measured with the Ricker model at the 20x20 m scale
Mean r (Ricker 20x20)	Mean value of per-capita recruitment (r) measured with the Ricker model at the 20x20 m scale

Mean r (Ricker 20x20) CI	Confidence interval for the mean value of per-capita recruitment (r) measured with the Ricker model at the 20x20 m scale
Median CNDD rare species (20x20)	Median value of CNDD across rare species (all species in a plot with abundance < 0.1 m ² /ha) measured with the Ricker model at the 20x20 m scale
CNDD-abundance intercept (Ricker 10x10)	Intercept of relationship between CNDD measured with the Ricker model at the 10x10 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance intercept (Ricker 10x10) CI	Confidence interval for the intercept of relationship between CNDD measured with the Ricker model at the 10x10 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance slope (Ricker 10x10)	Slope of relationship between CNDD measured with the Ricker model at the 10x10 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance slope (Ricker 10x10) CI	Confidence interval for the slope of relationship between CNDD measured with the Ricker model at the 10x10 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance intercept (Ricker 20x20)	Intercept of relationship between CNDD measured with the Ricker model at the 20x20 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance intercept (Ricker 20x20) CI	Confidence interval for the intercept of relationship between CNDD measured with the Ricker model at the 20x20 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance slope (Ricker 20x20)	Slope of relationship between CNDD measured with the Ricker model at the 20x20 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance slope (Ricker 20x20) CI	Confidence interval for the slope of relationship between CNDD measured with the Ricker model at the 20x20 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
Neutral CNDD (Ricker 20x20)	Expected value of CNDD measured with the Ricker model at the 20x20 m scale with neutral population dynamics
Neutral CNDD (Ricker 20x20) SD	Standard deviation of the expected value of CNDD measured with the Ricker model at the 20x20 m scale with neutral population dynamics
CNDD SES (Ricker 20x20)	Standardized effect size of CNDD measured with the Ricker model at the 20x20 m scale with neutral population dynamics
Neutral Adult HNDD (Ricker 20x20)	Expected value of HNDD from heterospecific adults measured with the Ricker model at the 20x20 m scale with neutral population dynamics
Neutral Adult HNDD (Ricker 20x20) SD	Standard deviation of the expected value of HNDD from heterospecific adults measured with the Ricker model at the 20x20 m scale with neutral population dynamics
Adult HNDD SES (Ricker 20x20)	Standardized effect size of HNDD from heterospecific adults measured with the Ricker model at the 20x20 m scale with neutral population dynamics

Neutral Sapling HNDD (Ricker 20x20)	Expected value of HNDD from heterospecific saplings measured with the Ricker model at the 20x20 m scale with neutral population dynamics
Neutral Sapling HNDD (Ricker 20x20) SD	Standard deviation of the expected value of HNDD from heterospecific saplings measured with the Ricker model at the 20x20 m scale with neutral population dynamics
Sapling HNDD SES (Ricker 20x20)	Standardized effect size of HNDD from heterospecific saplings measured with the Ricker model at the 20x20 m scale with neutral population dynamics
Neutral CNDD-abund slope (Ricker 20x20)	Expected value of CNDD-abundance relationship with CNDD measured with the Ricker model at the 20x20 m scale with neutral population dynamics
Neutral CNDD-abund slope (Ricker 20x20) SD	Standard deviation of the expected value of CNDD-abundance relationship with CNDD measured with the Ricker model at the 20x20 m scale with neutral population dynamics
CNDD-abund slope SES (Ricker 20x20)	Standardized effect size of CNDD-abundance relationship with CNDD measured with the Ricker model at the 20x20 m scale with neutral population dynamics
CNDD (Power 10x10)	Mean value of CNDD measured with the Power model at the 10x10 m scale
CNDD (Power 10x10) CI	Confidence interval for the mean value of CNDD measured with the Power model at the 10x10 m scale
Adult HNDD (Power 10x10)	Mean value of HNDD from heterospecific adults measured with the Power model at the 10x10 m scale
Adult HDD (Power 10x10) CI	Confidence interval for the mean value of HNDD from heterospecific adults measured with the Power model at the 10x10 m scale
Sapling HNDD (Power 10x10)	Mean value of HNDD from heterospecific saplings measured with the Power model at the 10x10 m scale
Sapling HNDD (Power 10x10) CI	Confidence interval for the mean value of HNDD from heterospecific saplings measured with the Power model at the 10x10 m scale
r (Power 10x10)	Mean value of per-capita recruitment (r) measured with the Power model at the 10x10 m scale
r (Power 10x10) CI	Confidence interval for the mean value of per-capita recruitment (r) measured with the Power model at the 10x10 m scale
CNDD (Power 20x20)	Mean value of CNDD measured with the Power model at the 20x20 m scale
CNDD (Power 20x20) CI	Confidence interval for the mean value of CNDD measured with the Power model at the 20x20 m scale
Adult HNDD (Power 20x20)	Mean value of HNDD from heterospecific adults measured with the Power model at the 20x20 m scale
Adult HDD (Power 20x20) CI	Confidence interval for the mean value of HNDD from heterospecific adults measured with the Power model at the 20x20 m scale
Sapling HNDD (Power 20x20)	Mean value of HNDD from heterospecific saplings measured with the Power model at the 20x20 m scale
Sapling HNDD (Power 20x20) CI	Confidence interval for the mean value of HNDD from heterospecific saplings measured with the Power model at the 20x20 m scale
r (Power 20x20)	Mean value of per-capita recruitment (r) measured with the Power model at the 20x20 m scale

