

5.1-2 - Populations

Before & After Wolves

Restoring wolves to Yellowstone after a 70-year absence as a top predator—especially of elk—set off a cascade of changes that is restoring the park's habitat as well.

YELLOWSTONE WITHOUT WOLVES 1926-1995

ELK overbrowsed the stream side willows, cottonwoods, and shrubs that prevent erosion. Birds lost nesting space. Habitat for fish and other aquatic species declined as waters became broader and shallower and, without shade from streamside vegetation, warmer.

ASPEN trees in Yellowstone's northern valleys, where elk winter, were seldom able to reach full height. Elk ate nearly all the new sprouts.

COYOTE numbers climbed. Though they often kill elk calves, they prey mainly on small mammals like ground squirrels and voles, reducing the food available for foxes, badgers, and raptors.

ART BY FERNANDO G. BAPTISTA, NO STAFF;
AMANDA HOBBS, NO STAFF
SOURCES: ROBERT L. BISHOP AND
WILLIAM J. PIPPLE, OSISCH STATE
UNIVERSITY; DOUGLAS W. SMITH,
YELLOWSTONE NATIONAL PARK



YELLOWSTONE WITH WOLVES 1995-PRESENT

ELK population has been halved. Severe winters early in the reintroduction and drought contributed to the decline. A healthy fear of wolves also keeps elk from lingering at streamside, where it can be harder to escape attack.

ASPENS The number of new sprouts eaten by elk has dropped dramatically. New groves in some areas now reach 10 to 15 feet tall.

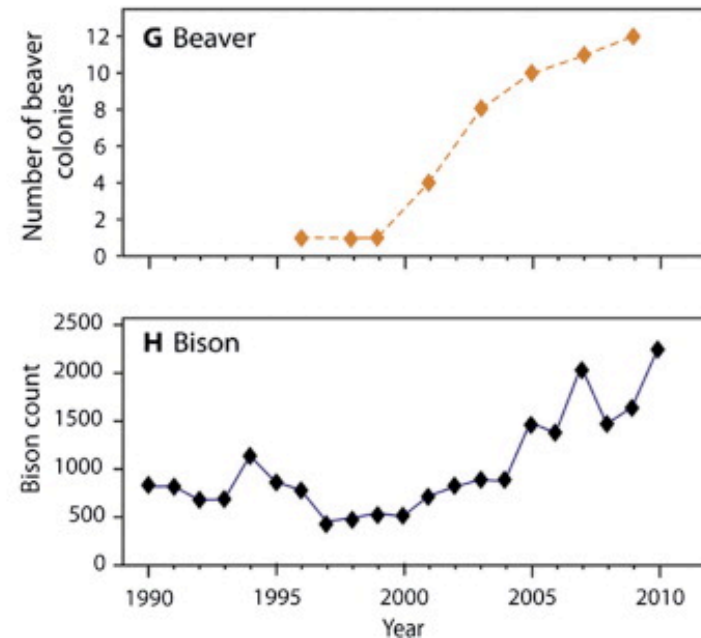
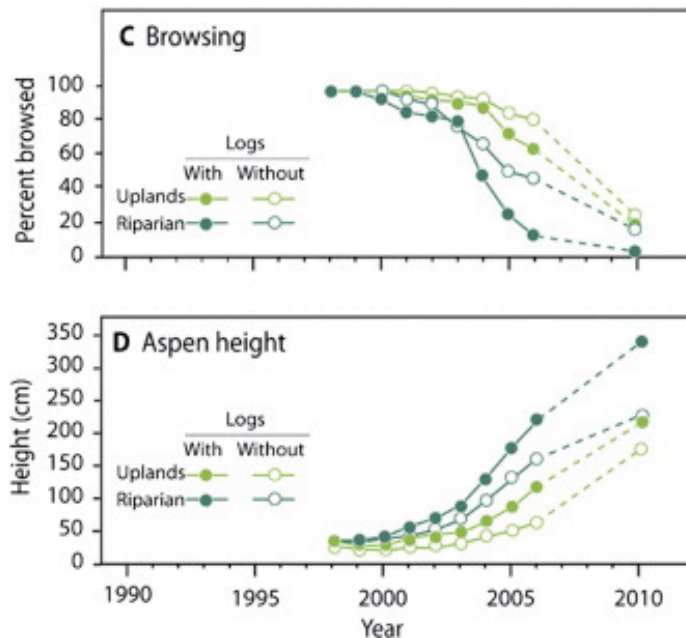
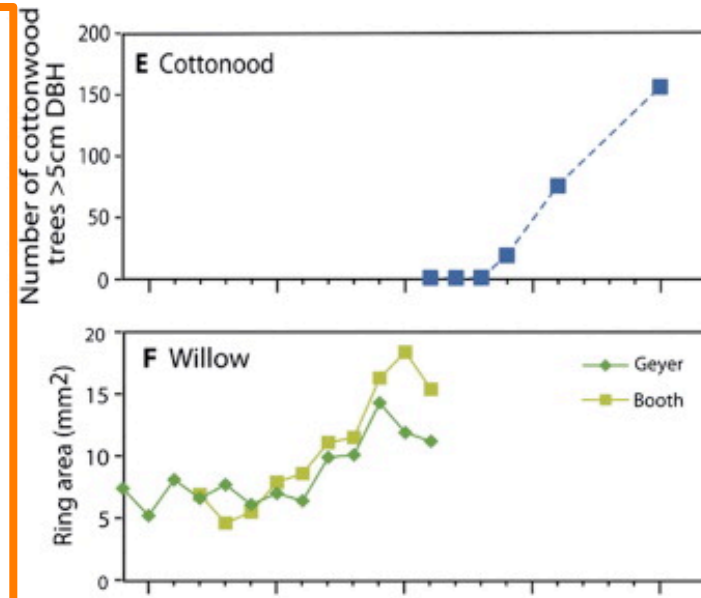
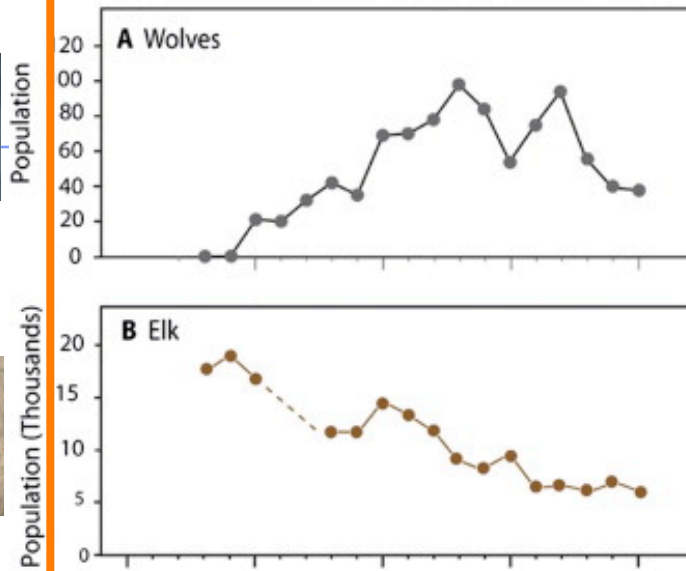
COYOTES Wolf predation has reduced their numbers. Fewer coyote attacks may be a factor in the resurgence of the park's pronghorn.

