Review
Exam II

Fall 2007

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Materials for studying

- Your lecture notes
- Your homework and quizzes
- Your notes from today
- Materials on Dr. Sargent's website
  - "Population Biology Resources"
  - "Populus "
  - "Old Exam 2"
  - "Review for Exam 2"

Subjects to study

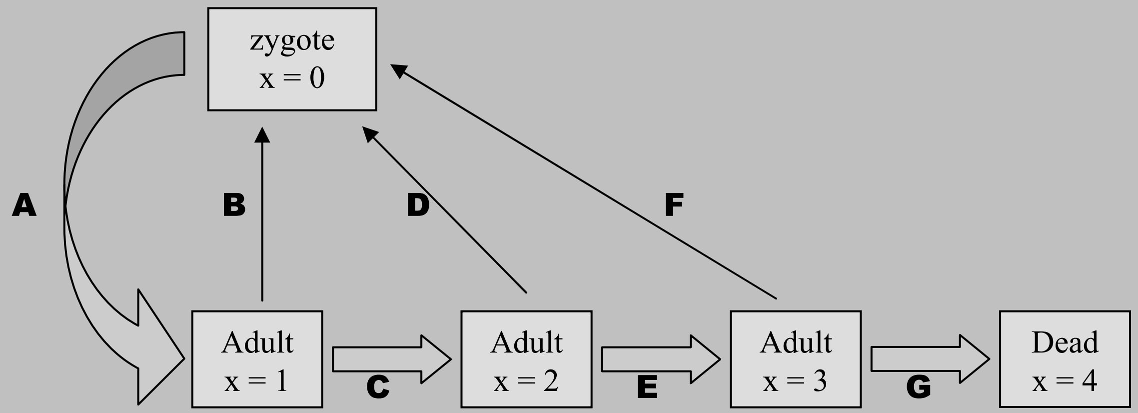
- Tradeoffs
- Life cycles & Williams' model
- Parental investment Theory
- Life tables
- Senescence
- Population Dynamics

Tradeoffs among fitness components

What are fitness components?

- Lack's tradeoff between....?
    - ➢ clutch size in birds...?
- Williams' tradeoff between....?
    - ➢ Biological examples illustrating Williams' tradeoff
        - – Sabat's experiments...?
        - – Balshine-Earn's experiments...?

Life cycle & Tradeoffs



Where would you indicate....

- Lack's tradeoff?
- Williams' tradeoff (as Sabat's expts showed)?
- Williams' tradeoff (as Balshine-Earn's expts showed)?

Practice (from old Quiz 3)

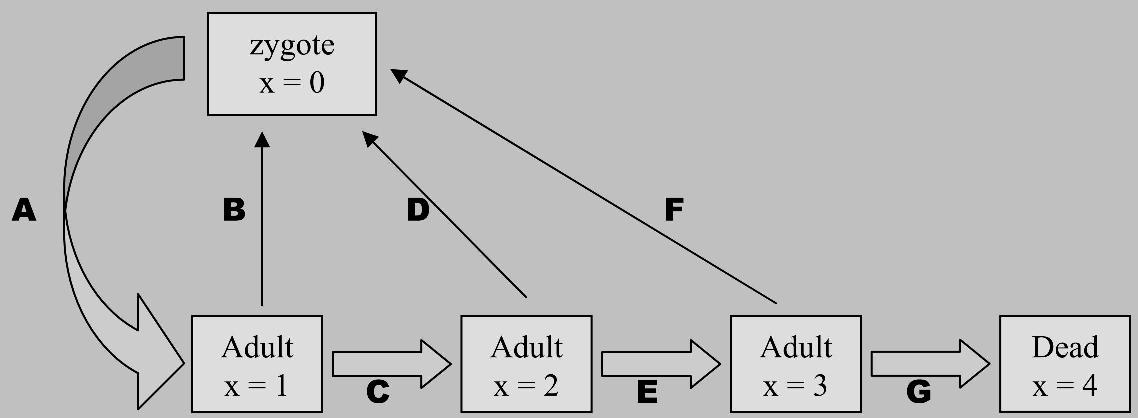
Write "Lack's" or "Williams'" in the blanks below

A. ________ tradeoff is demonstrated if an increase in current brood size results in decreased survival of that brood.

B. ________ tradeoff is demonstrated if an increase in current brood size results in decreased parental survival to the next breeding attempt.

