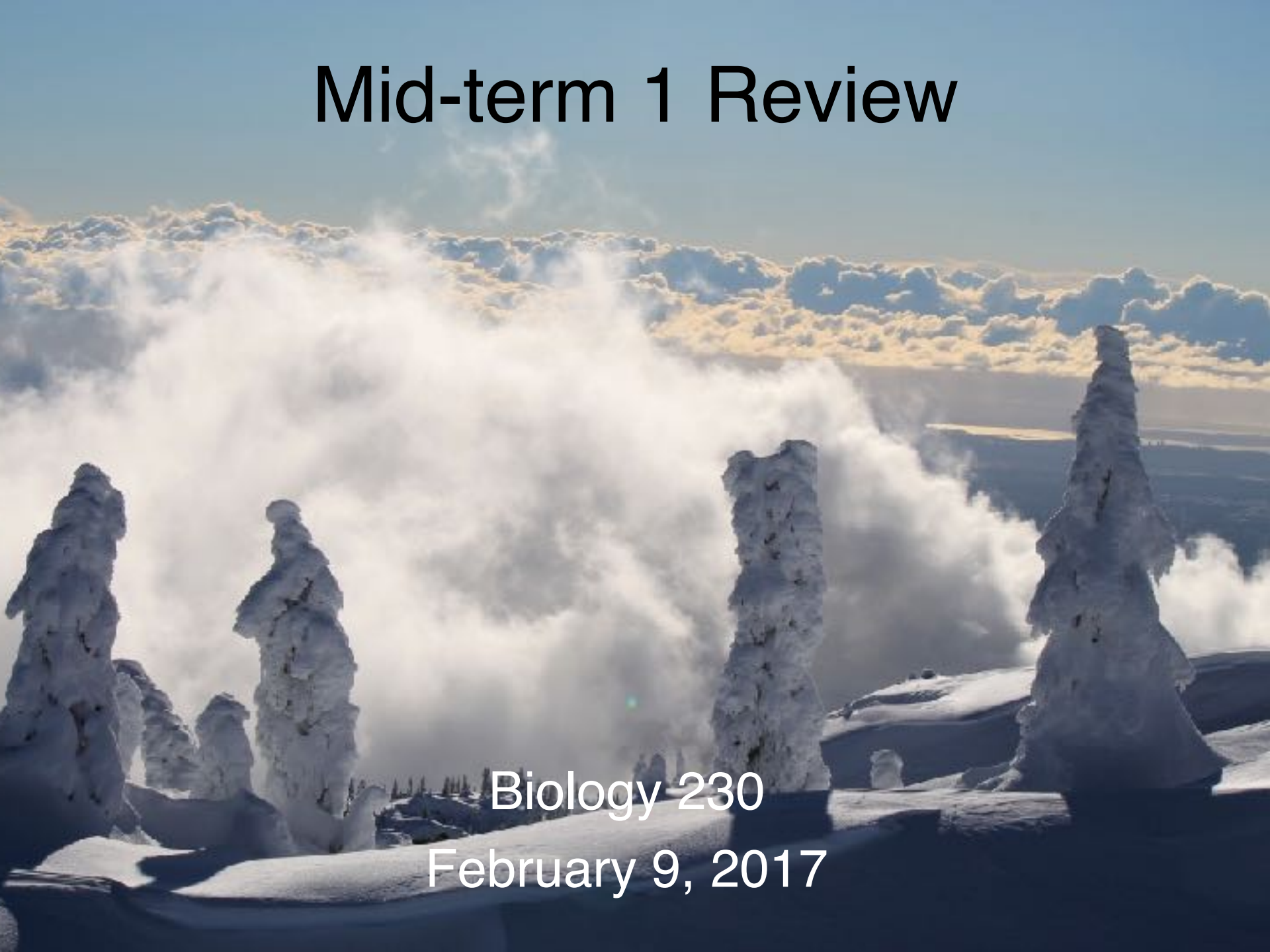
Mid-term 1 Review

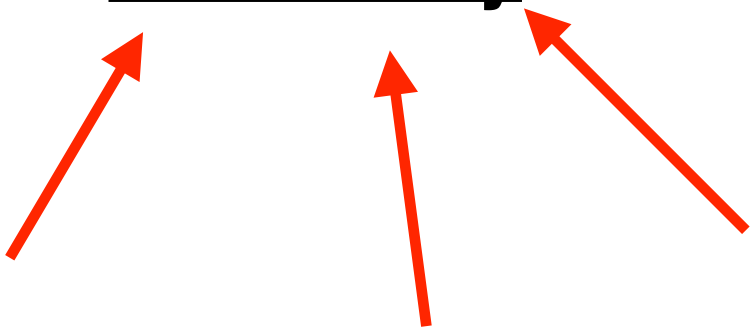


Biology 230

February 9, 2017

Mid-term 1

- Tuesday, Feb. 14
- In-class
- 60 minutes
- Non-graphing calculators only
- No regrades if written in pencil
- You are allowed a 8.5” x 11” cheat sheet
  - **1 side only**



Mid-term 1

- Office hours on Monday
  - 10-12 in Wesbrook 200

Population dynamics of invasive and native species on the Galapagos Islands

The Galapagos Islands have almost as many introduced species as native species. Many of the introduced species are invasive and are often either outcompeting native species or disturbing their habitat.

Introduced goats

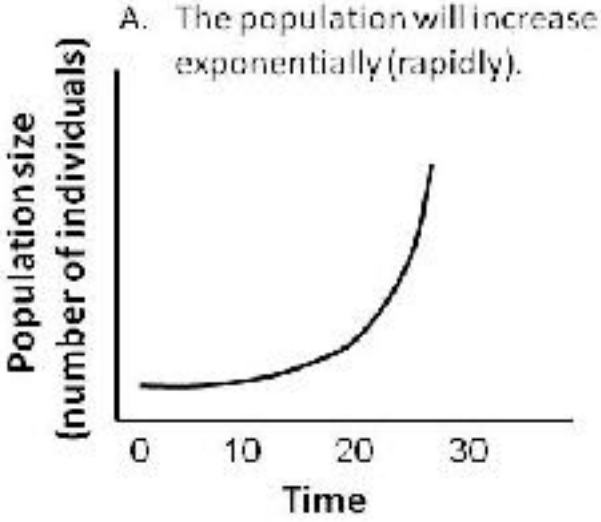
Native vermillion flycatcher

Native giant tortoise

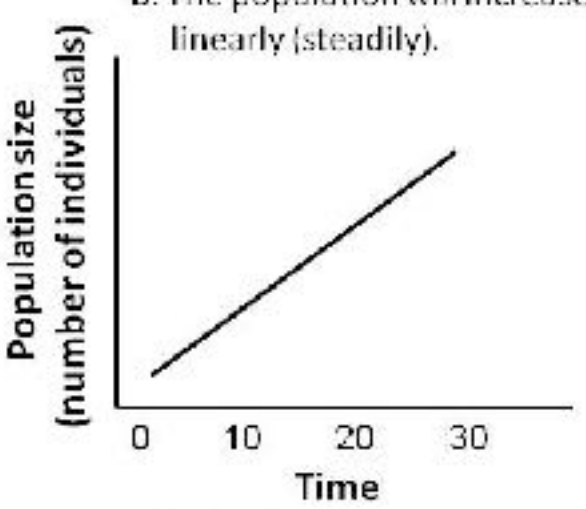
Native lava heron

1. Goats were introduced to a number of the Galapagos Islands several centuries ago. For the first 30 years after introduction, the goats lived under ideal conditions with unlimited space, unlimited resources and no predators. Which graph below shows how the goat population size would change during these 30 years?

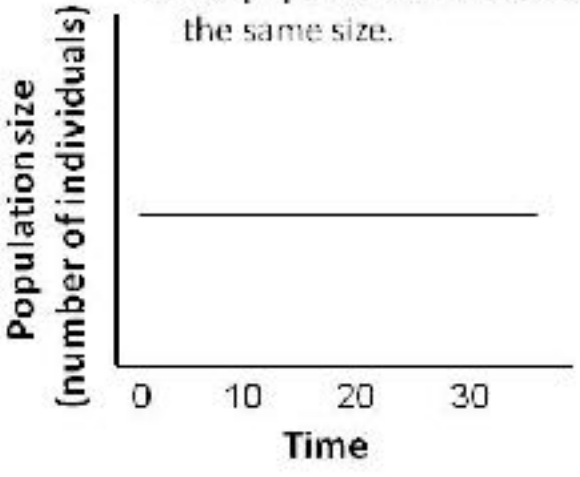
A. The population will increase exponentially (rapidly).



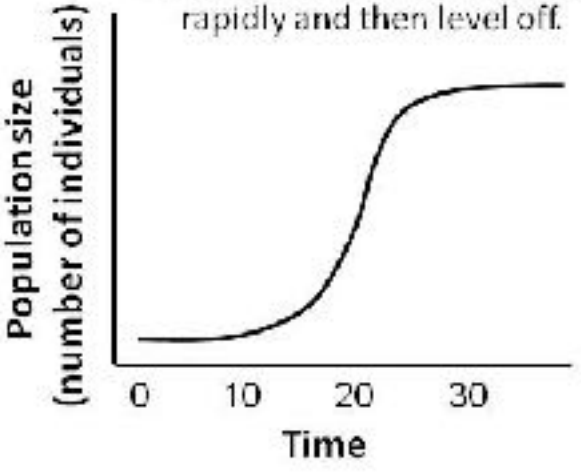
B. The population will increase linearly (steadily).



C. The population will remain the same size.



D. The population will first increase rapidly and then level off.



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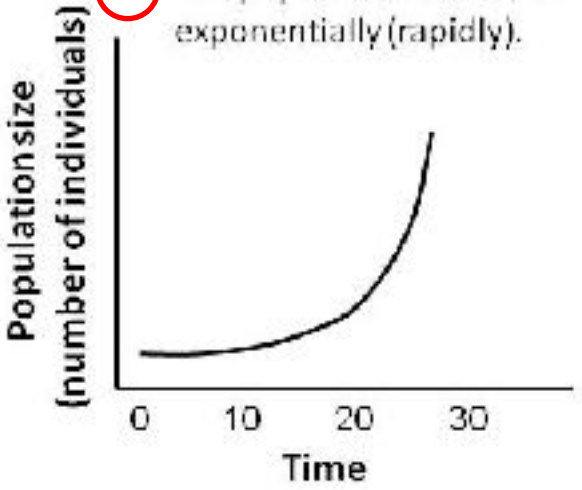

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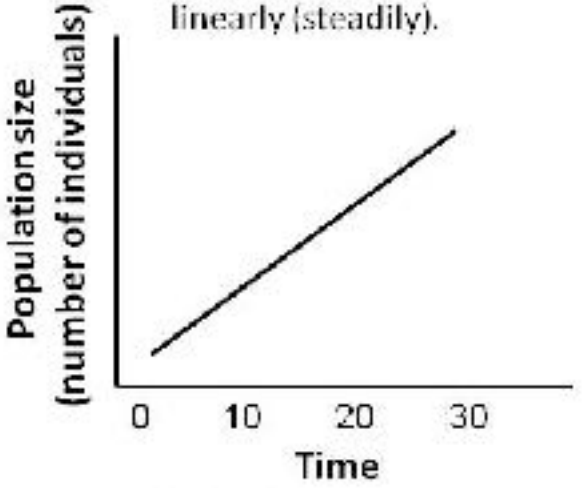