WILLOWS, cottonwoods, and other riparian vegetation have begun to stabilize stream banks, helping restore natural water flow. Overhanging branches again shade the water and welcome birds.

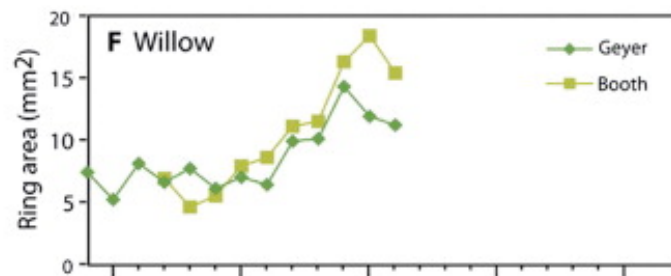
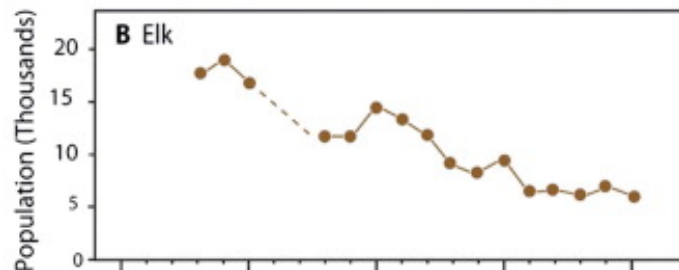
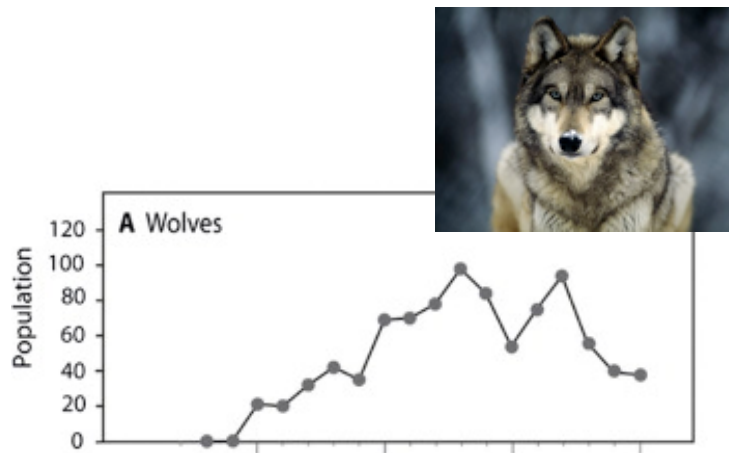
BEAVER colonies in north Yellowstone have risen from one to 12, now that some stream banks are lush with vegetation, especially willows (a key beaver food). Beaver dams create ponds and marshes, supporting fish, amphibians, birds, small mammals, and a rich insect population to feed them.

CARRION Wolves don't cover their kill, so they've boosted the food supply for scavengers, notably bald and golden eagles, coyotes, ravens, magpies, and bears.





Yellowstone Before and After Wolves



Objectives

- Examine the 3 **key features** of a population.
- Contrast **exponential growth** and **logistic growth**.
- Differentiate ***r*-strategists** from ***K*-strategists**.

Population

- A **population** consists of all the individuals of ONE species that live together in one place and use the same resources.



- What factors affect the growth of a population? How will a population change?...
- **Population ecology**

3 Key Features of Populations

- 1) **Population Size** – the number of individuals in a population



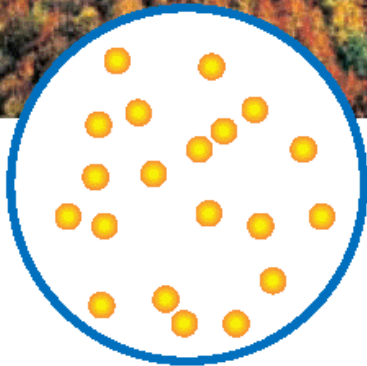
2) **Population density** – the number of individuals that live in a given area.



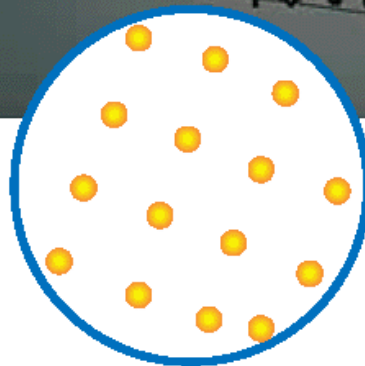
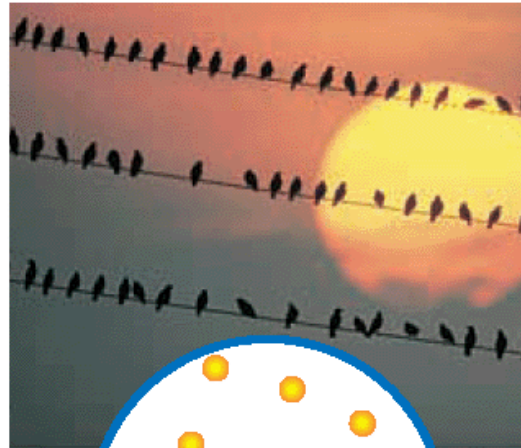
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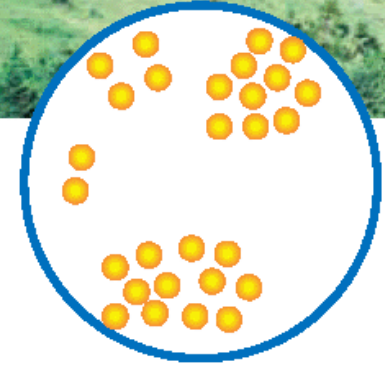
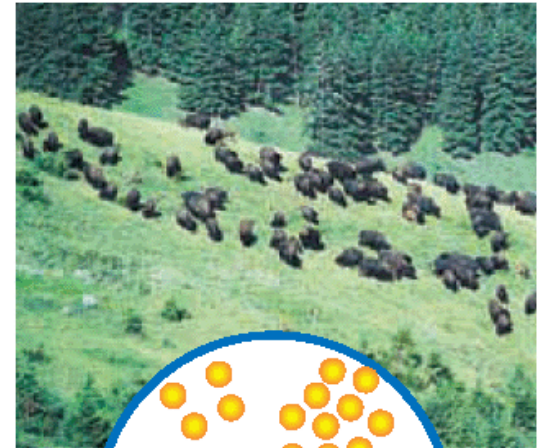
3) **Dispersion** – how individuals of the population are arranged in space



