Competition ~ Chapter 14

1917 - A.G. Tansley

Galium (bedstraw plant)

1917 A.G. Tansley

Observation

G. hercynicum (G.h.) → acidic soils
G. pumillum (G.p.) → Calcareous soils

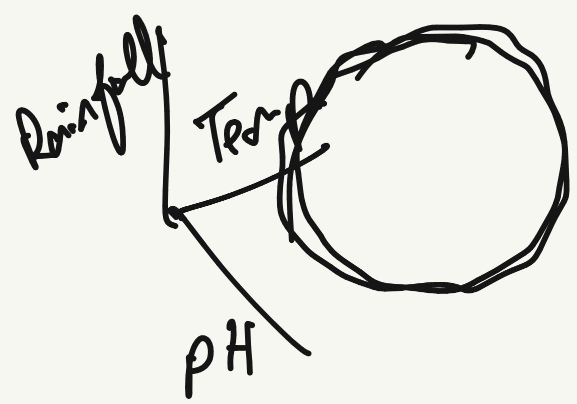
Experiment

Grew G.h. < Acidic Soil / Calcareous Soil

G.p. < Acidic Soil / Calcareous soil

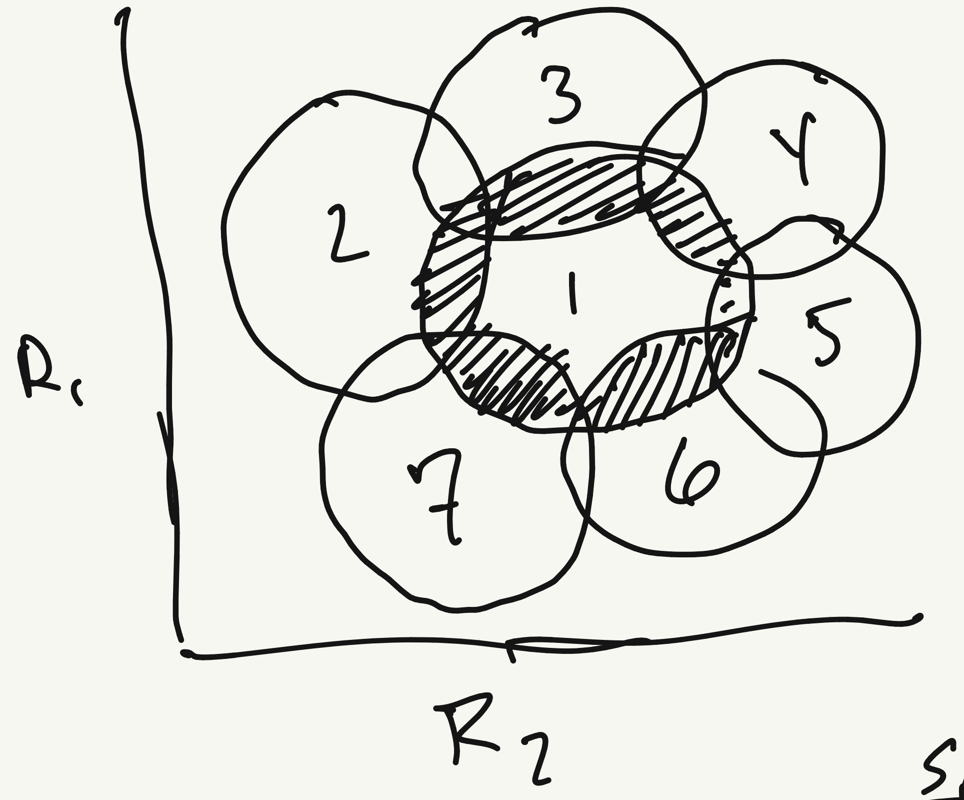
Niche - Resources and Conditions species require in order to grow and have fitness > ∅

n-dimensional hyper volume



Together → G.h. dominated and out-competed G.p. in acidic soils

→ G.p. dominated and and outcompeted G.h. in calcareous soils



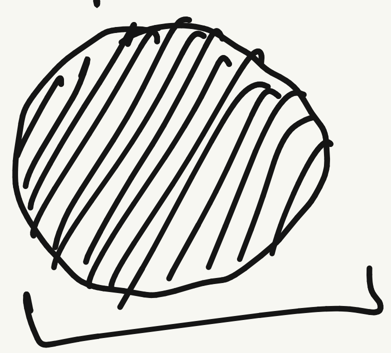
Resources
- Food
- Water
- Space
- Light
- Nutrients

