Density-dependent (Neighbour-regulated forest dynamics in Nanjenshan subtropical rain forest.

Su-Wei Fan
Advisor: Dr. Hsieh, Chang-Fu
Institute of Ecology and Evolutionary biology

What's Neighbour-regulation?
Individuals are expected to experience lower recruitment success and survival near their conspecific neighbours.
Result from

Pest propagation from adults to their nearby offspring

The enhanced proliferation of species-specific herbivores and pathogens among more densely packed hosts.

Increased heterspecific crowding is expected to result in fewer encounters between a host and its species-specific pest and pathogens, even if the density of conspecific neighbors remains constant (Peters 2003).
Another similar hypothesi:s

Herd-immunity model (Wills & Green 1994)

Species herd protection (Peters 2003)

Overall diversity correlates positively with the performance of individual species.

Hypothesis
1. Conspecific neighbours or high density neighbours act as negative regulators which deter self-replacement (Peters 2003)(Peters 2003).

i.e. increasing the mortality rate (negative effect)

2. Heterspecific crowding is a positive effect which promotes self-replacement
   i.e. increasing the survival rate (positive effect)

3. Number and species of Neighbours may suppress growth (Canham et al. 2006).
   i.e. decreasing the transition probability (negative effect)

4. Neighbouring mother tree affect recruitment
   Negative effects (Janzen 1970).

Method

Discriminating neighbour classes:

by size: Juvenile: 1-4 cm dbh / adult tree: >4 cm dbh

by distance: <1 m, 1-2 m, 2-4 m, 4-6 m

by species: Conspecific / Heterspecific

Target tree class:

1-2 cm, 2-4 cm, 4-8 cm, >8 cm groups

different species (N=137)

Test different frequencies between with and without neighbors: X^2 test

Results:

1.

Summary X^2 test results of mortality in 1-2cm dbh class with or without all neighbor large trees among different distance..

	N01	N12	N24	N46
testable	66	5	0	0
negative	1	0	-	-
positive	0	0	-	-
neutral	65	5	-	-
Negative sp.	mallpa			

2.

Summary X^2 test results of growth in 1-2 cm dbh class with or without all neighbor large trees among different distance. (report P-value in table)

	N01	N12	N24	N46
testable	86	83	0	0
negative	1	24	-	-
positive	1	0	-	-
neutral	84	59	-	-
Negative sp.	illiar			
Positive sp.	antihi			

3.

X^2 test results of *Illicium* mortality in different dbh classes with or without all

neighbor large trees in 1m. (P-value reported in table)

	C12	C24	C46	C8
hab1	0.7689	0.0644	0.5368	0.9032
hab2	0.0580	0.0924	0.1232	0.6778
hab3	0.44592	0.5772	0.6065	0.7936
hab4	0.5823	0.7874	0.7176	0.9210

4.

X^2 test results of *Illicium* growth in different dbh classes with or without all neighbor large trees in 1 m.

(P-value reported in table, yellow blackest represents significance)

0-1m	C12	C24	C48	C8
hab1	0.3782	0.3256	0.9325	0.3447
hab2	0.0318	0.8053	0.1030	0.8316
hab3	0.0720	0.8466	0.0144	0.8724
hab4	0.2646	0.0123	0.0006	0.3262

5.

X^2 test results of *Illicium* growth in different dbh classes with or without all neighbor large trees in 1 m.

(P-value reported in table, yellow blackest represents significance)

1-2m	C12	C24	C48	C8
Hab1	<0.001	<0.001	NA	NA
Hab2	<0.001	NA	<0.001	NA
Hab3	0.0294	<0.001	<0.001	NA
hab4	<0.001	<0.001	<0.001	NA

6.

X^2 test results of *Illicium* recruitment in different dbh classes with or without all neighbor large trees in 1 m.

(P-value reported in table, yellow blackest represents significance)

N01		with		without	
	P value	Obs.	Exp.	Obs.	Exp.
hab1	<0.001	100	75.7	50	74.3

hab2	0.0255	73	62.4	25	35.6
hab3	<0.001	132	102.5	65	94.5
hab4	0.31	186	192.3	55	48.7

N12		with		withou	
		Obs.	Exp.	Obs.	Exp.
hab1	<0.001	142	127.5	8	22.5
hab2	0.0534	93	86.9	5	11.04
hab3	<0.001	187	171.0	10	25.9
hab4	0.988	234	233.9	7	7.03

Summary:

In our results, conspecific neighbours or high density neighbours did decrease mortality rate. Neighbors of all species had negaitive effect which inhibite self-replacement (increasing mortality and decrease growth).

Neighbouring mother tree had positive effect on recruitment, which showed nursery or species herd protection of large trees.

Canham, C.D., Papaik, M.J., Uriarte, M., McWilliams, W.H., Jenkins, J.C. & Twery, M.J. 2006. Neighborhood analyses of canopy tree competition along environmental gradients in new England forests. *Ecological Applications* 16: 540-554.

Janzen, D.H. 1970. Herbivores and the number of tree species in tropical forests. *American Naturalist* 104: 501-528.

Peters, H.A. 2003. Neighbour-regulated mortality: the influence of positive and negatve density dependence on tree populations in species-rch tropical forests. *Ecology Letters* 6: 757-765.