Pine trees in a *random distribution*



Birds in an *even distribution*



Buffalo in a *clumped distribution*

Factors that Affect Population Size

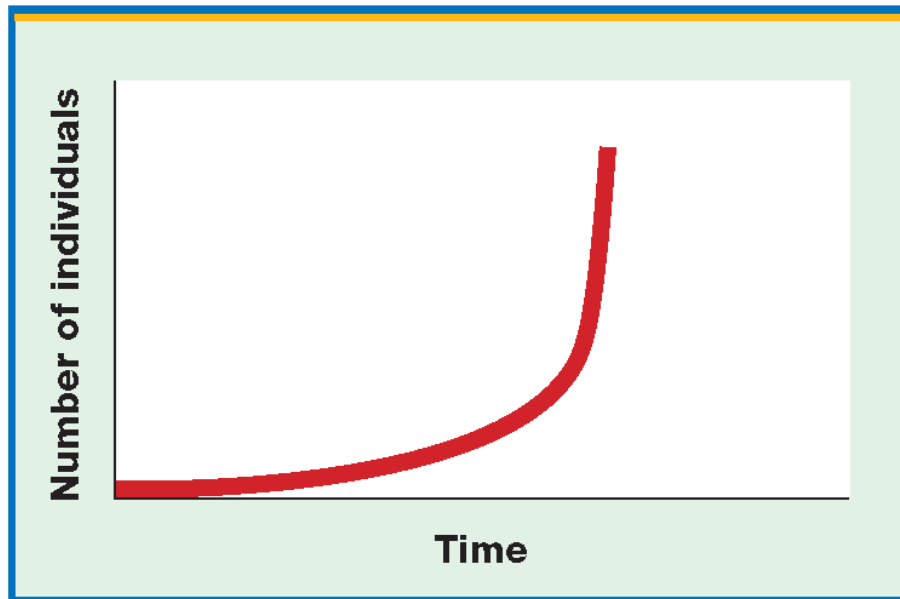
- **Births**
- **Deaths**
- **Immigration** – movement of individuals INTO a population
- **Emigration** – movement of individuals OUT of a population



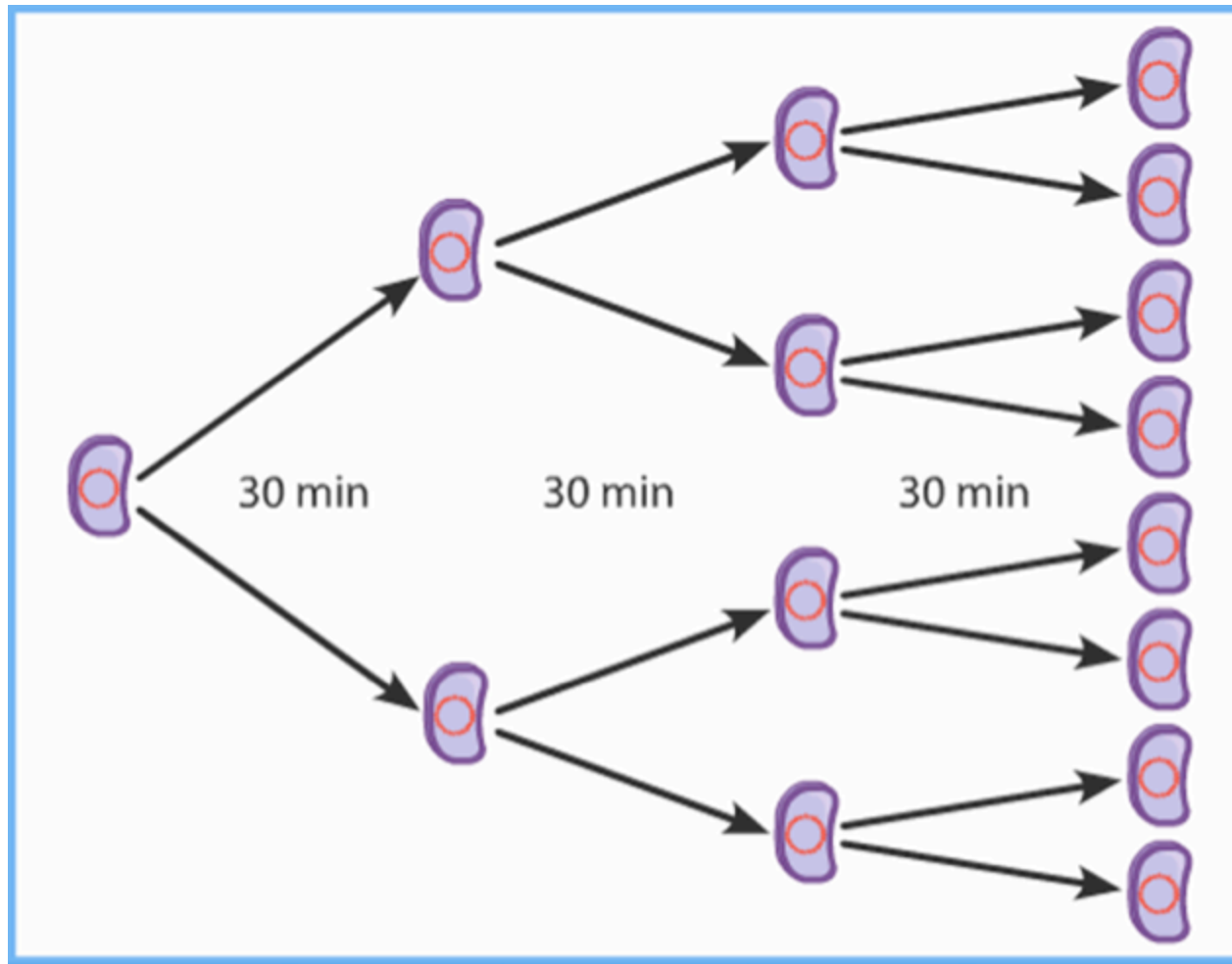
$$\text{Change in population size} = \text{Births} + \text{Immigration} - \text{Deaths} - \text{Emigration}$$

Exponential Growth Model

- A population of a few individuals in an environment with unlimited food, space, no disease or predator will... increase over time.
- 1) **Exponential growth curve (J-curve)** is a model in which a population **grows RAPIDLY** with **unlimited** resources.