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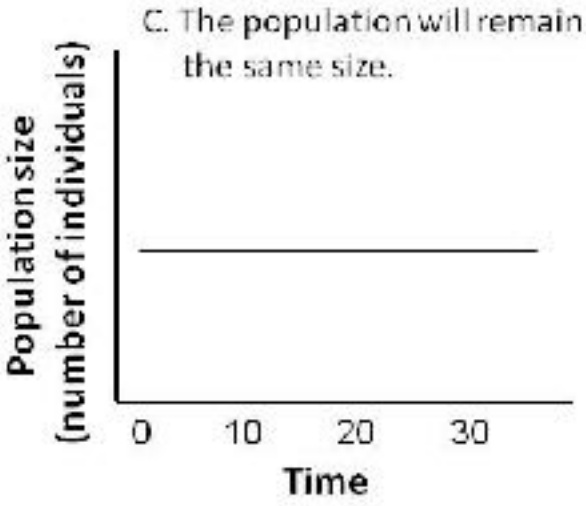

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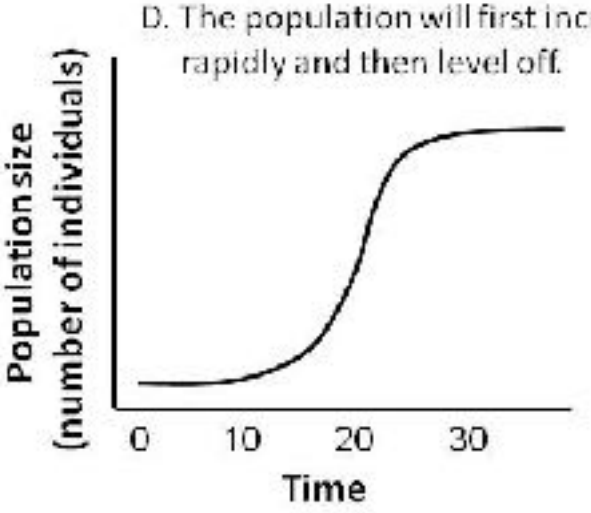
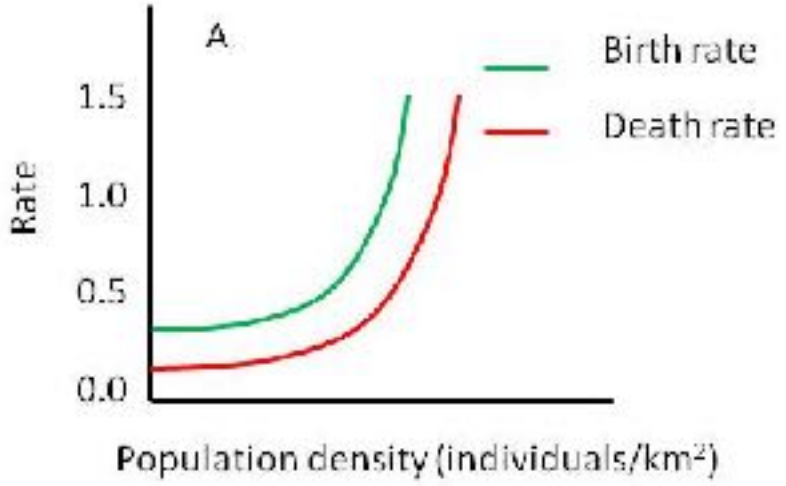
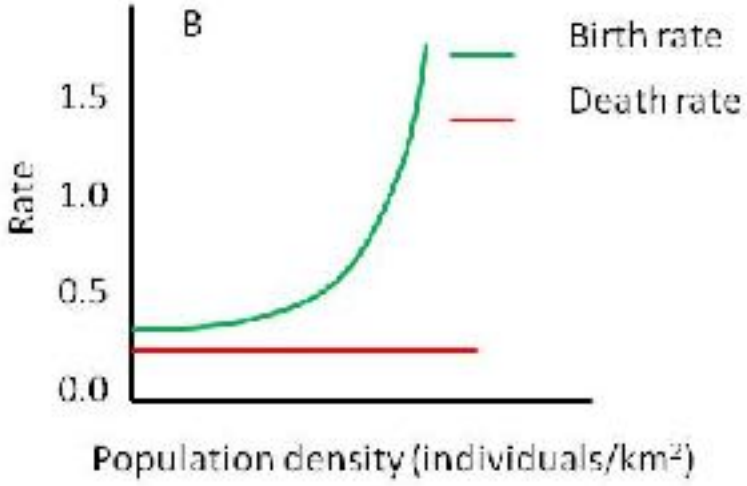
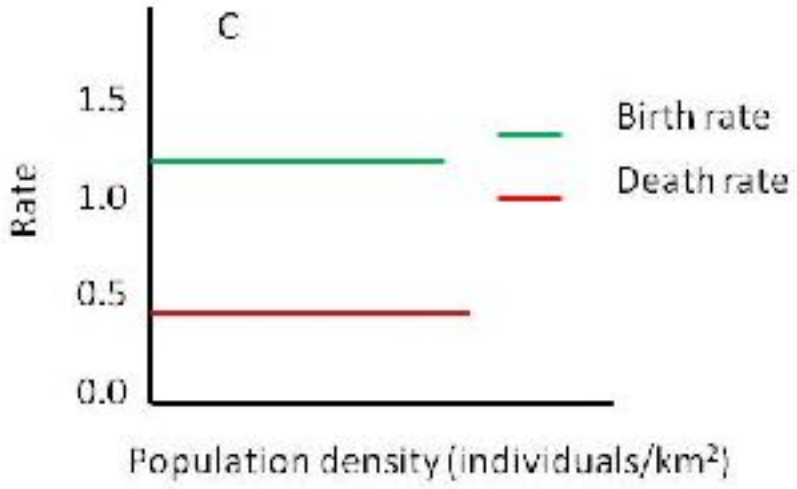
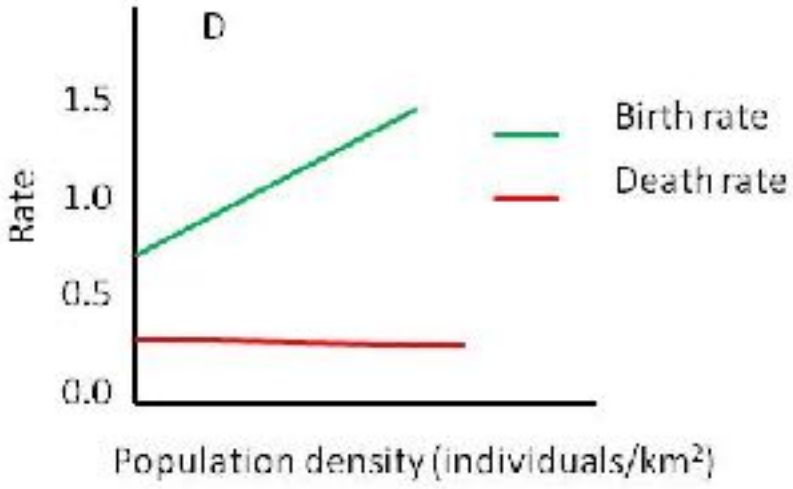


2. If the goats were living under ideal conditions for the first 30 years after their introduction, which of the graphs below correctly shows how **per capita birth and death rates** would change with population density during that time?









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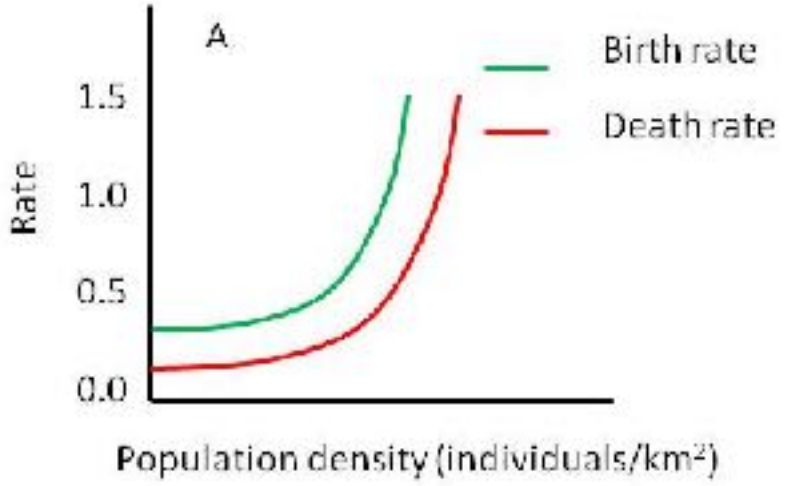
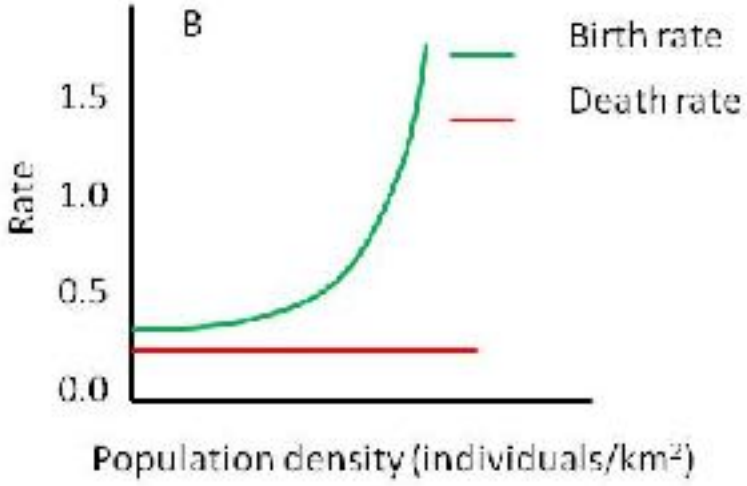
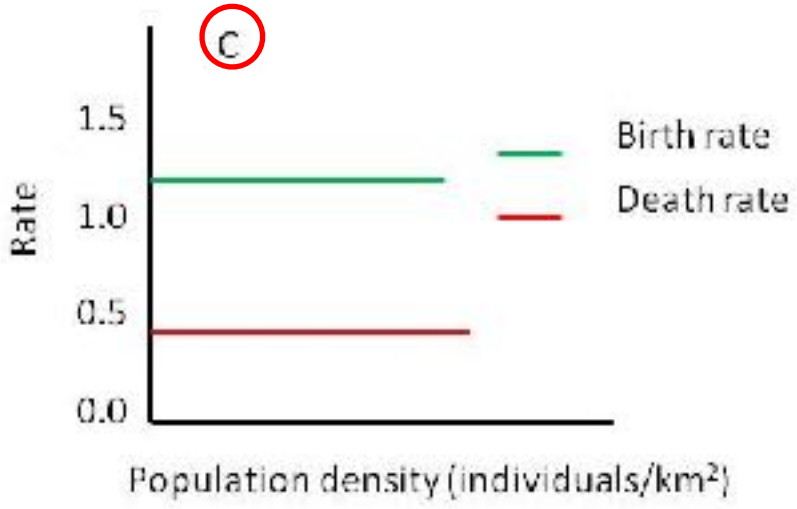
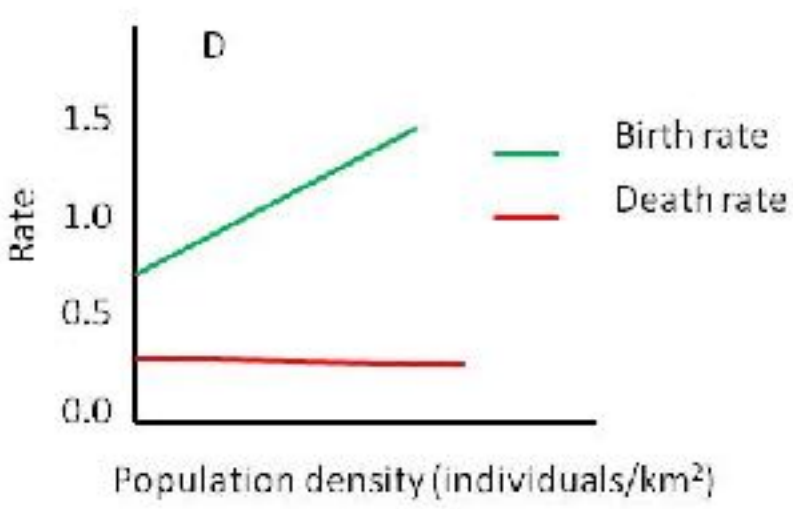