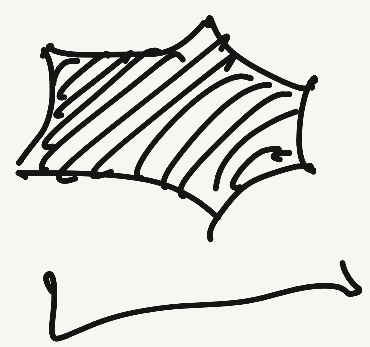
Anything that is limited that a species needs

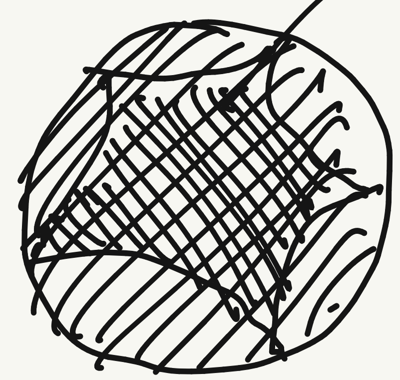
Niche – **Fundamental**

Realized

Species 1







Realized Niche (Actual) < Fundamental Niche (Potential)

due to Competition

$$\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right)$$

Intraspecific Competition

(Same species)

$$rN\left(1 - \frac{N}{K}\right) = 0 \quad ?$$

assuming $r > 0$