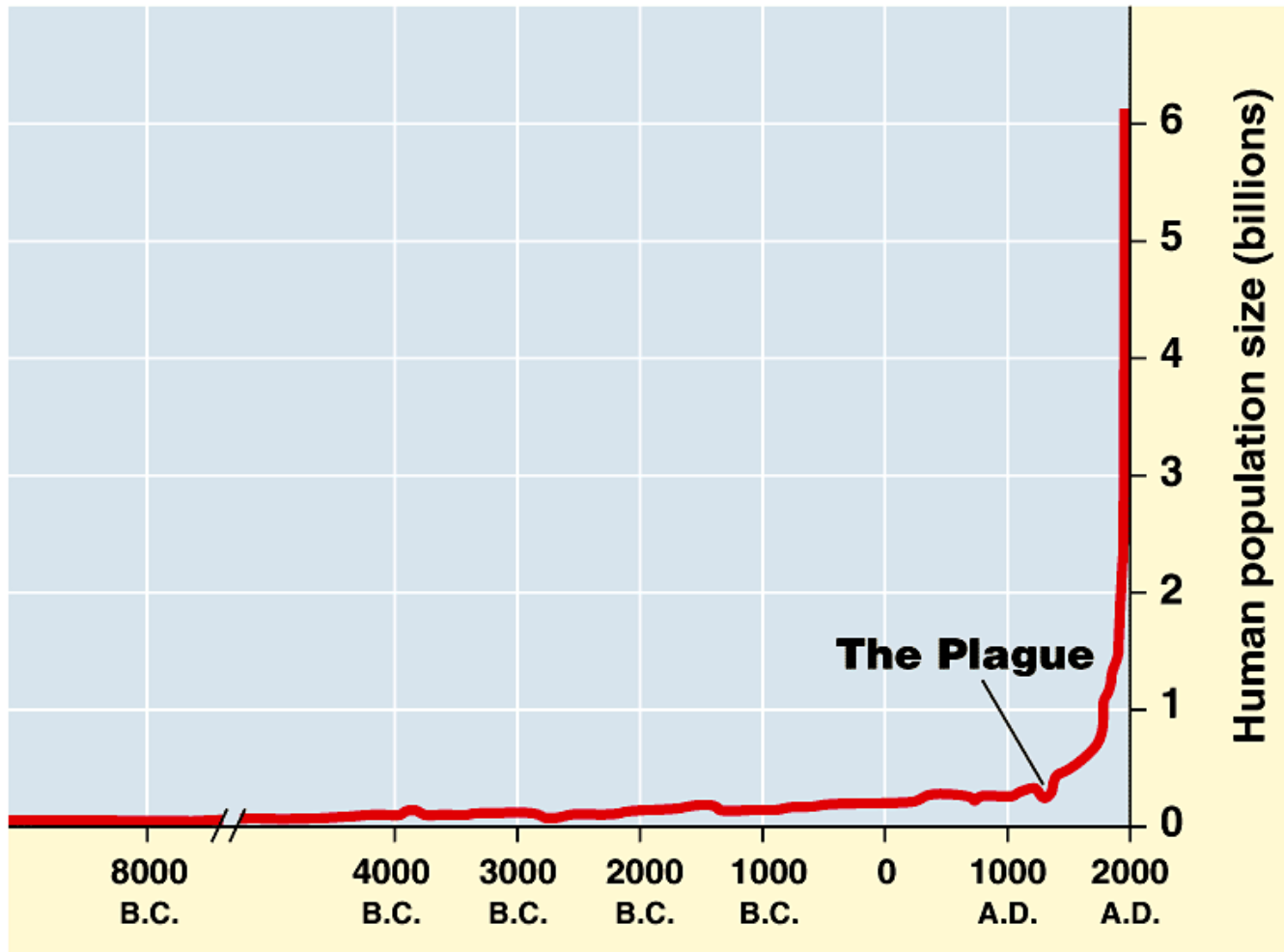
Exponential Growth of Bacteria



Bacterial Exponential Growth

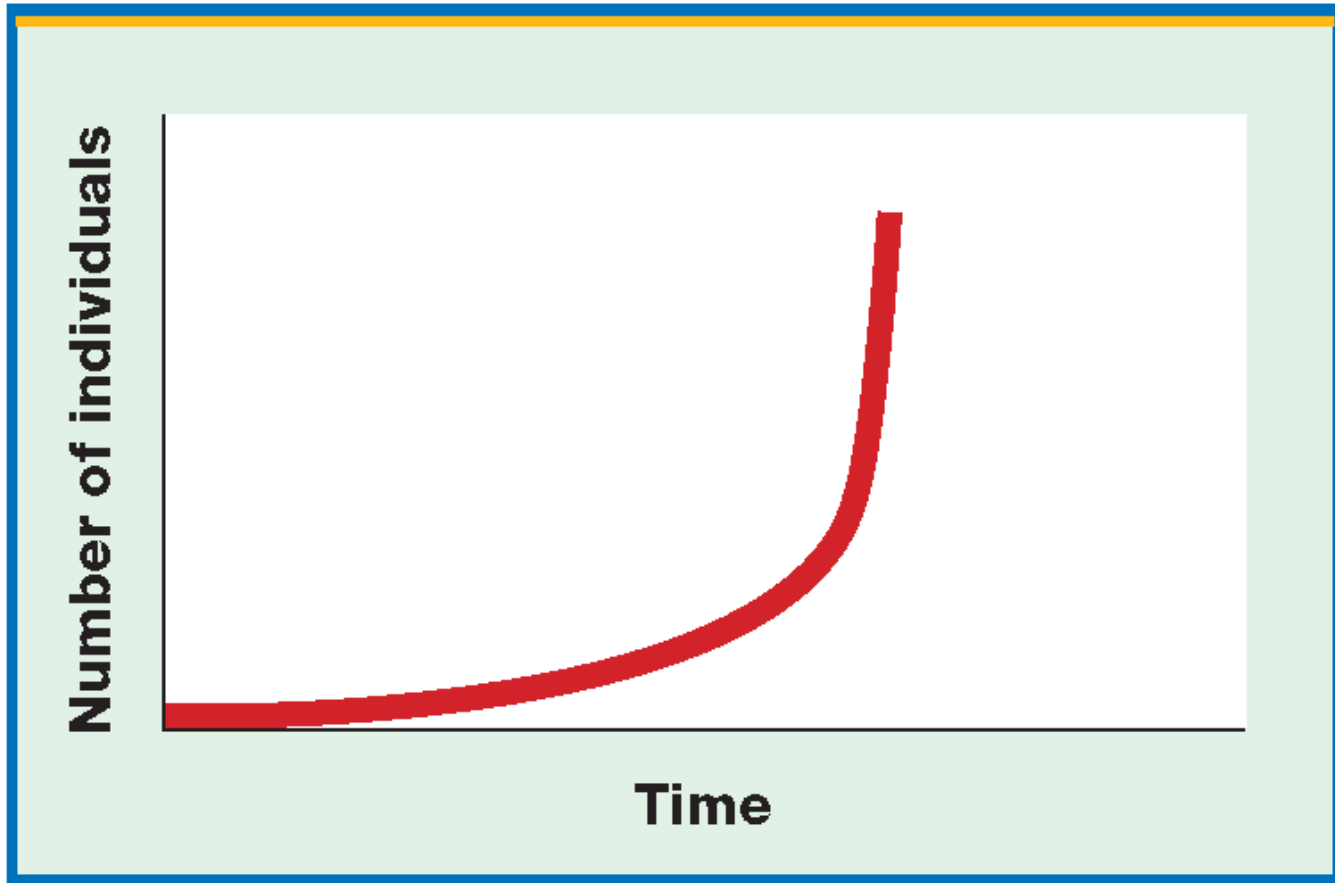