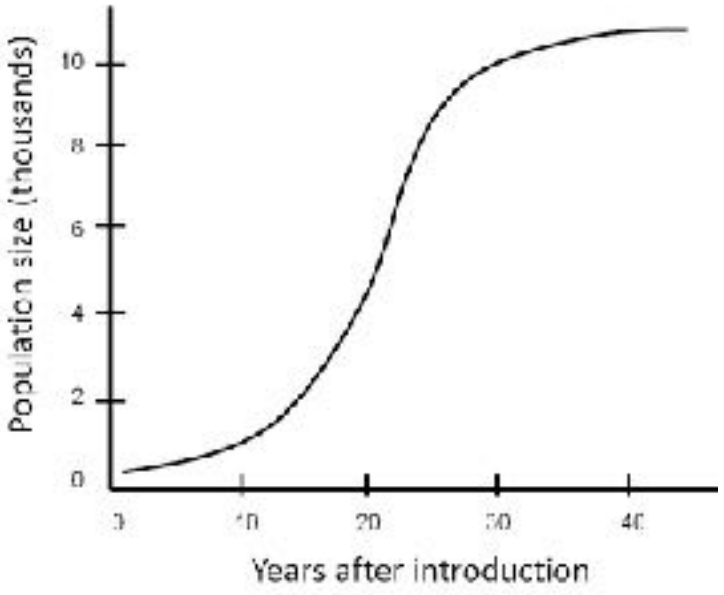


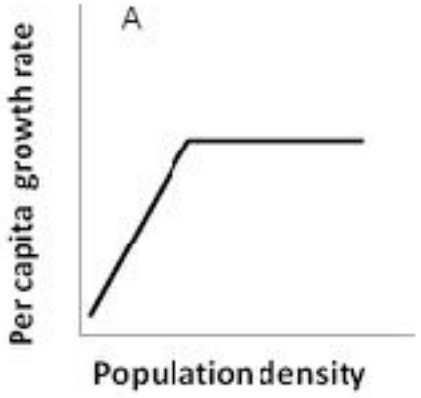


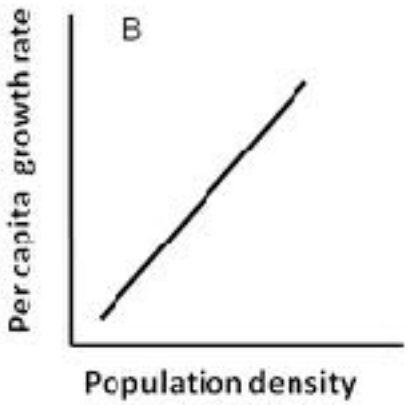


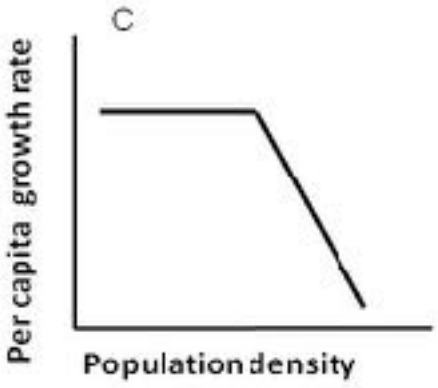
3. On the island of Northern Isabela the goat population grew rapidly for about 30 years, but then began to level off at a population size of approximately 10 000 individuals (see graph on the left).

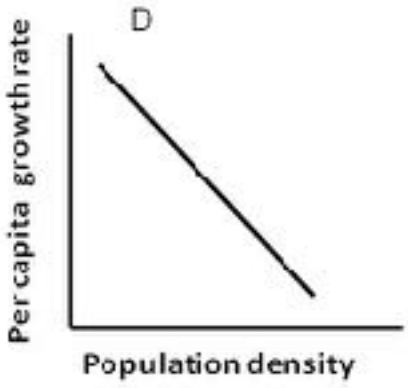
   Which one of the four graphs on the right would **BEST** illustrate the same data points if the **per capita growth rate** for the population was plotted as a function of **population density**?











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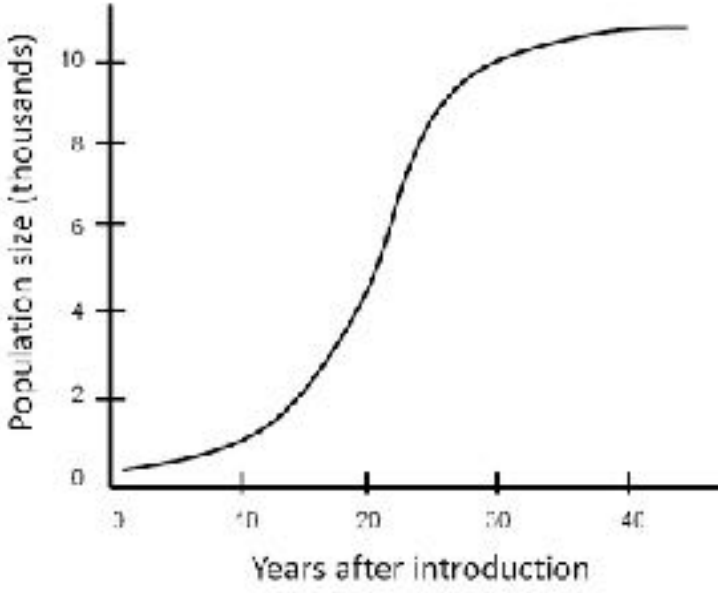
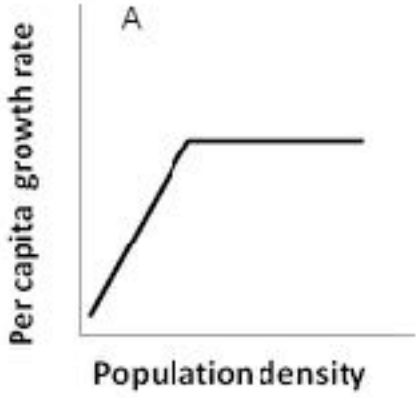
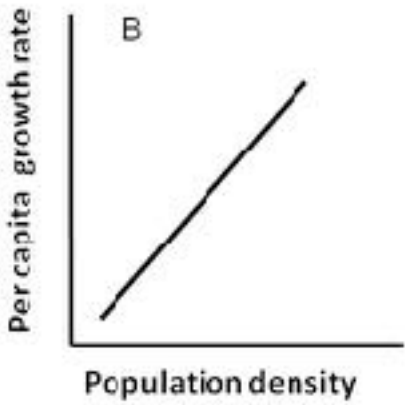
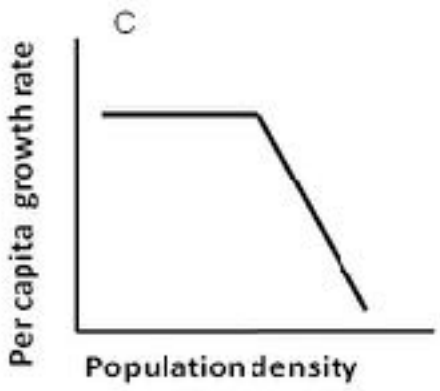
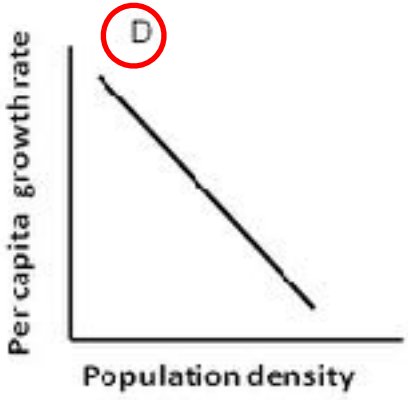


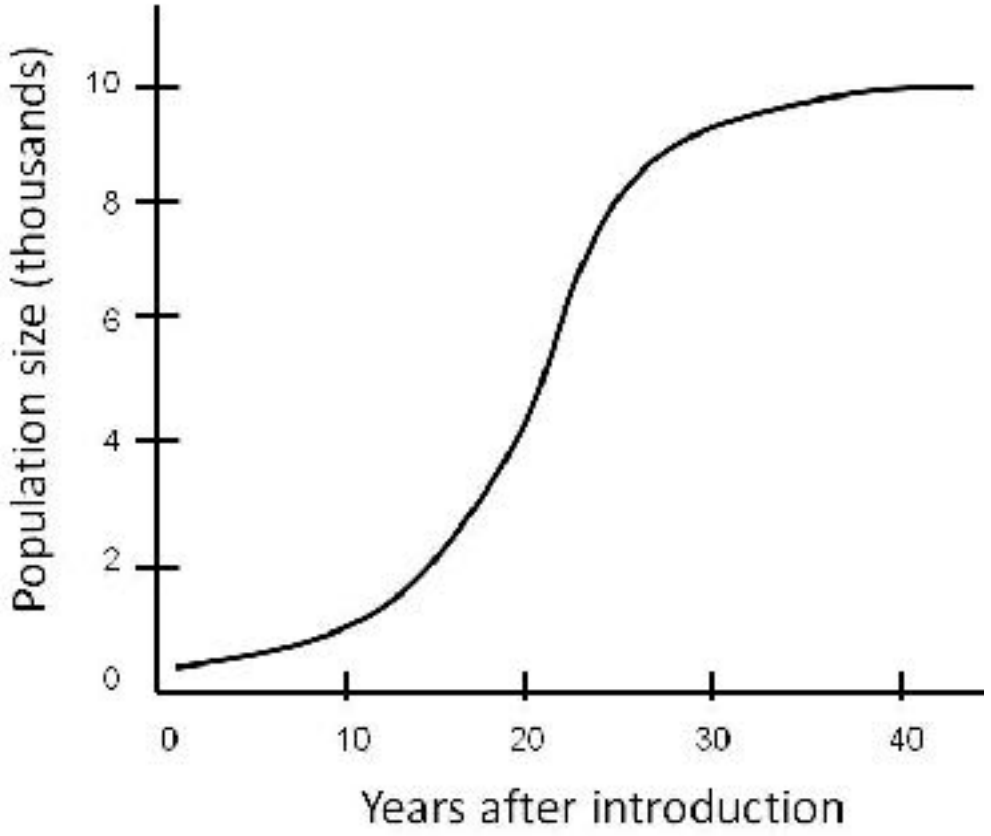








4. The goat population began to level off at a population size of approximately 10,000 individuals. Which ONE of the following statements provides **THE BEST** explanation for why the curve below levels off?