C. ________ tradeoff is demonstrated if an increase in current brood size results decreased size of the next brood.

Life cycle & Williams' Model



Define variables:

x

R_x

m_x

l_x

$s_{x,x+1}$

$$\boxed{R_x = \text{Present RS} + \text{future RS}}$$

$$R_x = m_x + s_{x,x+1} R_{x+1}$$

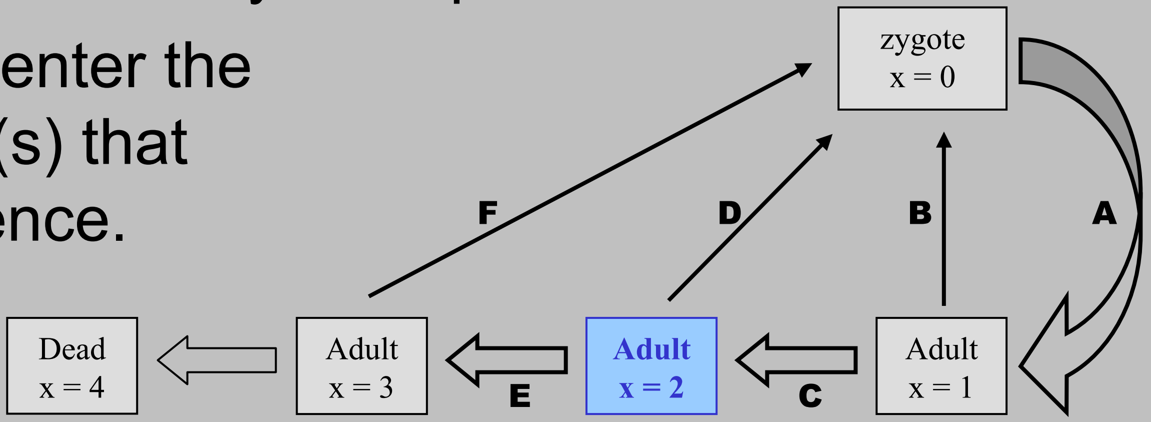
$$R_x = \frac{1}{x} \sum_{t=x}^{\infty} l_t m_t$$

$$R_0 = \sum_{t=0}^{\infty} l_t m_t$$

Practice (from old Quiz 4)

Let x=2, and refer to the life cycle depicted.

In the blanks below, enter the letter(s) of the arrow(s) that complete each sentence.



1) Arrow(s) _________ represent(s) R_x
2) Arrow(s) _________ represent(s) l_x
3) A tradeoff between arrow(s) ________ would be a Williams' trade-off.