Human Population Growth



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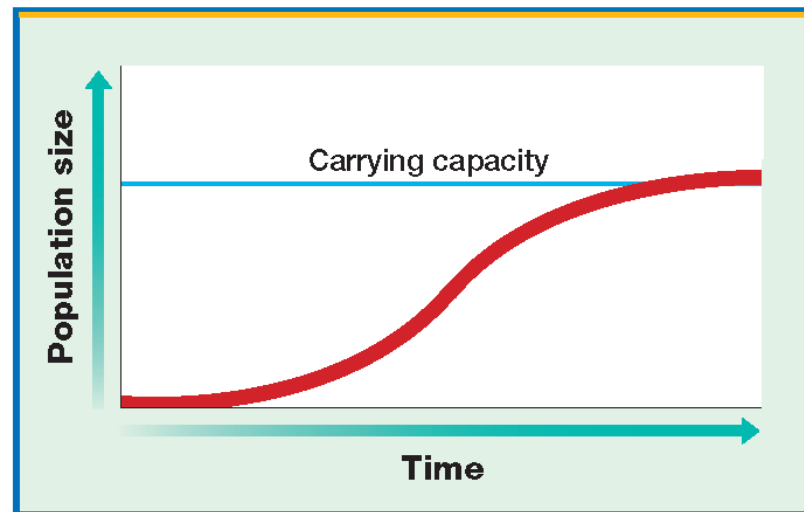
Exponential Growth Model