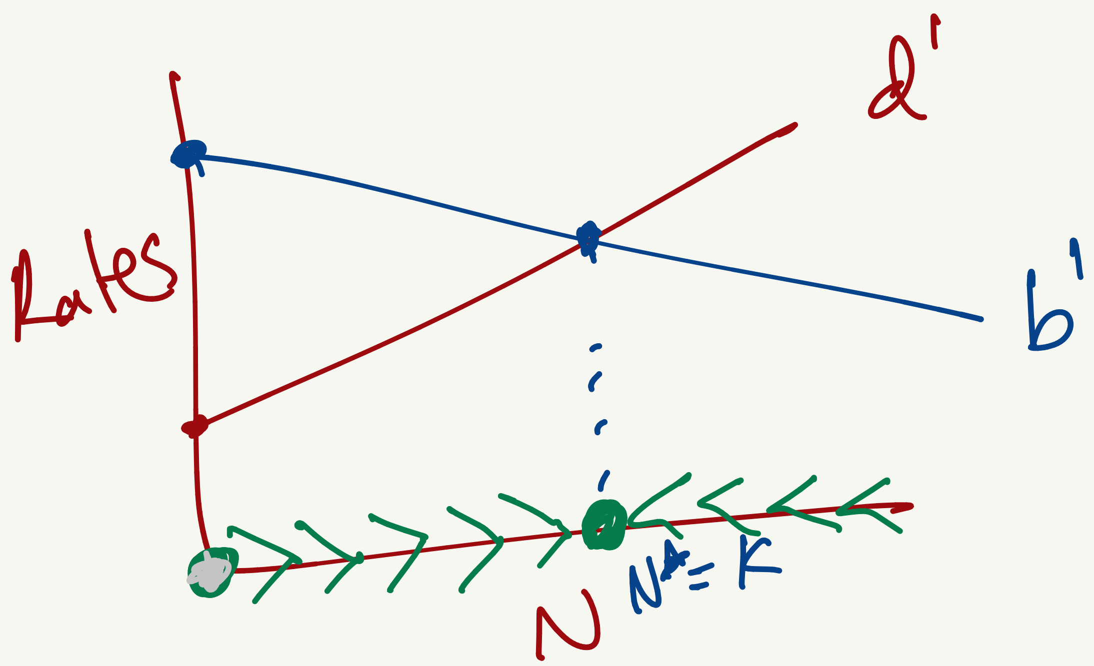
$N^* = 0$ extinction

$$1 - \frac{N}{K} = 0 \rightarrow 1 = \frac{N}{K}$$

$$N^* = K$$

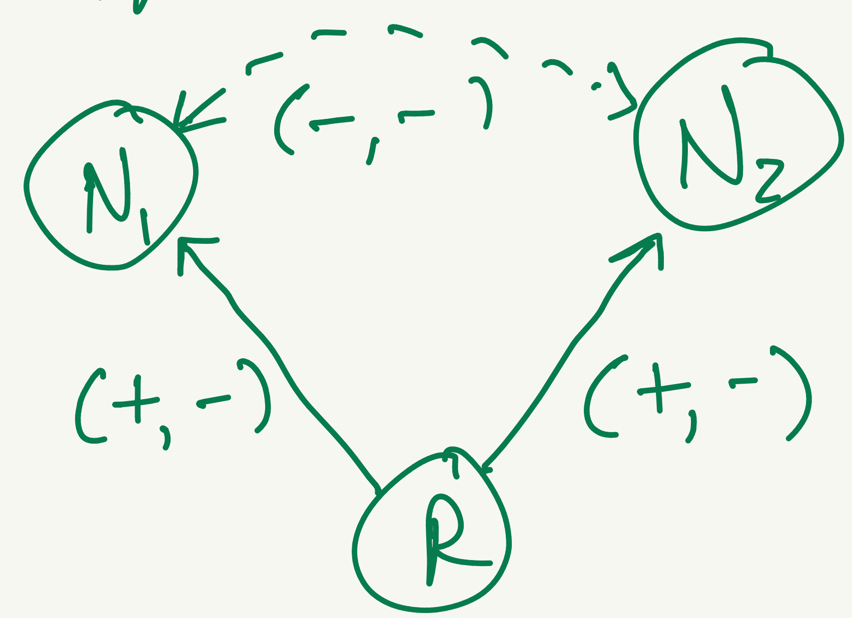
$$\frac{dN}{dt} = rN\left(1 - \frac{\boxed{N}}{K}\right)$$

As $N \to K$ then $\left(1 - \frac{N}{K}\right) \to \emptyset$ and $\frac{dN}{dt} \to \emptyset$ meaning growth is slowing down. It is slowing down b/c individuals are running out of resources