Parental Investment Theory & Williams' Model

$R_x(E) = P(E) + F(E)$

define: $E \equiv$

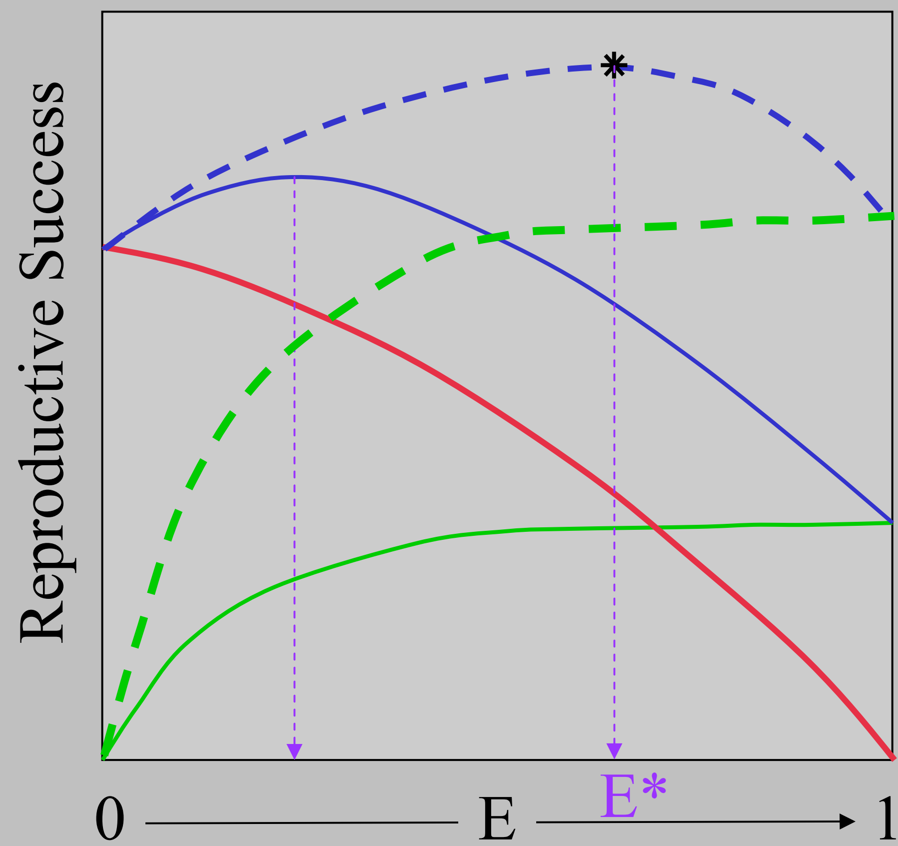
$(1\text{-}E) \equiv$

$R_x(E) \equiv$

$P(E) \equiv$

$F(E) \equiv$

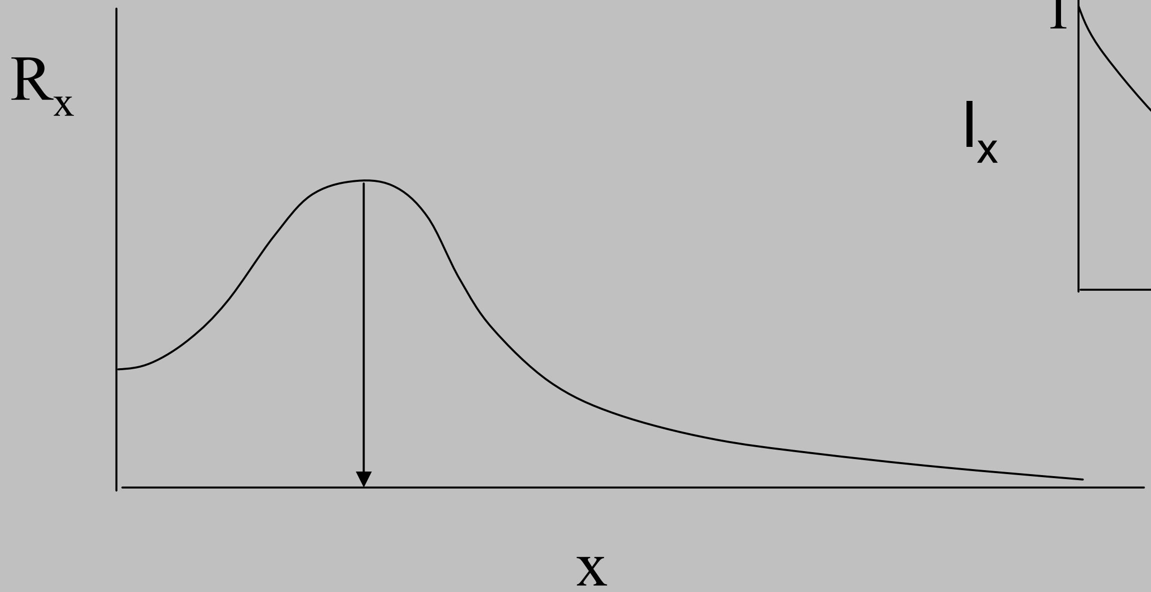
As $E\uparrow$, $P(E)\uparrow$, $F(E)\downarrow$