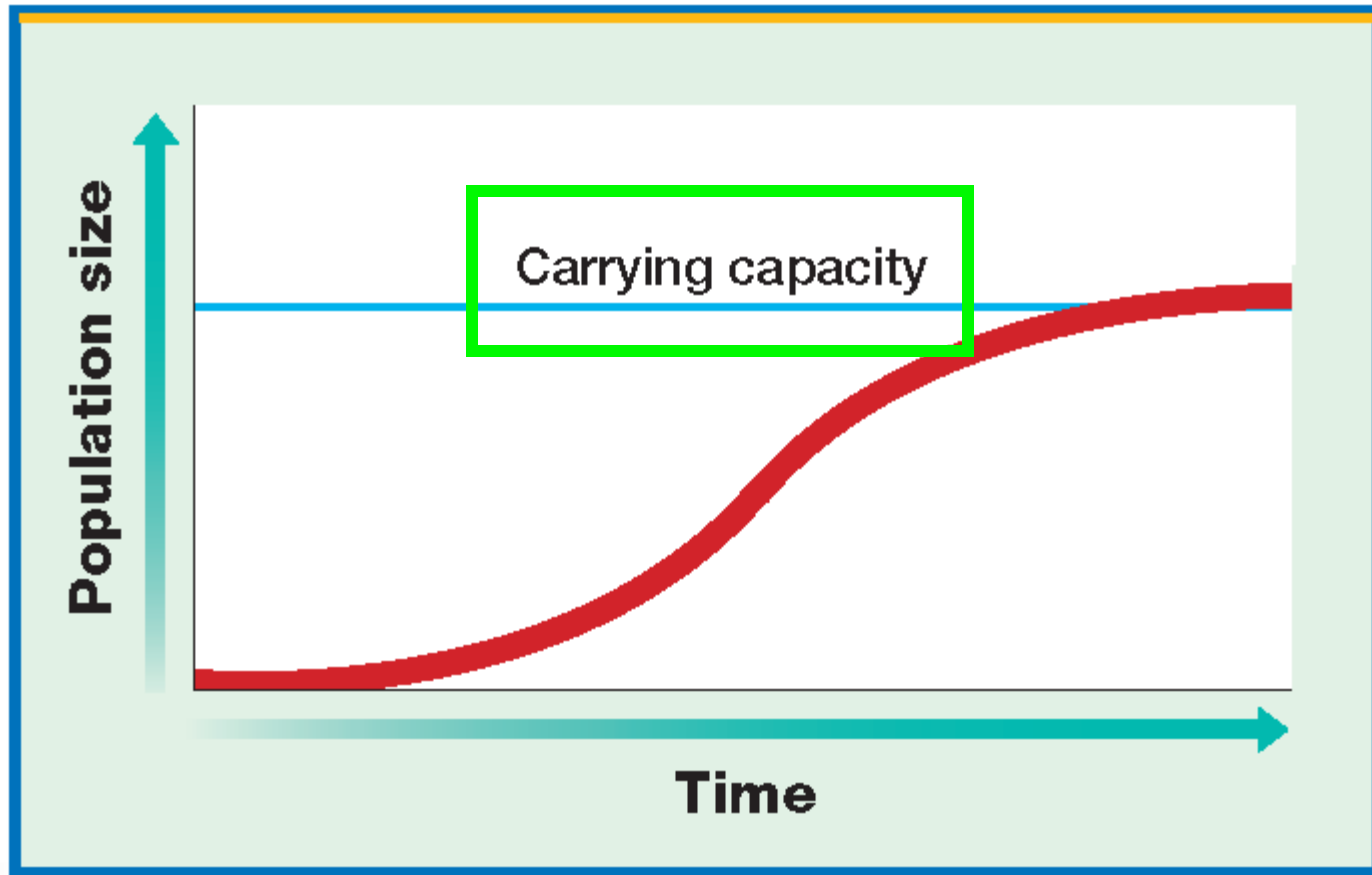
Logistic Growth Model

- Realistically, population size depends on resources or **density-dependent factors** (competition, predation, parasitism, disease, etc.)
- 2) The **logistic growth curve (S-curve)** – (exponential) growth is limited by **density-dependent factor(s)**.
- The **population size** that an environment can sustain is called the **carrying capacity (K)**.

Drought is
**density-
independent
factor.**



Logistic Growth Model



Growth Patterns in Real Populations

- Environmental conditions (weather) and human disturbances are **density-independent factors**.
- The growth of many plants and insects is often described by an **exponential growth** model.
- The population growth of slower growing organisms is better described by the **logistic growth** model.

α. Rapid Growing Populations

- ***r*-strategists**
- Populations of bacteria, some plants, many insects (cockroaches, mosquitoes) grow exponentially when environmental conditions allow them to reproduce.
- When environmental conditions worsen, the population size drops quickly.



b. Slow Growing Populations

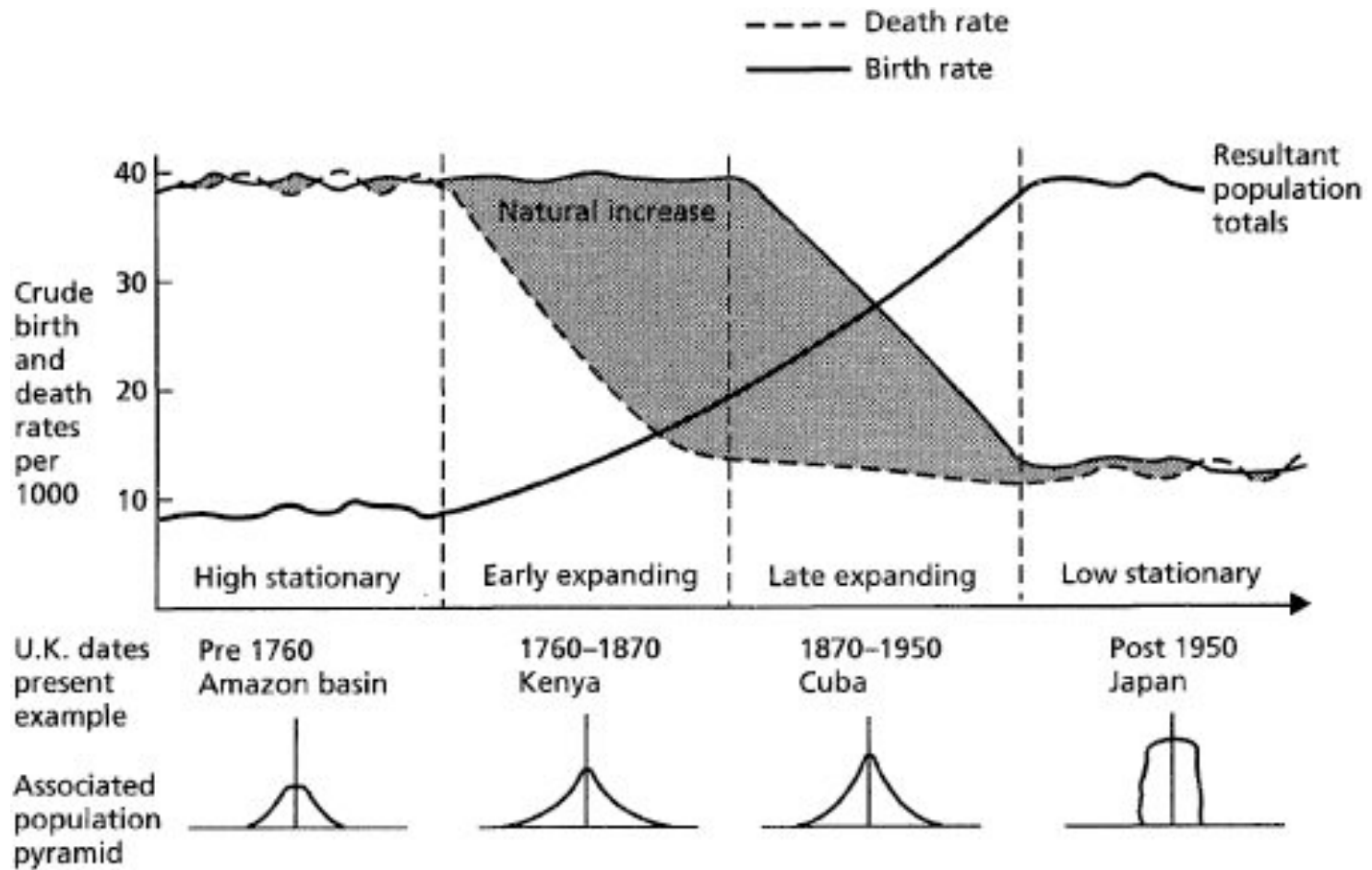


- Other organisms (whales, etc.) often have long life span, few young, slow maturing process and small populations.
- These species are called **K-strategists** because their population density is usually near the carrying capacity (K) of their environment.