r (Power 20x20) CI	Confidence interval for the mean value of per-capita recruitment (r) measured with the Power model at the 20x20 m scale
CNDD-abundance intercept (Power 10x10)	Intercept of relationship between CNDD measured with the Power model at the 10x10 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance intercept (Power 10x10) CI	Confidence interval for the intercept of relationship between CNDD measured with the Power model at the 10x10 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance slope (Power 10x10)	Slope of relationship between CNDD measured with the Power model at the 10x10 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance slope (Power 10x10) CI	Confidence interval for the slope of relationship between CNDD measured with the Power model at the 10x10 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance intercept (Power 20x20)	Intercept of relationship between CNDD measured with the Power model at the 20x20 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance intercept (Power 20x20) CI	Confidence interval for the intercept of relationship between CNDD measured with the Power model at the 20x20 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance slope (Power 20x20)	Slope of relationship between CNDD measured with the Power model at the 20x20 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
CNDD-abundance slope (Power 20x20) CI	Confidence interval for the slope of relationship between CNDD measured with the Power model at the 20x20 m scale and species abundance (basal area) across species within each CTFS-ForestGEO plot
Neutral CNDD (Power 20x20)	Expected value of CNDD measured with the Power model at the 20x20 m scale with neutral population dynamics
Neutral CNDD (Power 20x20) SD	Standard deviation of the expected value of CNDD measured with the Power model at the 20x20 m scale with neutral population dynamics
CNDD SES (Power 20x20)	Standardized effect size of CNDD measured with the Power model at the 20x20 m scale with neutral population dynamics
Neutral Adult HNDD (Power 20x20)	Expected value of HNDD from heterospecific adults measured with the Power model at the 20x20 m scale with neutral population dynamics
Neutral Adult HNDD (Power 20x20) SD	Standard deviation of the expected value of HNDD from heterospecific adults measured with the Power model at the 20x20 m scale with neutral population dynamics
Adult HNDD SES (Power 20x20)	Standardized effect size of HNDD from heterospecific adults measured with the Power model at the 20x20 m scale with neutral population dynamics
Neutral Sapling HNDD (Power 20x20)	Expected value of HNDD from heterospecific saplings measured with the Power model at the 20x20 m scale with neutral population dynamics

Neutral Sapling HNDD (Power 20x20) SD	Standard deviation of the expected value of HNDD from heterospecific saplings measured with the Power model at the 20x20 m scale with neutral population dynamics
Sapling HNDD SES (Power 20x20)	Standardized effect size of HNDD from heterospecific saplings measured with the Power model at the 20x20 m scale with neutral population dynamics
Neutral CNDD-abund slope (Power 20x20)	Expected value of CNDD-abundance relationship with CNDD measured with the Power model at the 20x20 m scale with neutral population dynamics
Neutral CNDD-abund slope (Power 20x20) SD	Standard deviation of the expected value of CNDD-abundance relationship with CNDD measured with the Power model at the 20x20 m scale with neutral population dynamics
CNDD-abund slope SES (Power 20x20)	Standardized effect size of CNDD-abundance relationship with CNDD measured with the Power model at the 20x20 m scale with neutral population dynamics

How to cite:

Publications using these data should cite LaManna *et al.* (2017).

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Citations:

- B. M. Bolker, *Ecological models and data in R* (Princeton University Press, Princeton, New Jersey, USA, 2008).
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