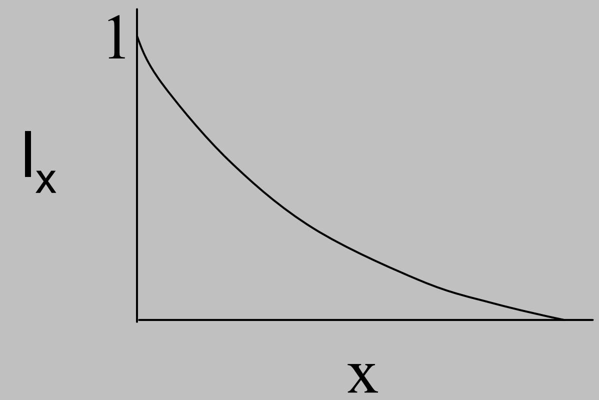


Life tables

- go to homework
- go to lecture notes

l_x & R_x as x ↑





Why does Rx increase as x approaches age of first reproduction?
Why does Rx decrease after age of first reproduction?
Where is selection strongest? Why?

Senescence

Two hypotheses:

1. Medwar's "Mutation Accumulation"
   - age-specific intensities of selection
   - (note: accumulation in population, not individuals)
2. Williams' "Antagonistic Pleiotropy"
   - specific example with fruit flies – correlated response
   - tradeoffs here

Population dynamics - overview

density INdependent

- Geometric $\boxed{N_t = N_0 \lambda^t}$
- Exponential $\boxed{N_t = N_0 e^{rt}}$ $\boxed{dN/dt = rN}$