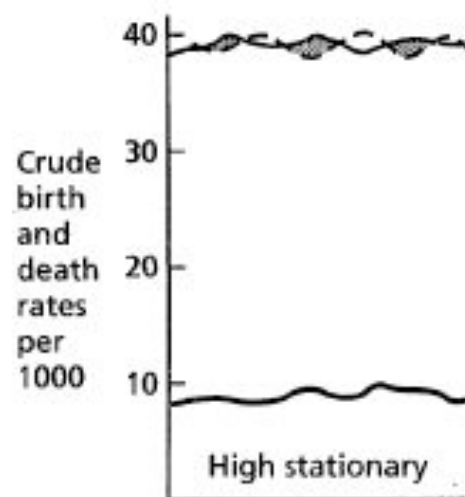
5.3 - Human Population Growth



Demographic Transition Model



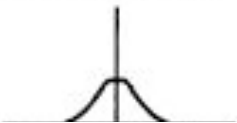
Stage 1 - High Stationary



U.K. dates
present
example

Pre 1760
Amazon basin

Associated
population



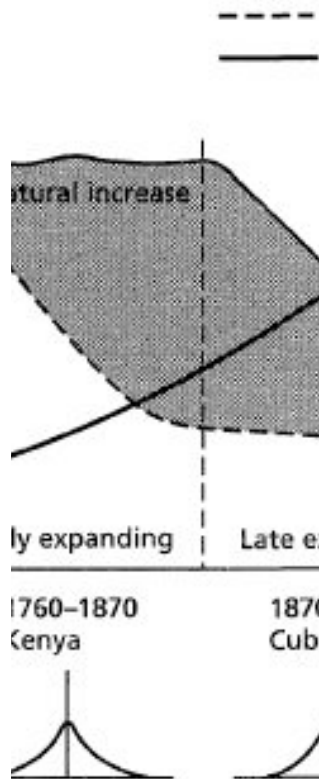
- Low population, increasing very slowly (if at all)
 - High birth rate
 - High death rate
- Ex: Ethiopia, Niger



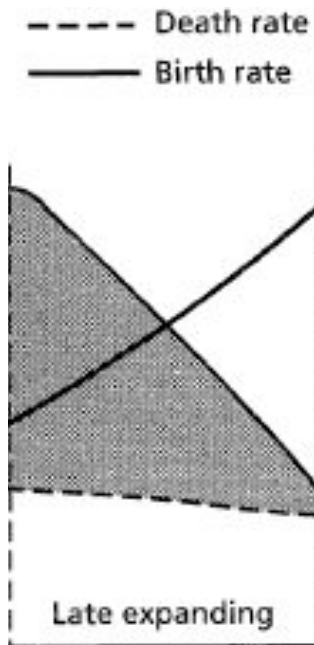
Stage 2 - Early Expanding

- Population growing at faster rate
- High but decreasing birth rate
- Decreasing death rate

Ex: Sri Lanka, Bolivia



Stage 3 - Late Expanding

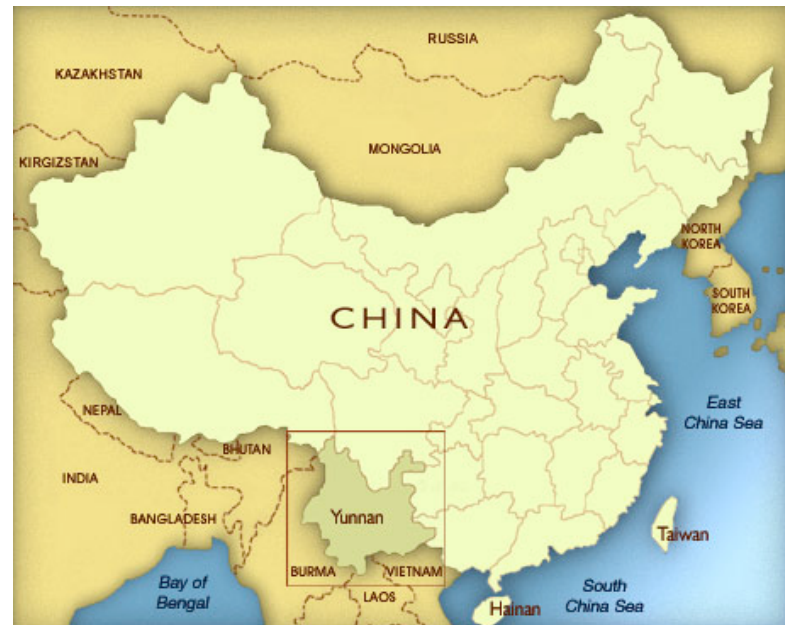


1870-1950
Cuba



- Population still increasing but rate slowing down
- Decreasing birth rate
- Low death rate

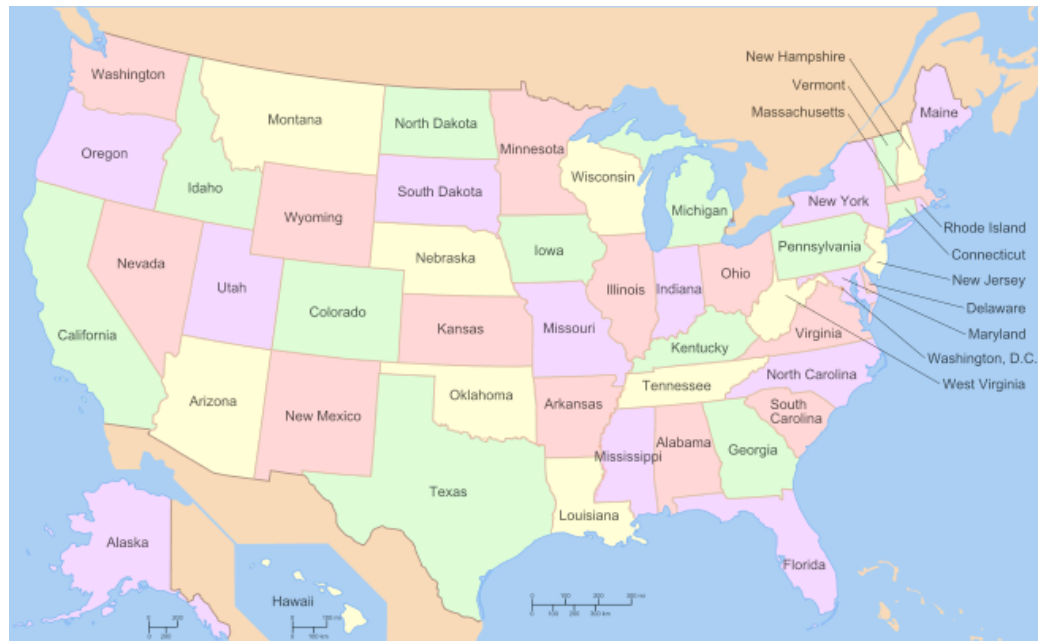
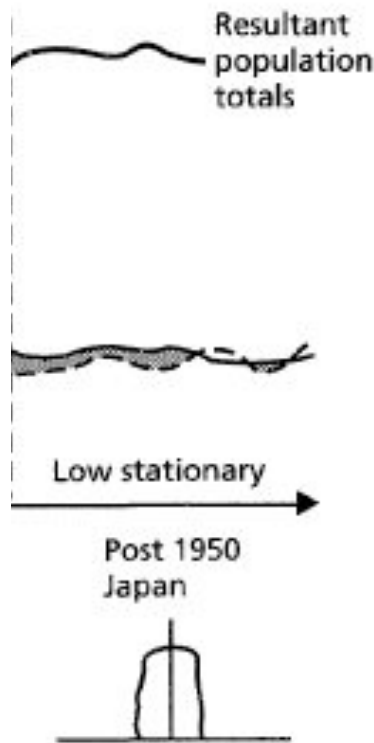
Ex: China