Another type of Competition: Interspecific Competition

- Competition between different species



Competition is indirect

Symmetric - neither spp. has an advantage

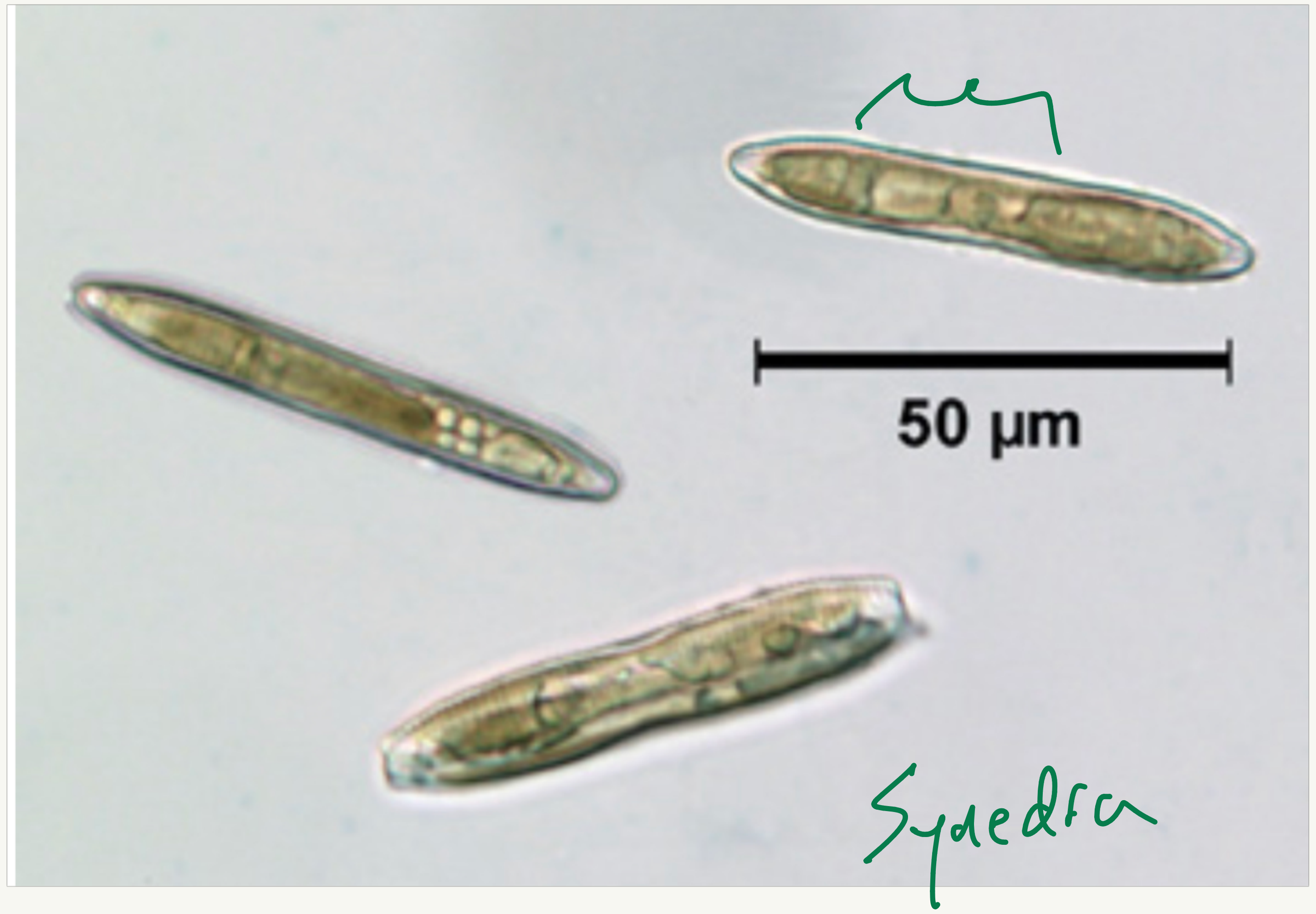
vs.

