

BASE

Disturbance and Coexistence



In this exercise, we will investigate successional models with disturbance. In the exercise about coexistence between two populations, we have simulated disturbance by using an extinction rate. Let's start with that model, and assess what happens to coexistence when the disturbance is amplified.

Let's first remember the model we used in the [Metapopulation coexistence](#) exercise. We were studying two species, one being the best competitor (which was able to colonize patches already occupied by the other species), and one that was only able to colonize empty patches. The variation in the patch occupancy is given by:

$$\frac{df_1}{dt} = i_1 f_1 (1 - f_1) - p_e f_1 \quad \frac{df_2}{dt} = i_2 f_2 (1 - f_1 - f_2) - i_1 f_1 f_2 - p_e f_2$$

Where:

- f = fraction of occupied patches
- p_e = local extinction probability
- i = rate in which the colonization probability increases as f increases
- Thus, the colonization rate is given by $i \cdot f$ - the greater the occupancy, the greater the colonization rate

A necessary condition for the persistence of species 2 was:

$$e_{i_1} > i_{(1)} / i_{(2)}$$

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Let's remember the parameters that can be changed:

option	parameter	effect
data set	R object	stores the simulation results
Maximum time	$t_{(max)}$	number of model iterations to be run
columns	$n_{(col)}$	number of columns in the habitat
rows	$n_{(rows)}$	number of rows in the habitat
Best Competitor	Parameters for the best competitor	

option	parameter	effect
initial occupancy	\$\$fi_1 \$\$	proportion of initial patch occupancy by species 1
colonization coef.	\$\$i_1 \$\$	colonization coefficient for sp1
Inferior Competitor	Parameters for the inferior competitor	
initial occupancy	\$\$fi_2 \$\$	proportion of initial patch occupancy by species 2
colonization coef.	\$\$i_2 \$\$	colonization coefficient for sp2
Both Species	Parameters shared by both species	
prob. extinction	\$\$p_e \$\$	extinction probability
Habitat Destruction	D	proportion of patches not available
Show simulation frames	$anima=TRUE$	should every step be graphically animated?

Simulating the disturbance

Let's simulate an increase in the extinction probability, by keeping the following parameters fixed:

```
tmax=100;  
ncol=100;  
nrow=100;  
fi1=0.1;  
fi2=0.1;  
i1=0.4;  
i2=0.8;  
D=0;  
anima=FALSE
```

Now use the following extinction probabilities to simulate an increase in disturbance:

- $pe = 0.1$
- $pe = 0.2$
- $pe = 0.25$
- $pe = 0.3$
- $pe = 0.4$
- $pe = 0.5$

1. What happens to the system when we increase the intensity of habitat disturbance?
2. In which scenario is the system more diverse?
3. What is the biological interpretation for the behavior of the inferior competitor in the first four simulations? What is happening?

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