A. Other species use up most of the resources
B. The goat population has stopped reproducing
C. The goats have used up most of the resources they rely on
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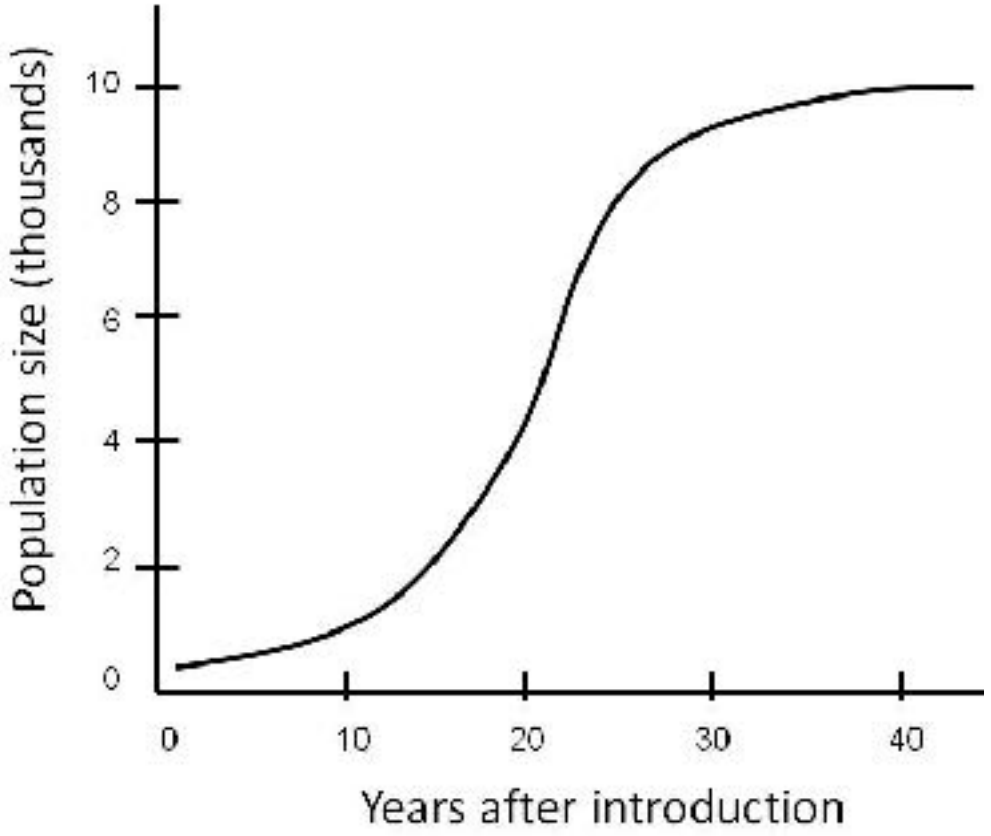

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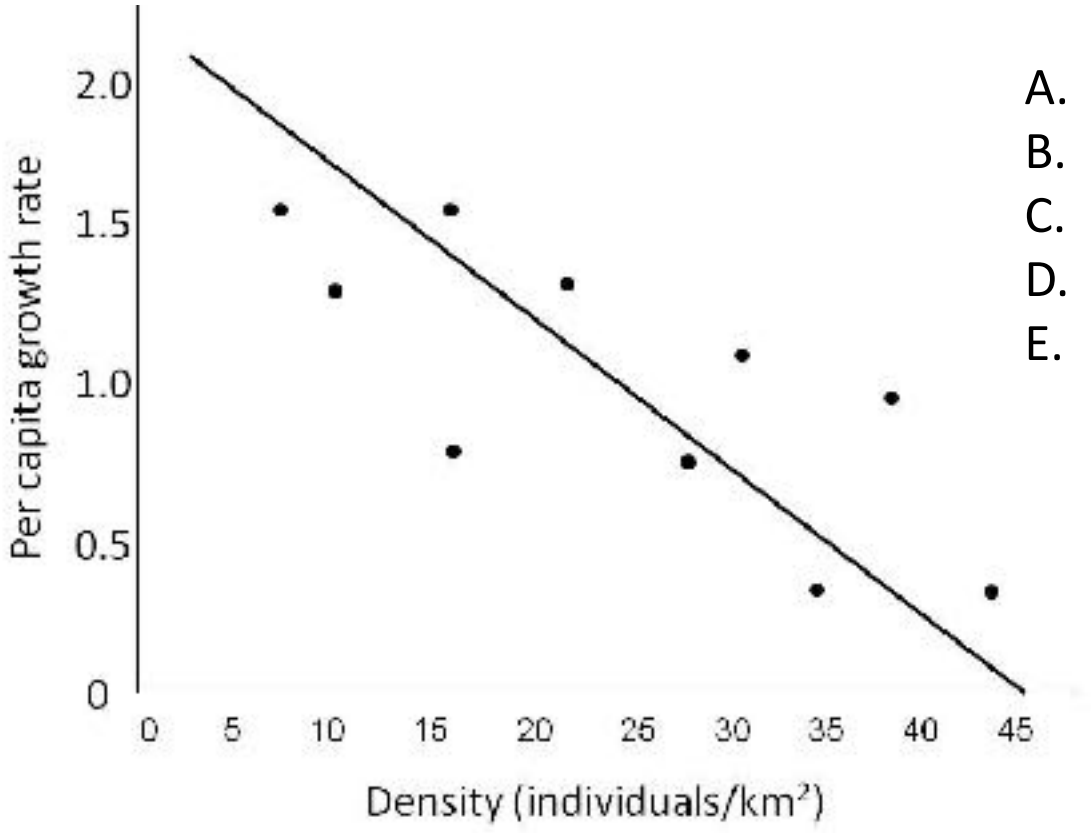
5. The lava heron is a native bird species that has decreased drastically since the goats were introduced. Ecologists are studying the population dynamics of this species to learn how its carrying capacity has changed. The graph below shows the **per capita growth rate (i.e. birth rate minus death rate)** for ten different sites. The lava heron population density varied among the sites, but the availability of resources was about the same.

What is the current carrying capacity of the lava heron population?



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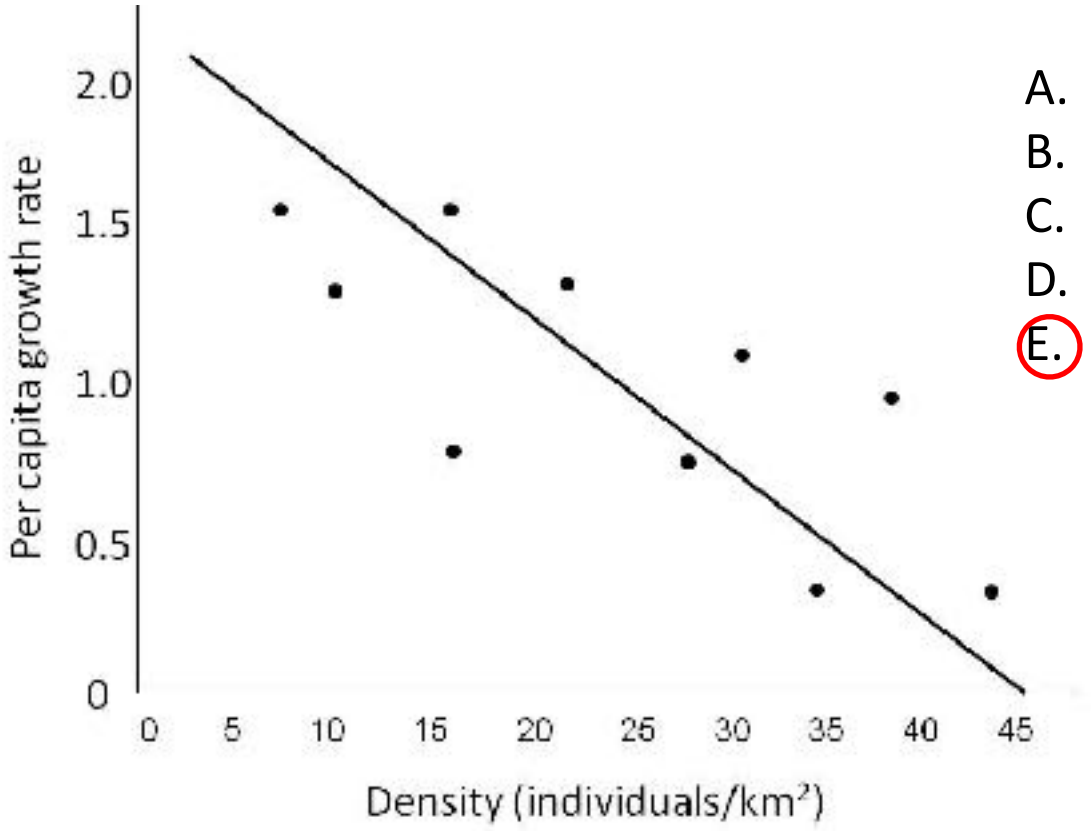

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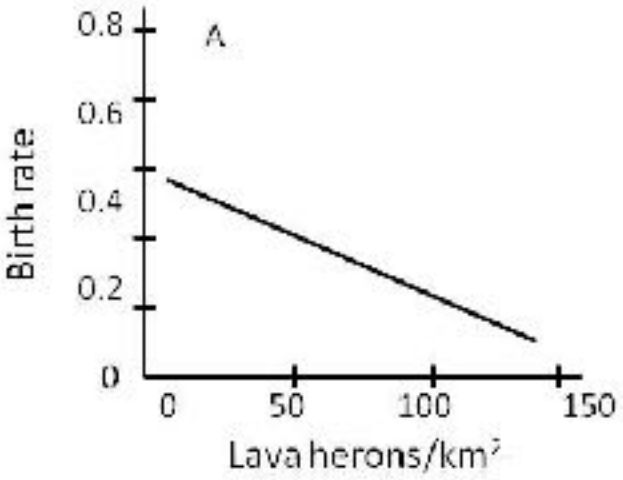
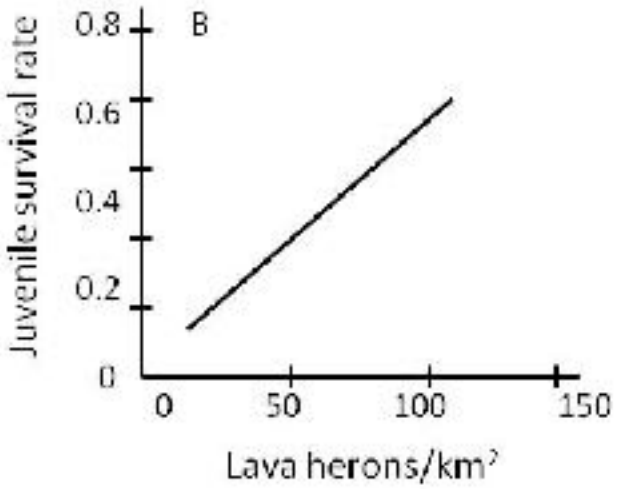
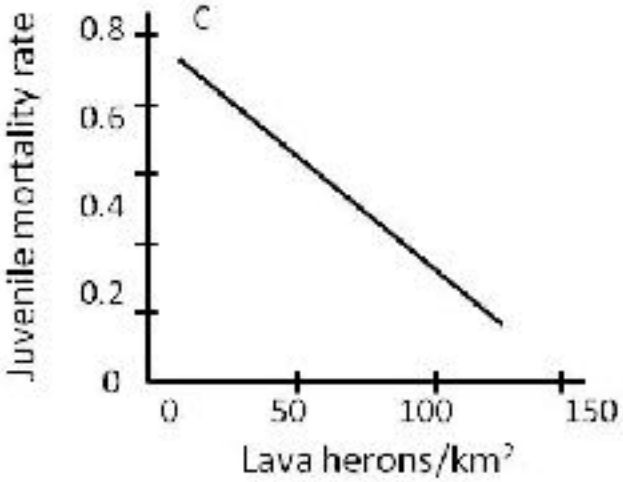
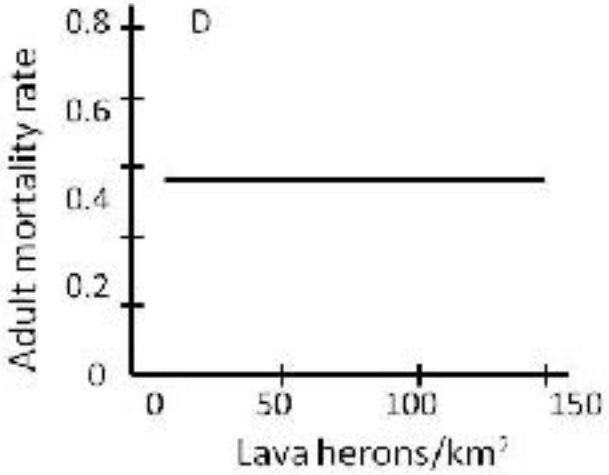
7. To learn more about the lava heron population ecologists collected demographic data at several study sites featuring different population densities (lava herons/km^2) of this species to determine which factors are responsible for **regulating** its population size.