Asymmetric

Competition < Intraspecific / Interspecific

- Symmetric – Neither spp. has advantage
- Asymmetric – One spp. has advantage

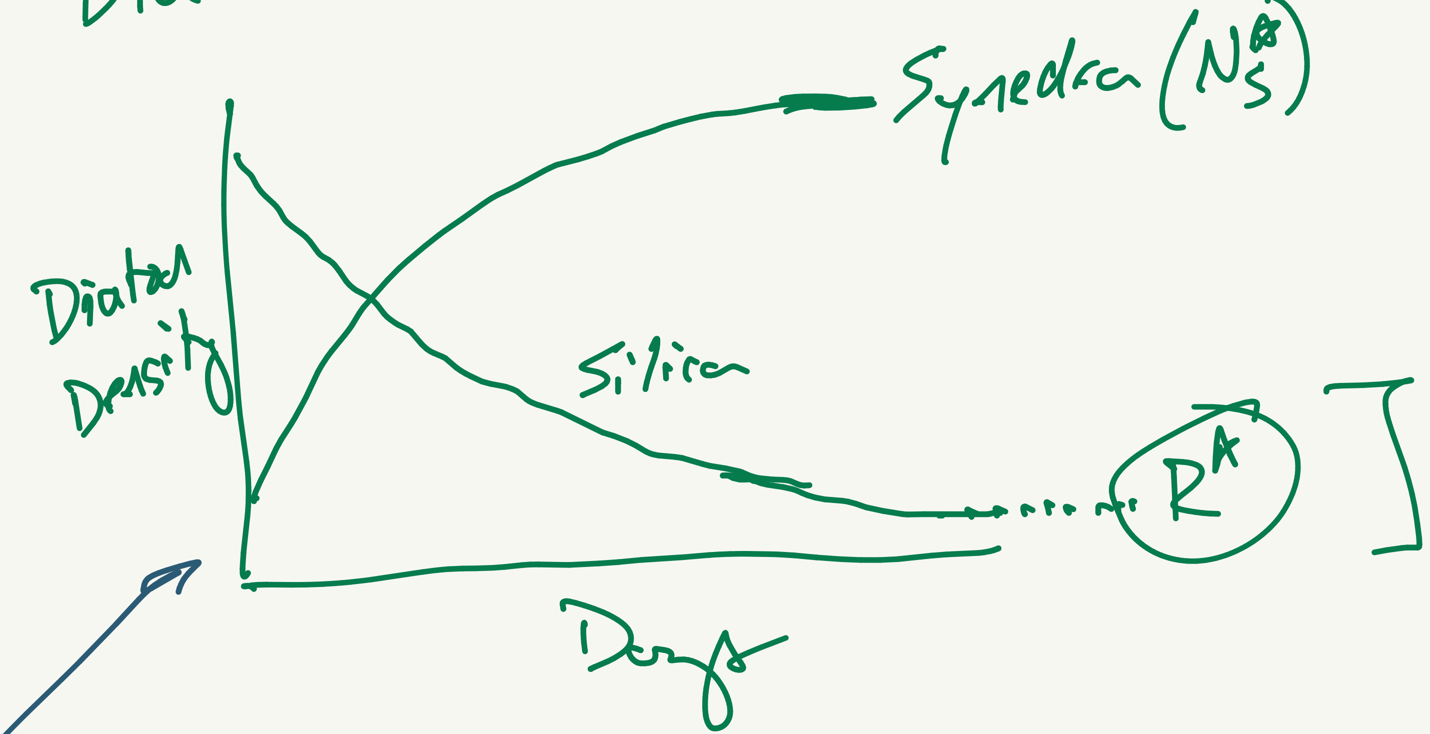
- Indirect (exploitation) competition
- Direct (Interference) Competition
  - antagonistic interactions
    - spatial exclusion (territories)
    - Theft (kleptoparasitism)
    - Allelopathy (plants)



