30. Population Growth and Regulation *(Chapter 51, 52)*

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I. Introduction to Ecology *(1193-1195, 1222-1225)*

# A. Definition

-Ecology is the study of all the relationships between organisms and their environments

-Abiotic (physical)

-Biotic (other organisms)

B. Four Perspectives on Ecology

-Biossphere:

-Ecosystems

-ecological communities and environment

-Community Enology

-Groups of populations that live together

-Have emergent properties that individual properties do not have

-Population Ecology

-Interactions between populations/interbreeding

-Physiological Ecology

C. Central Questions in Ecology

-What limits the sizes and geographical distribution of species?

-Why are there so many species and how are they organized into communities?

-How do human activities disrupt…

-How do we preserve what’s left

II. Unlimited Population Growth *(1232-2333)*

A. Reproduction

B. Geometric Population Growth

-Bacterial cell division- every 20 min a bacterium will undergo binary fission and produce two daughter cells

-N = population size

-Delta N = change in N

-t = time interval

-At t = 0, N = N\_0

-At t = 1, N = N\_1

-N\_t = population size at some future time

-R\_0 = replacement rate 🡪 number of offspring an individual leaves behind

-R for bacteria is 2 because they undergo binary fission (R\_0 =2)

-At t = 0, N\_0 = 1

-At t = 1, N\_0 = 2

-At t = 2, N\_0 = 3

-N\_1 = R\_0\*N\_0

-N\_2 = R\_0\*N\_1 = R\_0\*R\_-\*N\_0

-N\_3 = R\_O\*N\_2=R\*\_0\*R\_0\*R\_0\*N\_0

-N\_t = N\_0\*R\_0^t

1. Simplest case: bacterial division

2. Graphical representation

3. Mathematical representation

C. Exponential Population Growth

1. Births and deaths

2. Per capita birth and death rates

-Delta N / time = B – D

-B -absolute number of births

-Absolute number of death

-Births and deaths expressed as per capita rate 🡪 per individual per unit time

b = per capita birth rate = B/N

d = per capita death rate = D/N

B = b\*N

D = d\*N

Chane in population over a time

Delta N/Delta T = B – D = bN – dN = N(b - d)

(b - d) = r

r is that per capita populiton growth rate

dN/dt=delta N/delta T=rN

-World population in 1959

N = 3\*10^9

36 births/1000/yr b = .036/yr

19 death/100/year d = .019/yr

r = b – d = (.036 - .019)/yr = .017/yr

delta N from 1959-1960

delta N/yr = r N = (.017)\*(3\*10^9) = 51\* 10^6

-if r > 0, N increase

-if r < 0 N decrease

-if r = 0 ZPG zero population growth

-Under ideal conditions r = r\_max

D. Examples from Human Population Studies

E. Per Capita Growth Rate (*r*) as a Population Characteristic

1. Variations in *r*

2. The intrinsic rate of increase (*r*max)

F. Effects of r on N

III. Limited Population Growth *(1234-1240)*

A. Resource Limitation

1. Resources that can be depleted

-Food, nest sites, refuge from predators

2. Crowding

-Large population 🡪 resource limitation

-Function of population density

- N/area or N/Volume (aquatic)

B. Density‑Dependent Responses

-If density is high, the availability of resources decreases which leads to a decrease in the per capita birth rate and increase in the per capita death rate. The value of r declines. r may go to zero 🡪 per capita birth and death rate are equal.

C. Logistic Population Growth

1. Sigmoid (= logistic) growth curve

2. Carrying capacity and population regulation

3. Growth of introduced populations

-Carrying Capacity = k

-Max population size that an environment can support

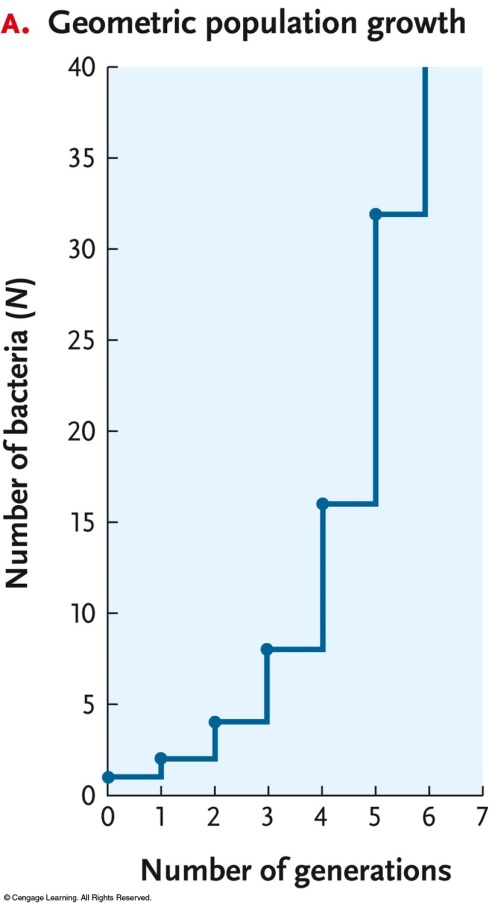
-Population regulation

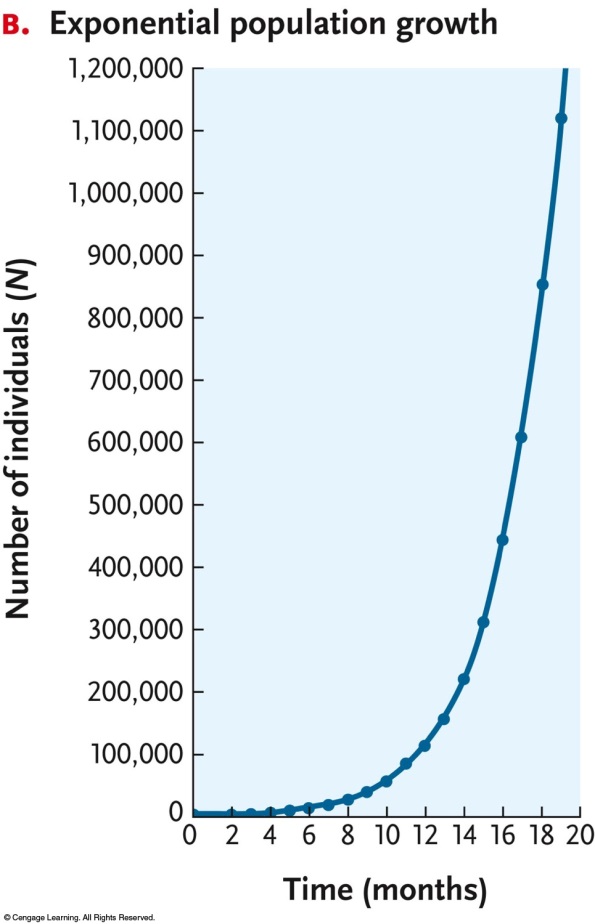
D. Interactions Causing Density‑Dependent Population Regulation

1. Predation

2. Competition

30-1





30-2