Based on the four demographic factors shown on the right, which graph shows the **largest regulatory effect** on the lava heron population?









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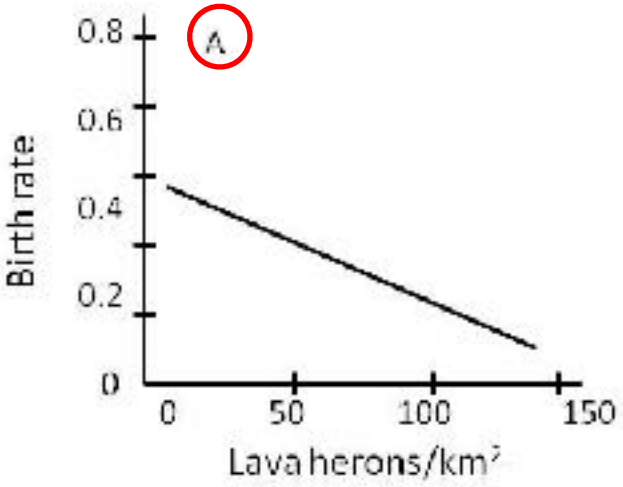
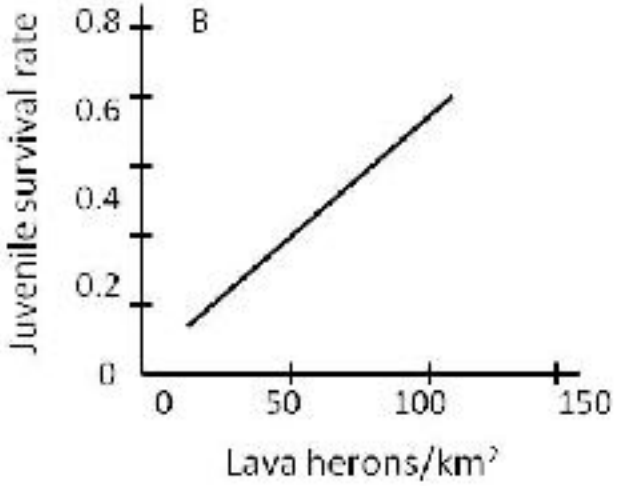
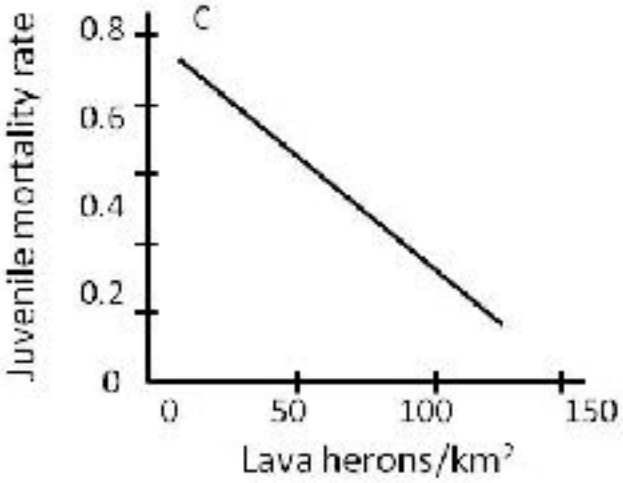
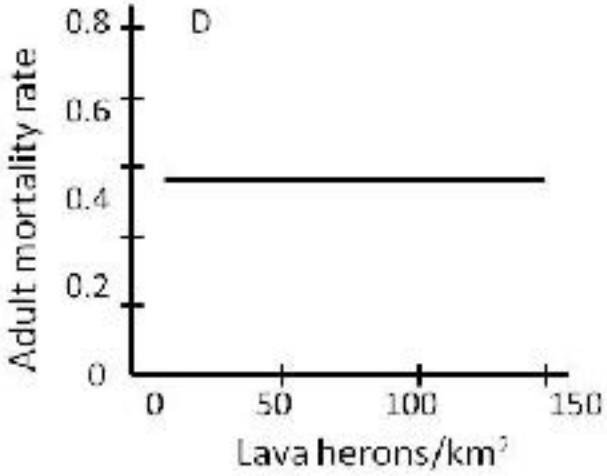


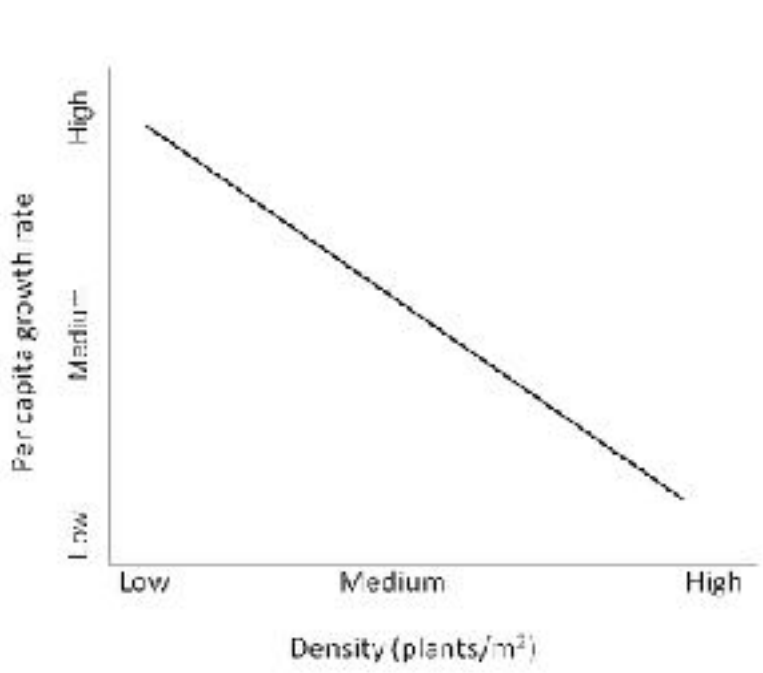


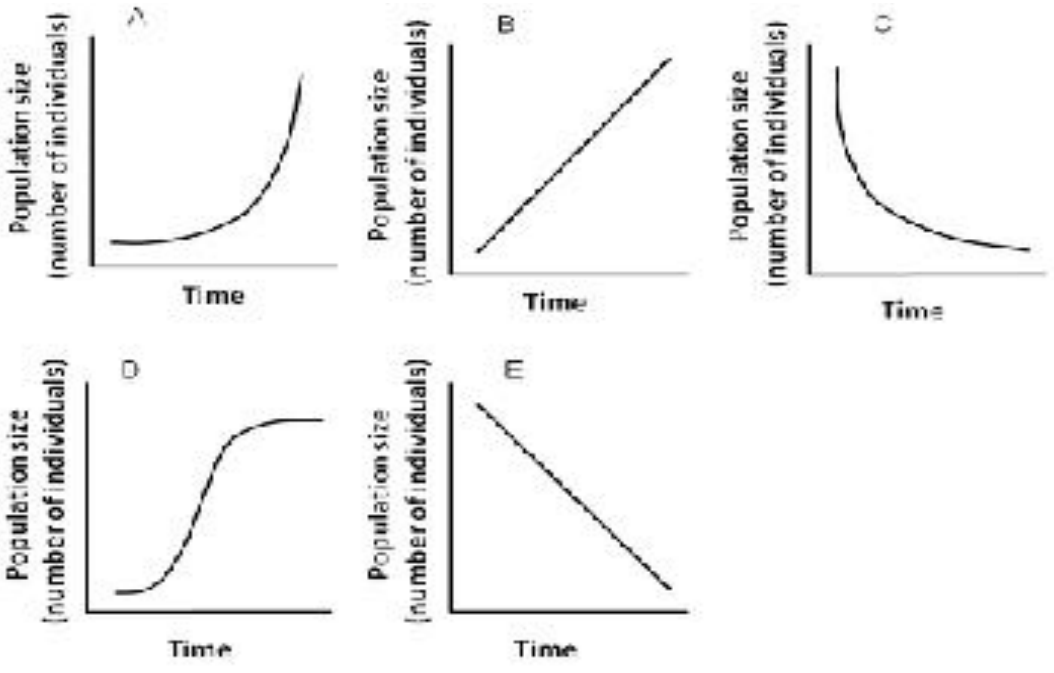




8. The opuntia cactus is endangered due to disturbance by goats. The cactus was reintroduced to one of the islands, Española, where the goats had been completely eradicated. Ecologists studied the growth rate of the cactus population as it recolonized different areas of Española Island. They calculated the **per capita growth rate** (low, medium and high) and plotted it as a function of population density (see graph on the left).

   Which one of the five graphs on the right would **BEST** illustrate the same data points if **population size** (number of individuals) was plotted as a function of **time since reintroduction**?