- Competing Organisms deplete Resources

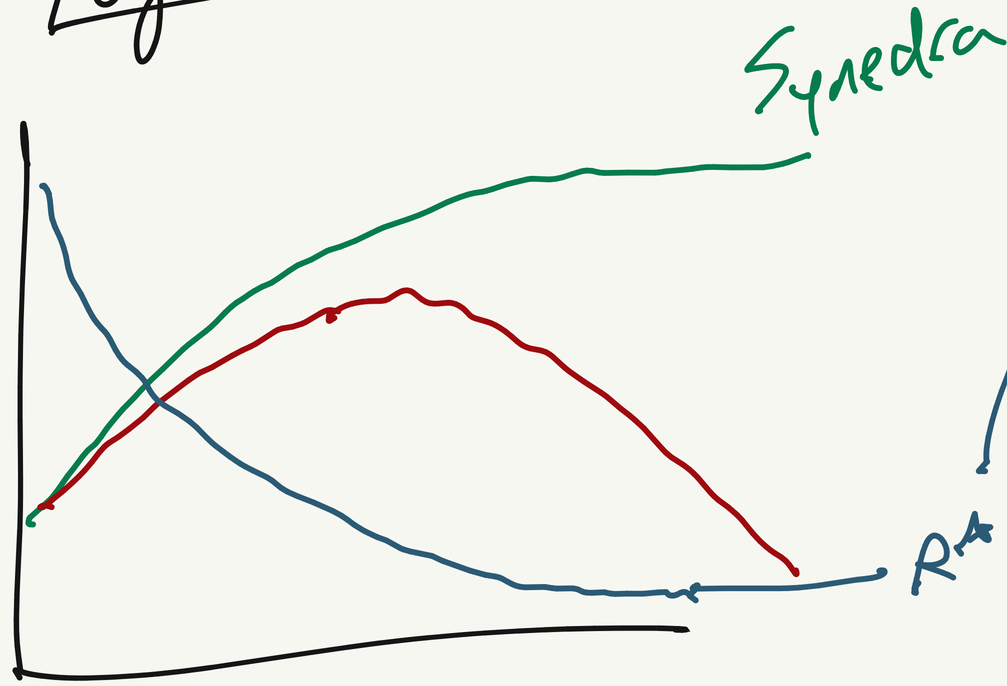
1981 by Tilman

Diatoms



Grown in isolation

Together



Syedra pushes ~~the~~ the shared resource to a lower steady state R^*

R^*-Theory: Competitor that can exist and maintain its population w/ fewer resources will be the superior competitor

$$\frac{dN}{dt} = rN\left(1 - \frac{\boxed{N}}{K}\right)$$

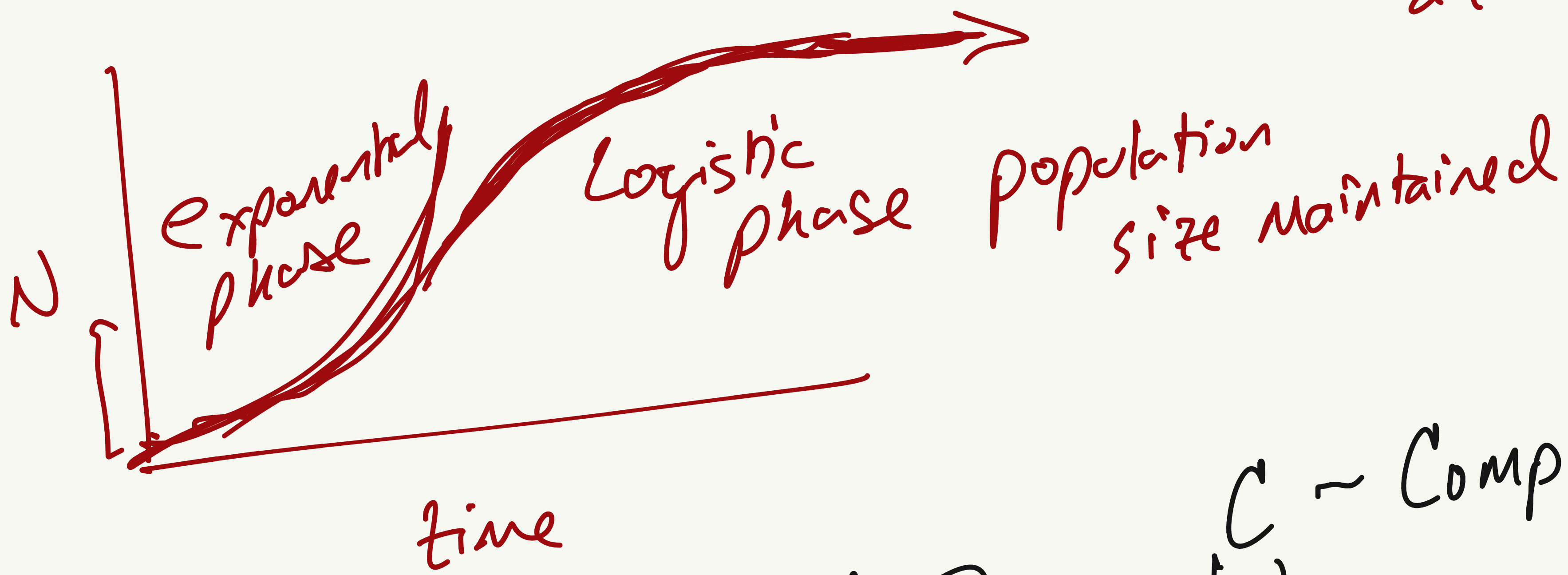
Defines the negative effect of individuals in a population on its own growth