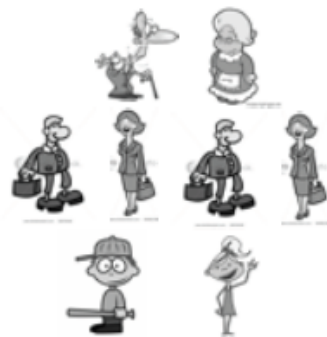
Stage 4 - Low Stationary

- High population, almost stable
- Low birth rate
- Low death rate

Ex: Canada, USA, Europe



Population growth momentum



Family A: 8 individuals



Family B: 8 individuals

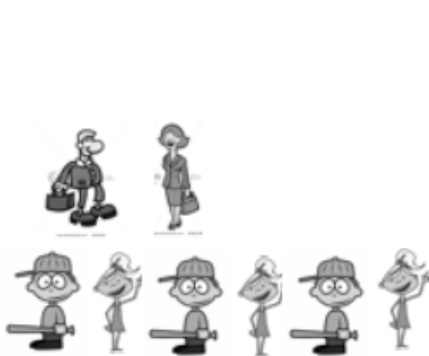
Population growth momentum



Family A: 8 individuals



Family A: 8 individuals



Family B: 8 individuals



Family B: 14 individuals

Population growth momentum



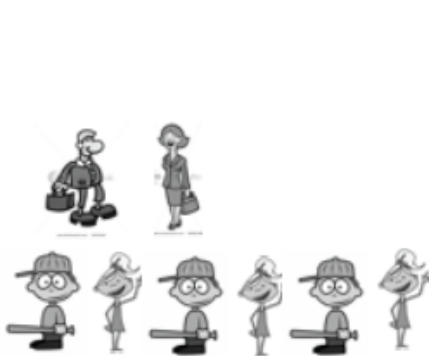
Family A: 8 individuals



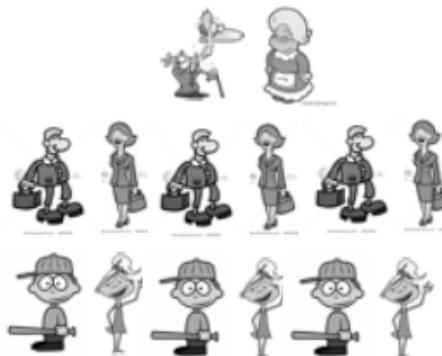
Family A: 8 individuals



Family A: 6 individuals



Family B: 8 individuals



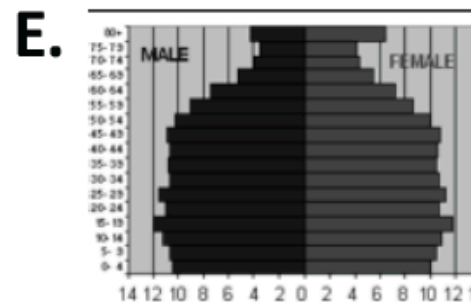
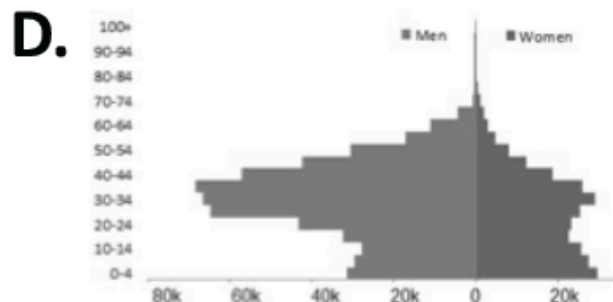
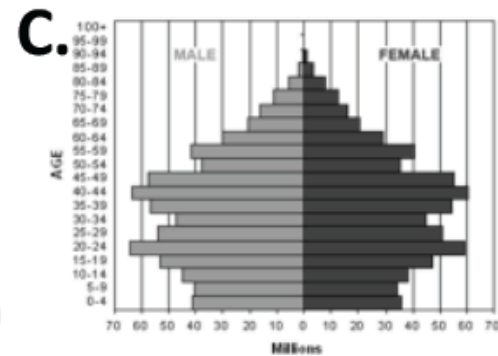
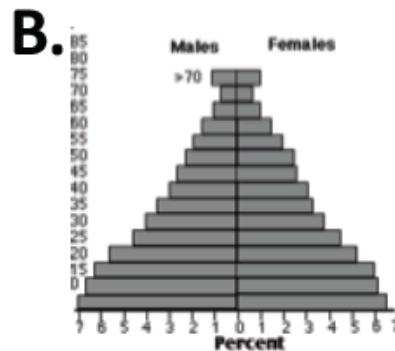
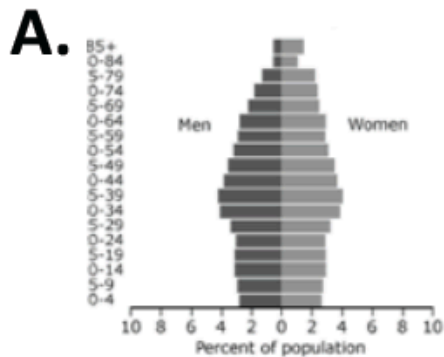
Family B: 14 individuals



Family B: 18 individuals

Question

Which country has rapid population growth?



Question

Which country is closest to zero population growth?