density DEpendent

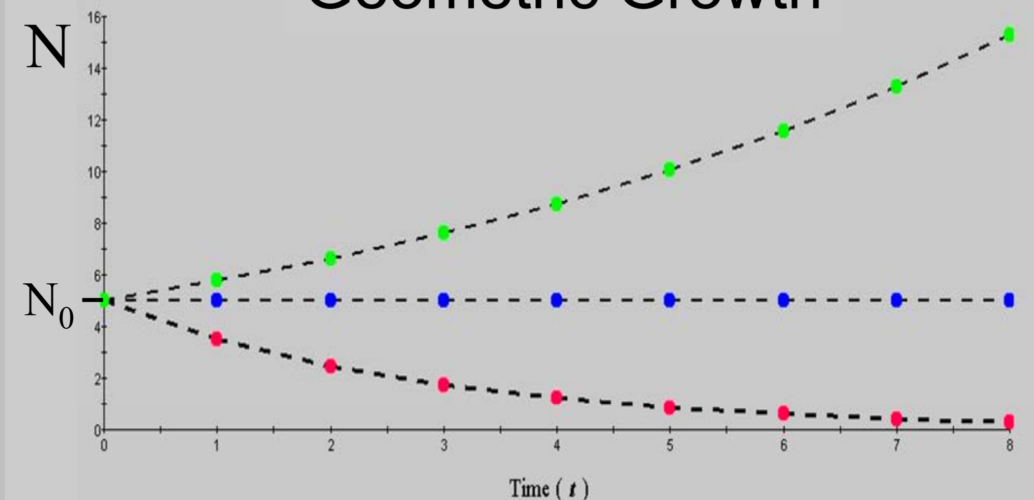
- Logistic

$$\frac{dN}{dt} = r_0 N \left(\frac{K - N}{K} \right)$$

Density–Independent Growth Models

$$N_t = N_0 \lambda^t$$

Geometric Growth



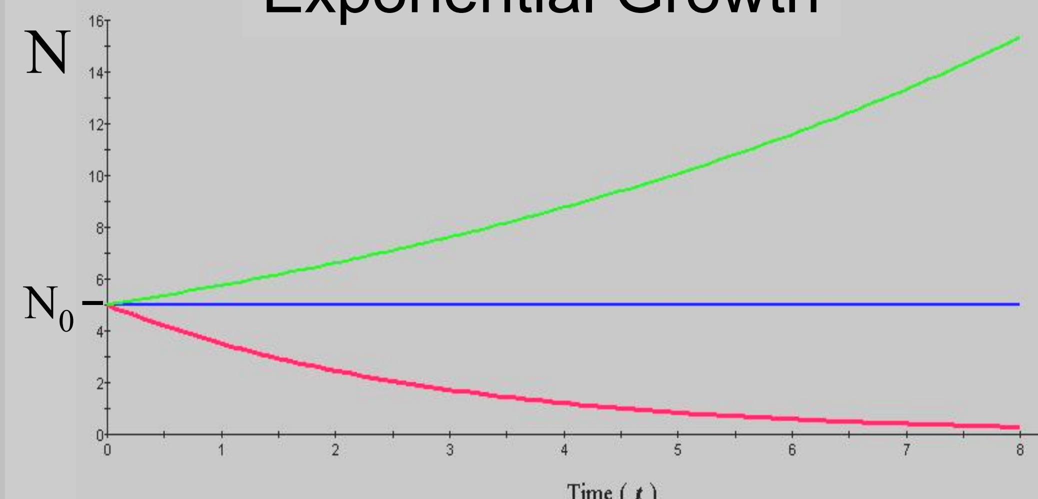
$\lambda > 1$

$\lambda = 1$

$\lambda < 1$

$$N_t = N_0 e^{rt}$$

Exponential Growth



$r > 0$ $(e^r > 1)$

$r = 0$ $(e^r = 1)$

$r < 0$ $(e^r < 1)$

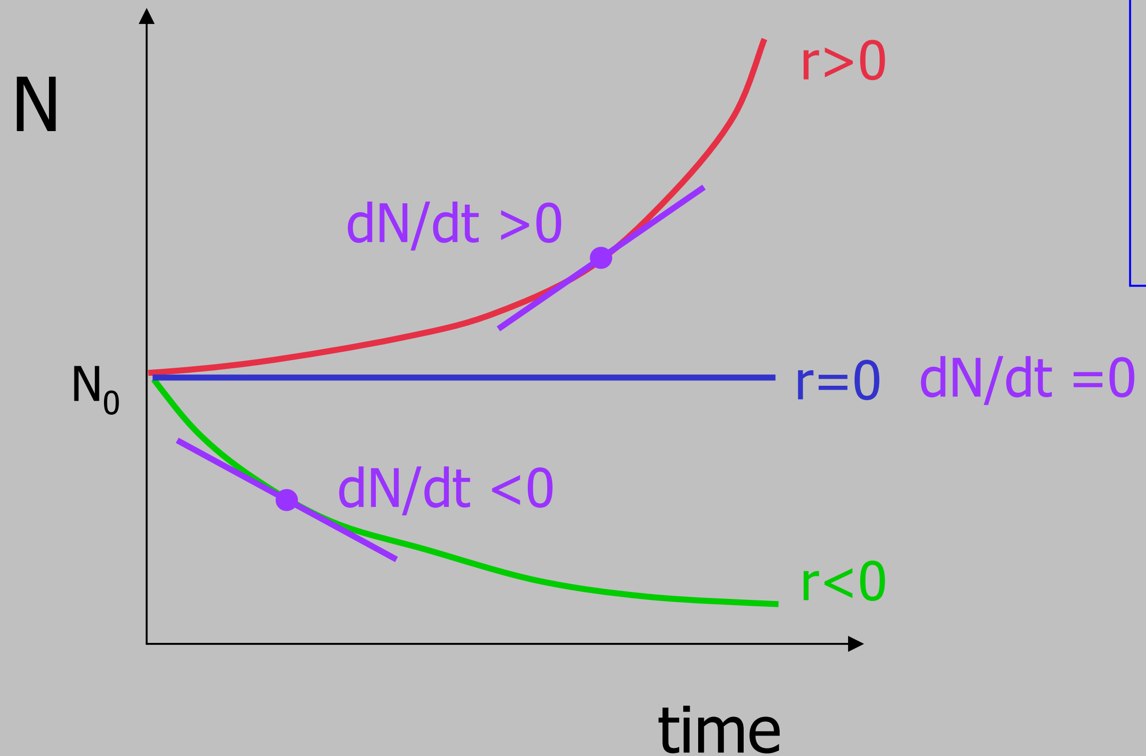
Exponential Growth Model (still density INdependent)