$N \approx \emptyset$

$$\frac{dN}{dt} = rN\left(1 - \frac{N \approx \emptyset}{K}\right) = rN(1-\emptyset)$$

$$= rN$$

~ exponential growth



C ~ Competitor population

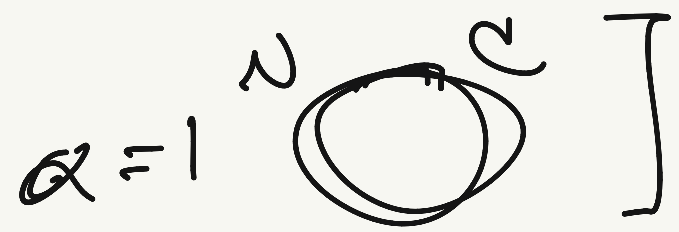
adding individuals

$$\frac{dN}{dt} = rN\left(1 - \frac{N + \alpha C}{K}\right)$$

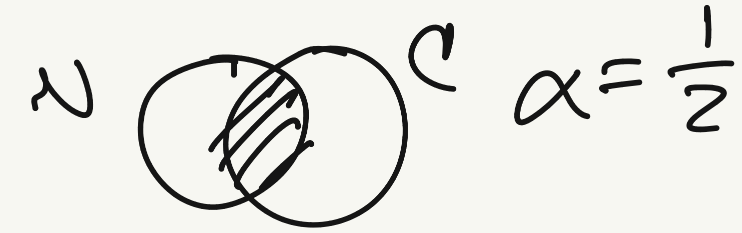
α describes how much resource overlap there is between N and C

if Numerator $> K$ then $\frac{dN}{dt} < \emptyset$

if Numerator $\approx K$ then $\frac{dN}{dt} \approx \emptyset$

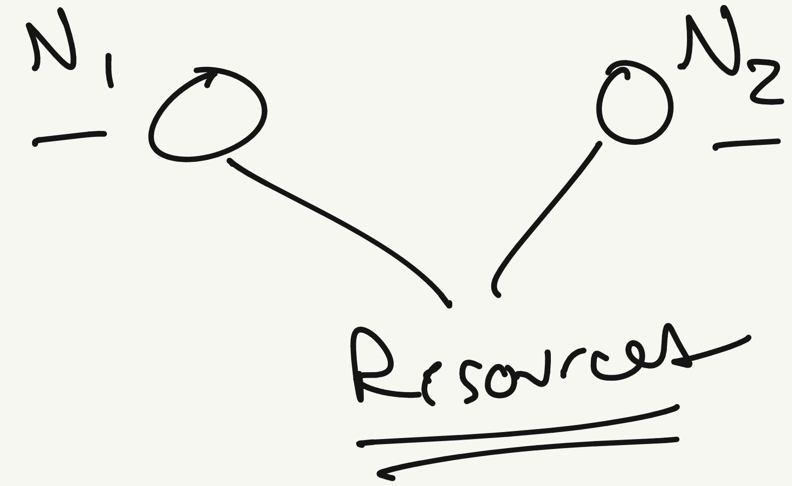


if $\alpha = \frac{1}{2}$ adding 2 individuals from C is like adding 1 individual from N



$$\frac{dN_1}{dt} = r_1 N_1\left(1 - \frac{N_1 + \alpha N_2}{K_1}\right)$$

$$\frac{dN_2}{dt} = r_2 N_2\left(1 - \frac{N_2 + \beta N_1}{K_2}\right)$$



growth of N_1 slowed by both N_1 and N_2

α = per-capita effect of species 2 on species 1

if $\alpha \uparrow$ there is a larger negative effect of N_2 on N_1

if $\alpha \downarrow$ there is a smaller negative effect of N_2 on N_1

growth of N_2 is slowed by both N_2 and N_1

β = per-capita effect of species 1 on species 2

if $\beta \uparrow$ there is a larger negative effect of N_1 on N_2

if $\beta \downarrow$ there is a smaller negative effect of N_1 on N_2