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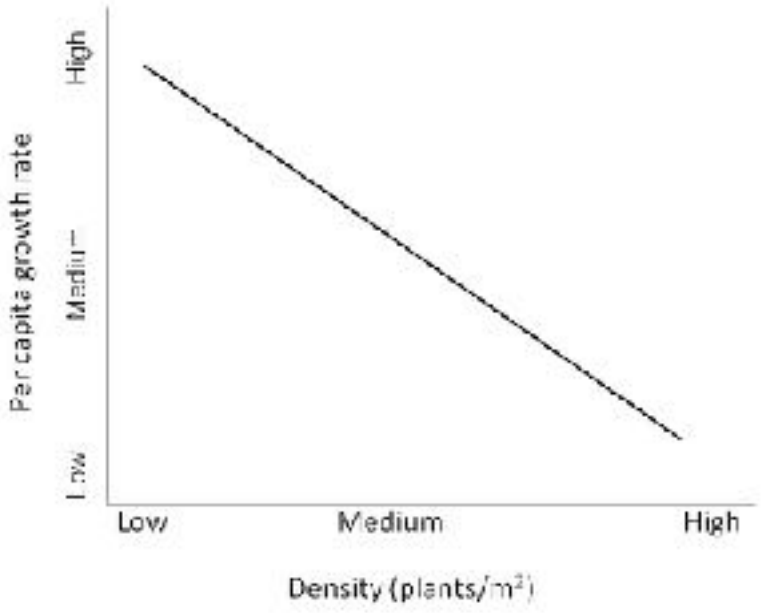
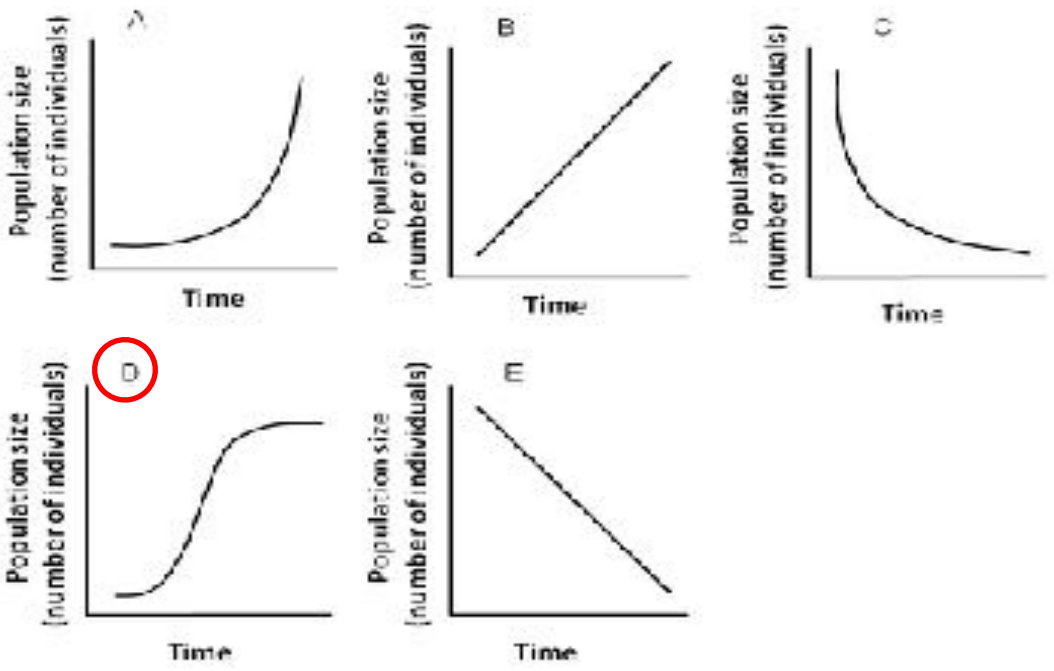
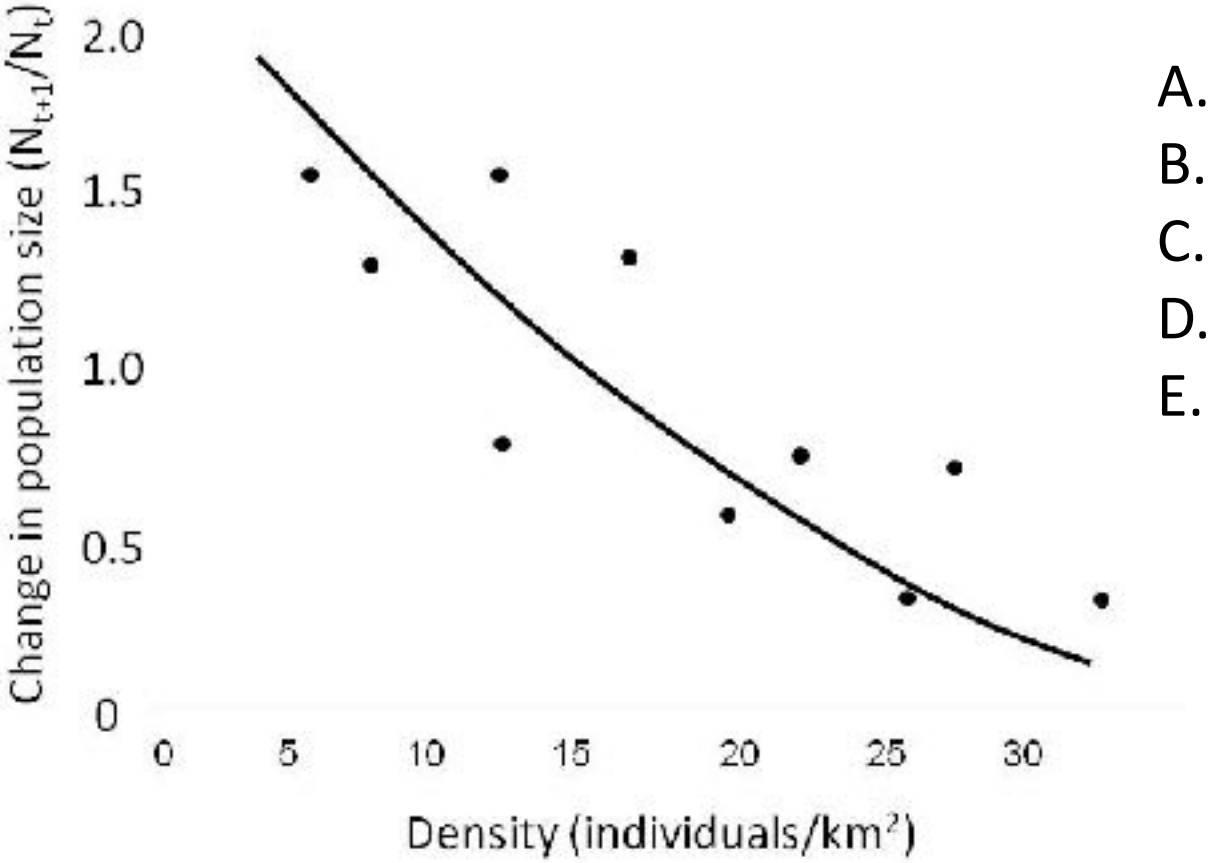




9. The giant tortoise is another threatened species on the Galapagos Island. The suitable habitat for the tortoise population has decreased since the goat invasion. The carrying capacity for this species is therefore much lower on most of the Galapagos Islands than it used to be. The graph below shows how the **change in population size from one year to another (i.e. N_{t+1}/N_t)** varies with population density on the island of Santa Cruz.
What is the current carrying capacity of the tortoise population?



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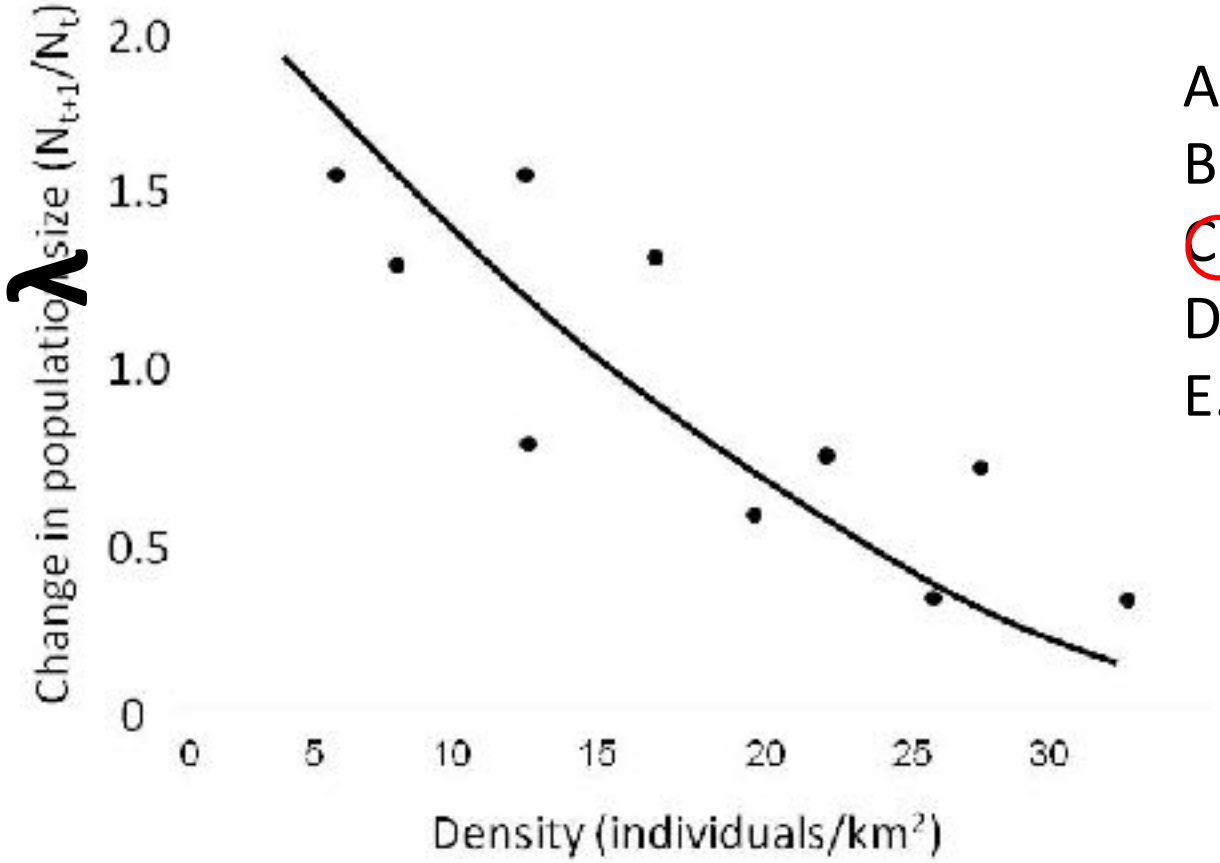