Integral form

$N_t = N_0 e^{rt}$

Derivative form

$dN/dt = rN$



dN/dt

Instantaneous slope at any time t

dN/dt can change but *r* is constant

r is independent of N

Density-DEPENDENT Growth - the Logistic model

Exponential Growth

$$\frac{dN}{dt} = rN$$

Logistic Growth

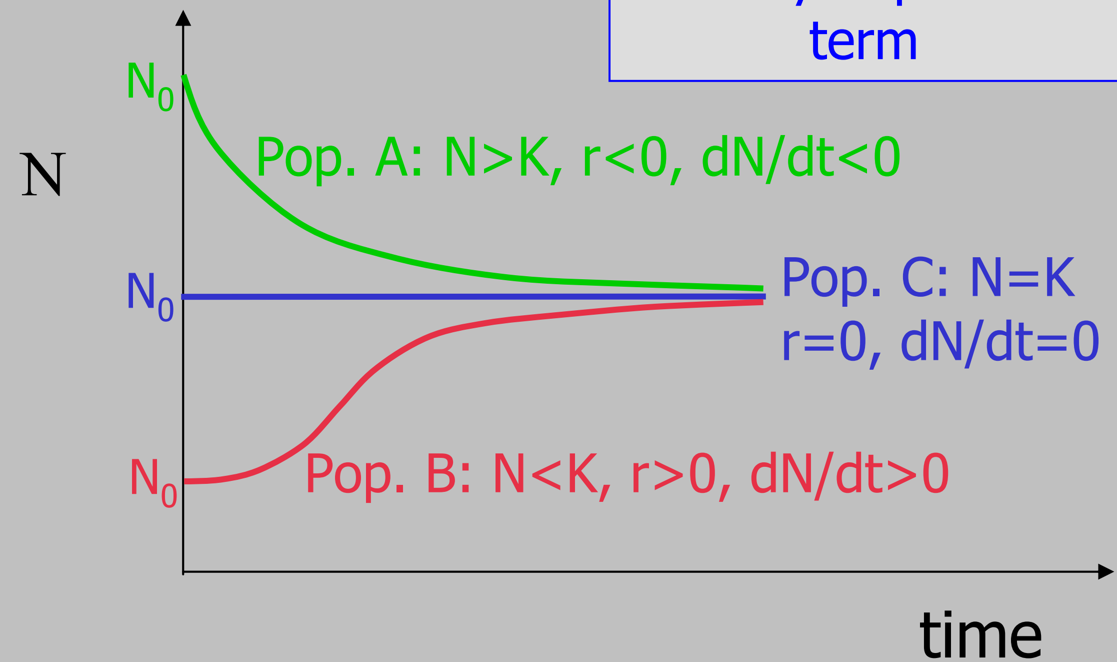
$$\frac{dN}{dt} = r_0 N \left(\frac{K - N}{K} \right)$$

$r_0 > 0$, constant

Density-dependent term

$$r = r_0 \left(\frac{K - N}{K} \right)$$

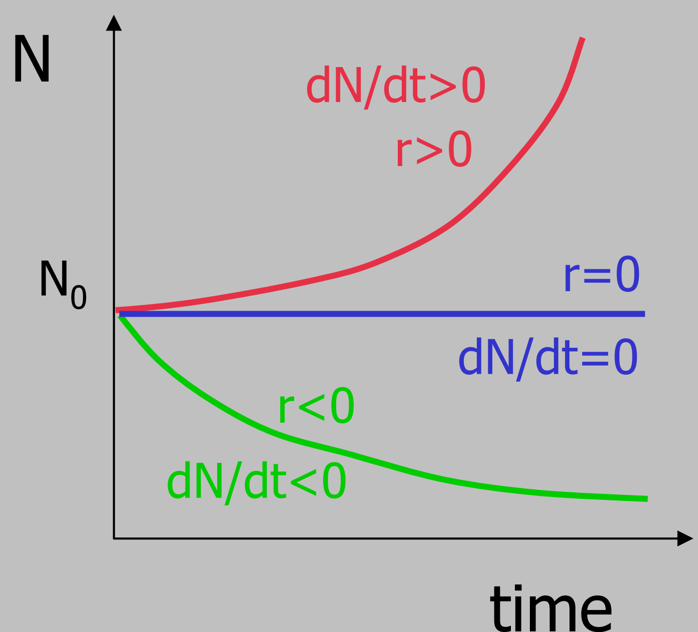
"effective r" is dependent on N



Density-DEPENDENT Growth - the Logistic model

Exponential Growth

$$\frac{dN}{dt} = rN$$

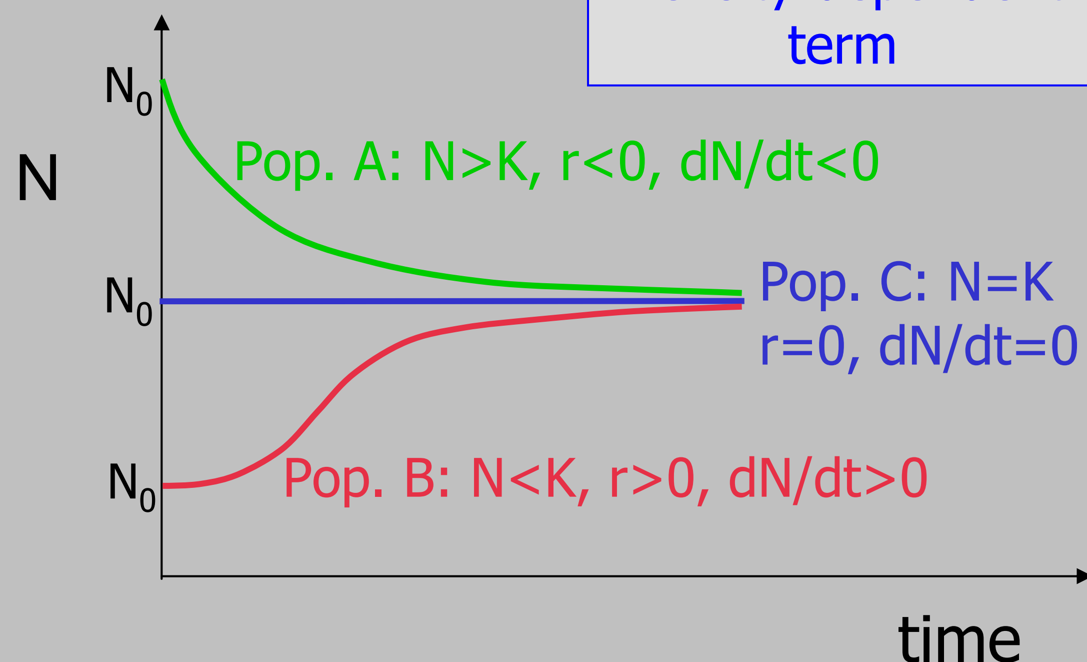


Logistic Growth

$r_0 > 0$, constant

$$\frac{dN}{dt} = r_0 N \left(\frac{K - N}{K} \right)$$

Density-dependent term



Logistic Growth – from Populus