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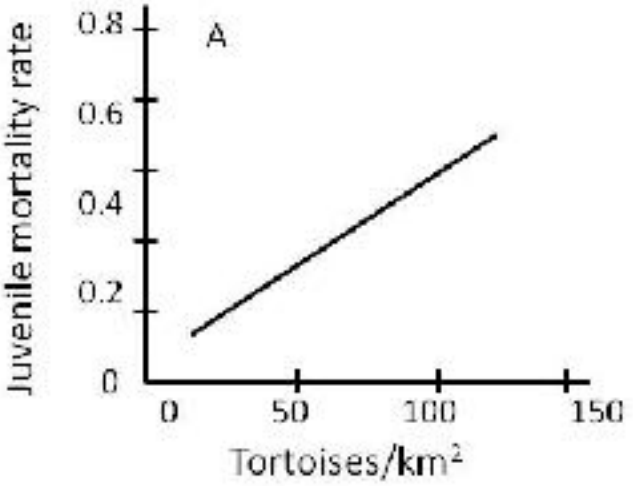
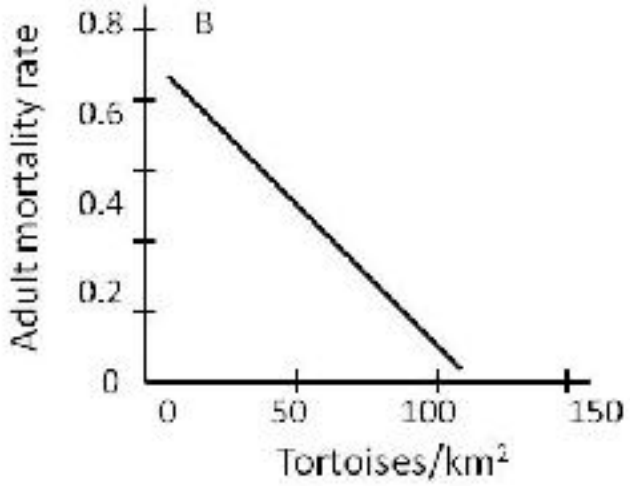
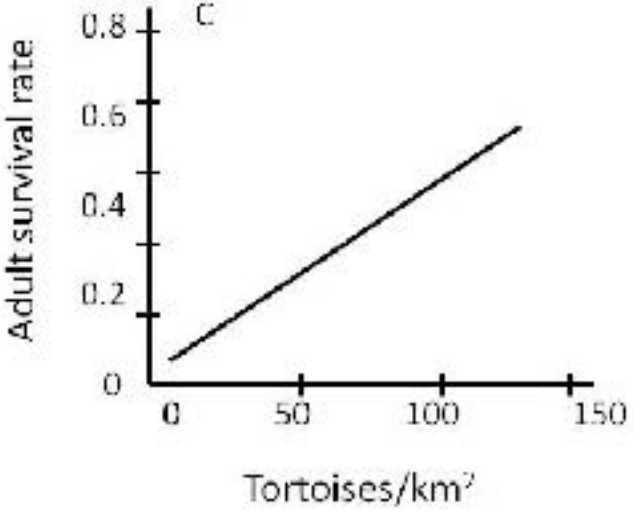
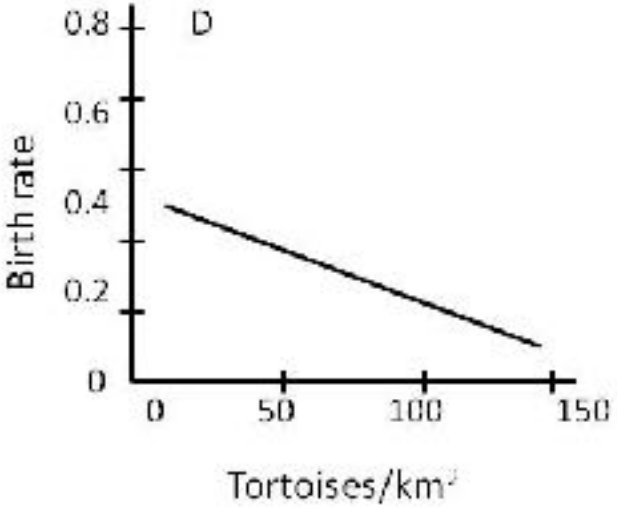
10. Imagine that you are an ecologist interested in determining which factors are responsible for **regulating** the tortoise population. You collect data at sites featuring different densities of this species and display these data graphically.

Based on the four demographic factors shown on the right, which graph shows the **largest regulatory effect** on the tortoise population?









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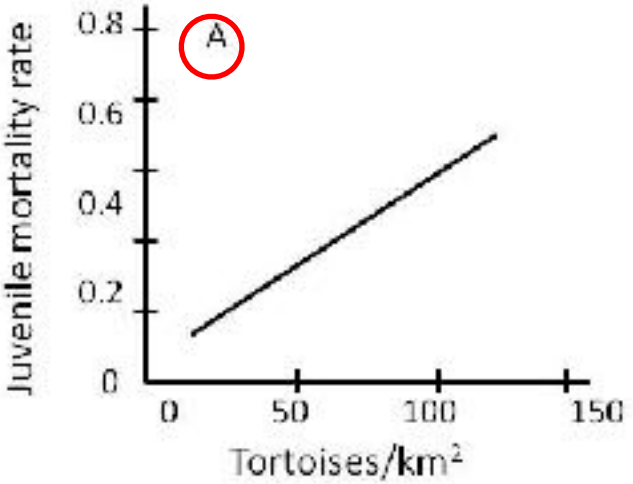
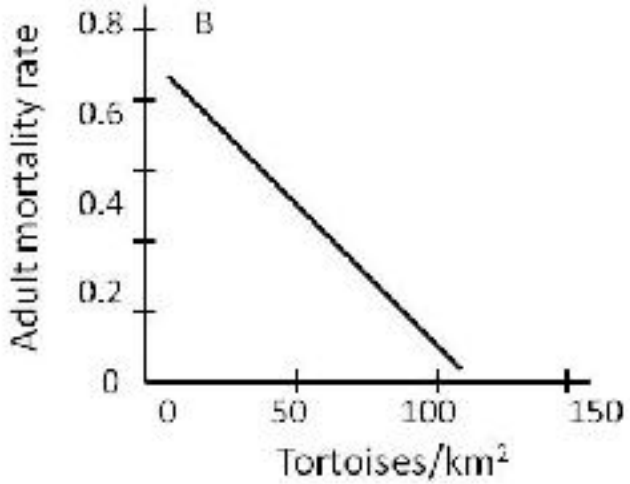
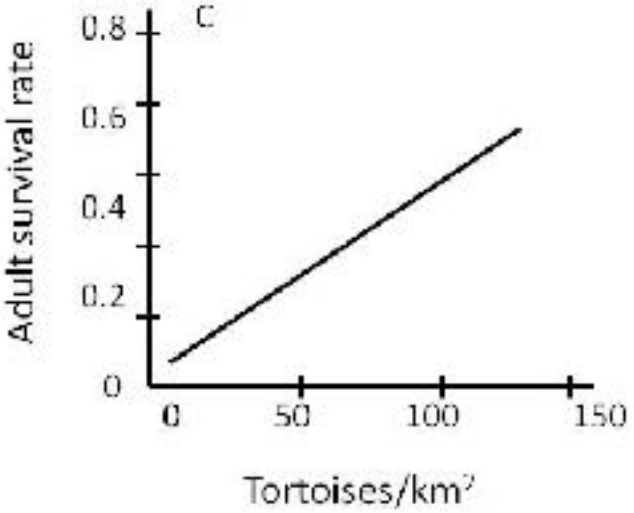
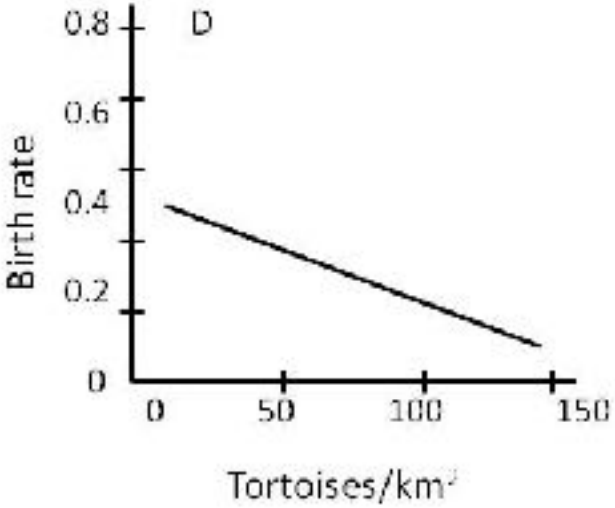


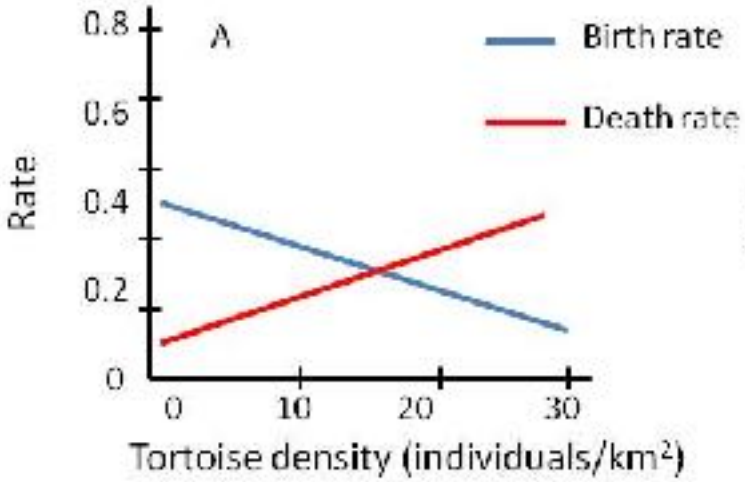


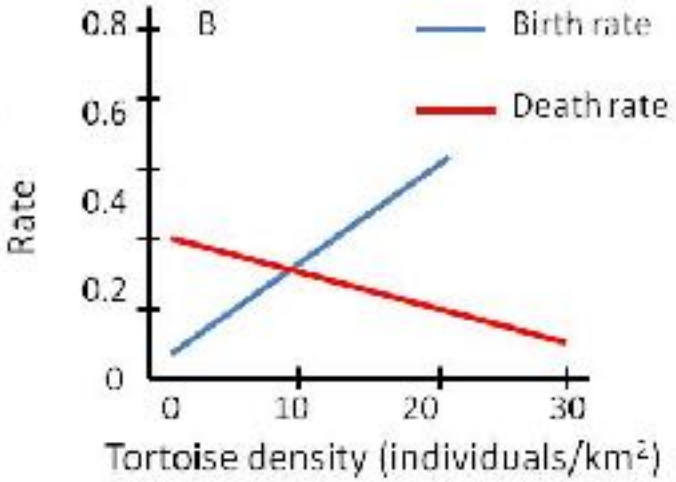


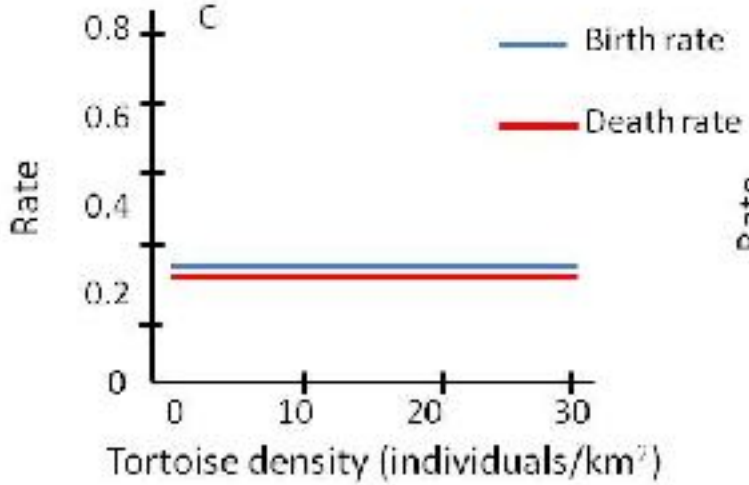


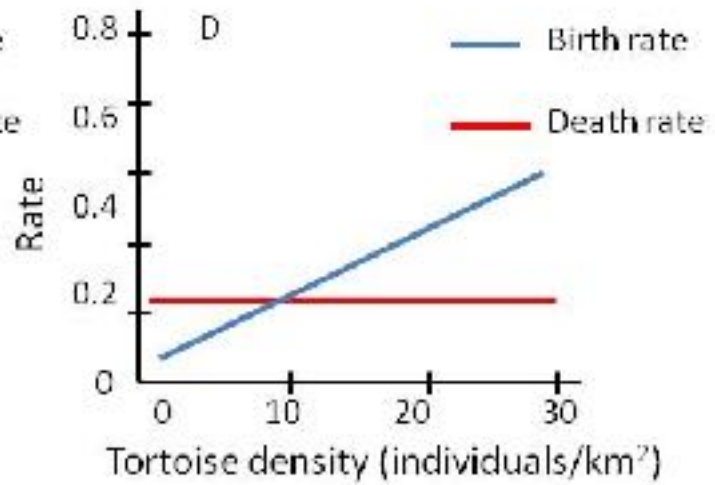
11. As a conservation ecologist you are also interested in learning how to facilitate the growth of small tortoise populations. It turns out that the tortoise population is affected by an Allee effect (i.e. it is difficult for tortoises to find mates when the population is below 30 individuals/km^2).

Which of the four graphs on the right **BEST** describes how birth and death rates vary with density in a population that is affected by an Allee effect?









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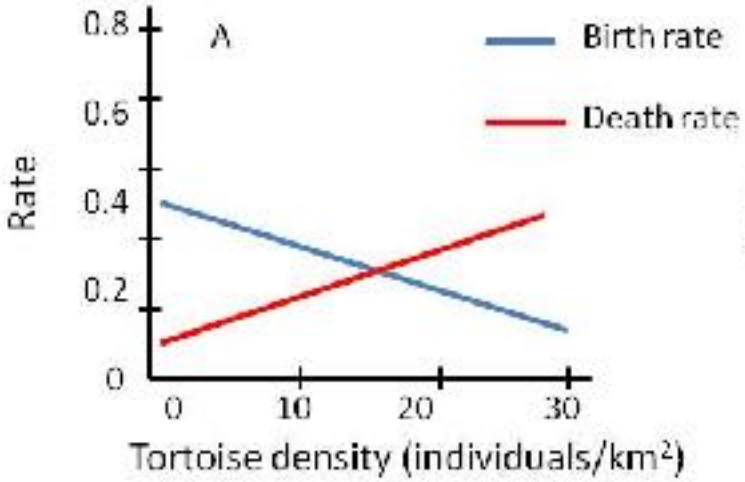

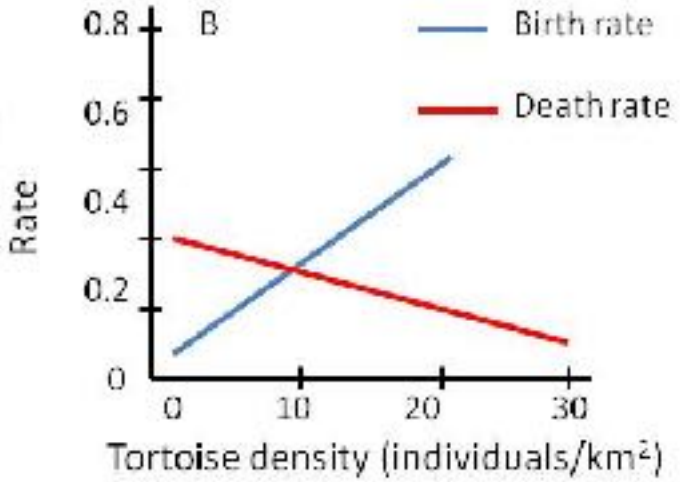

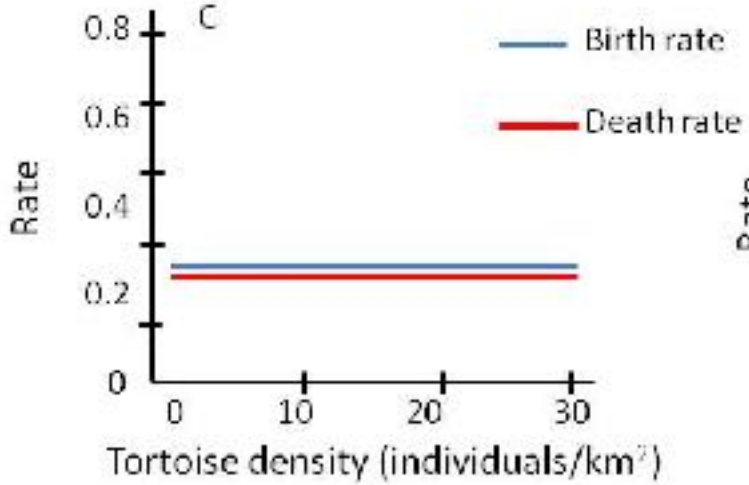

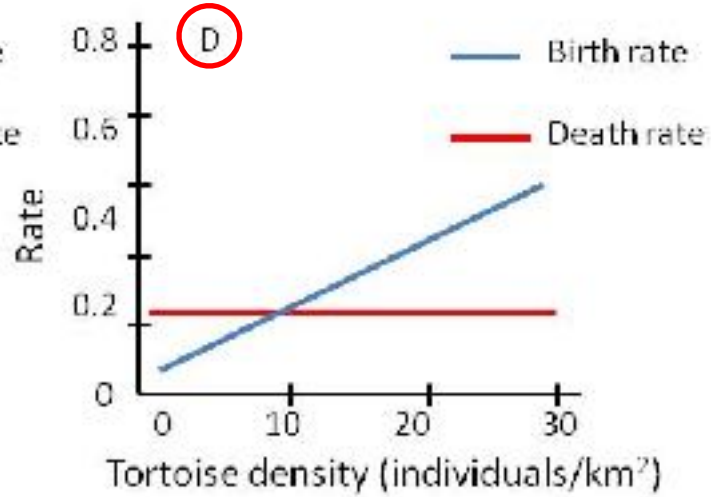

12. The Vermilion flycatcher is a small bird species native to the Galapagos Islands. Ecologists have been monitoring **per capita birth rates** for this species for several years to learn why this species is threatened. Use the data in the table below to determine if the factors that determine birth rate **regulate** the flycatcher population or not.

Year	Population density (number of individuals/km^2)	Birth rate
2006	30	0.3
2007	20	0.20
2008	25	0.25
2009	15	0.15
2010	10	0.1

A. The factors regulate because the birth rate does not vary with density.
B. The factors do not regulate because the birth rate does not vary with density.
C. The factors regulate because the birth rate increases with increasing density.
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13. Ecologists also studied factors that caused death in the flycatcher population. Use the data in the table below to determine if the factors that cause mortality in adult flycatchers **regulate** the population or not.

Year	Population density (number of individuals/km^2)	Number of dead adult flycatchers
2006	60	6
2007	40	4
2008	50	5
2009	30	3
2010	20	2

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Clicker Question!

If a new species is added to a habitat, and we show convincingly that it survives but another species is lost, we can conclude:

A. The community is unsaturated, i.e. dispersal limited

B. Habitat (abiotic) filtering is not important

C. This is a non-equilibrium community

D. The community is saturated, i.e. niche limited

E. Facilitation is more important than competition

Draw this!

Explain the cradle hypothesis by drawing a stock and flux diagram for a tropical region, and another for a temperate region.

Explain the museum hypothesis by drawing a stock and flux diagram for a tropical region, and another for a temperate region.

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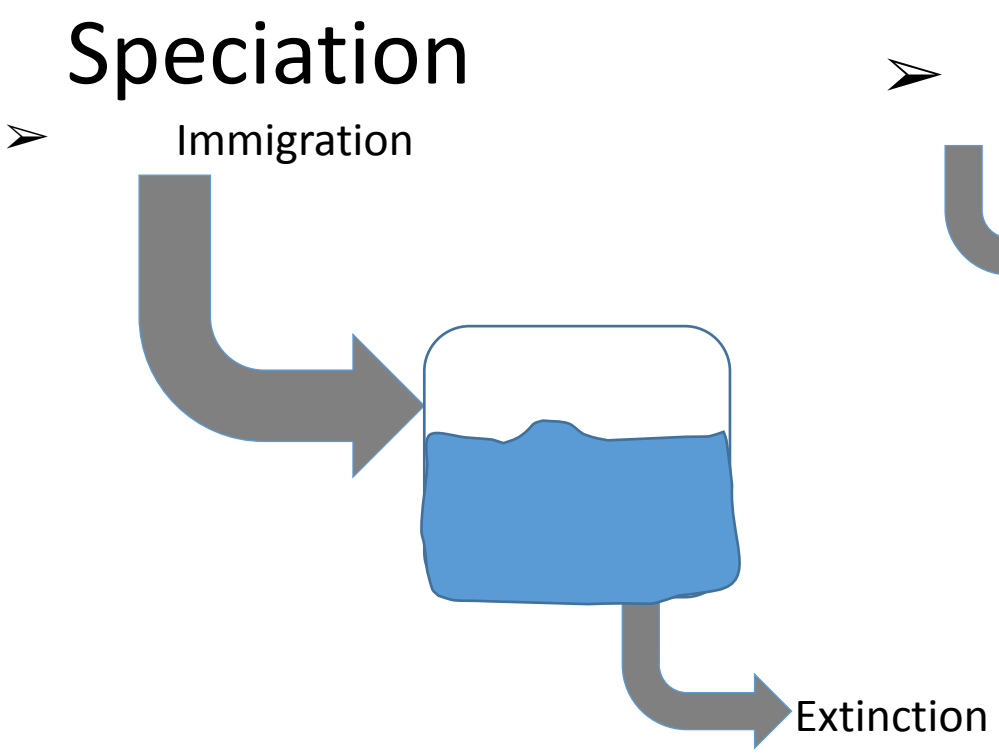
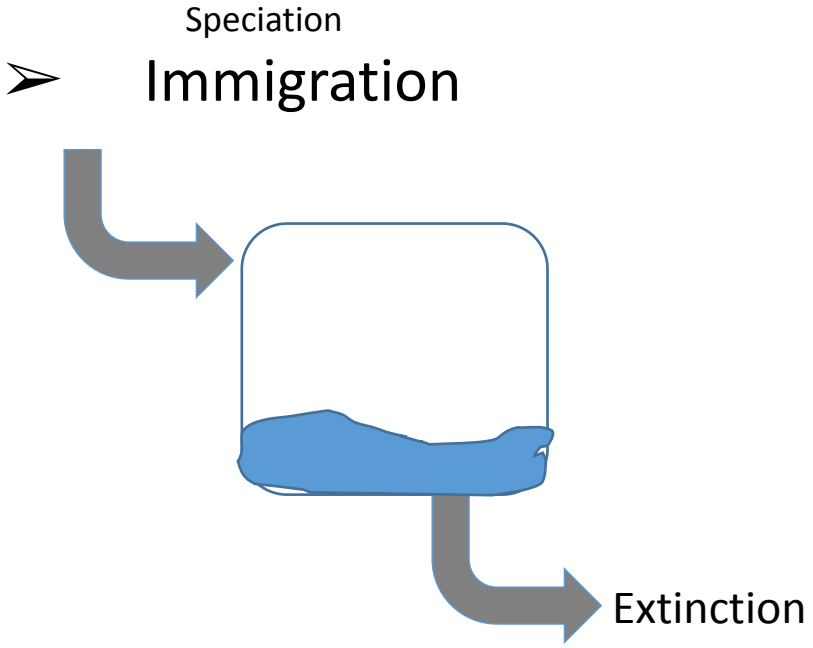
Tropics:



Temperate/polar:



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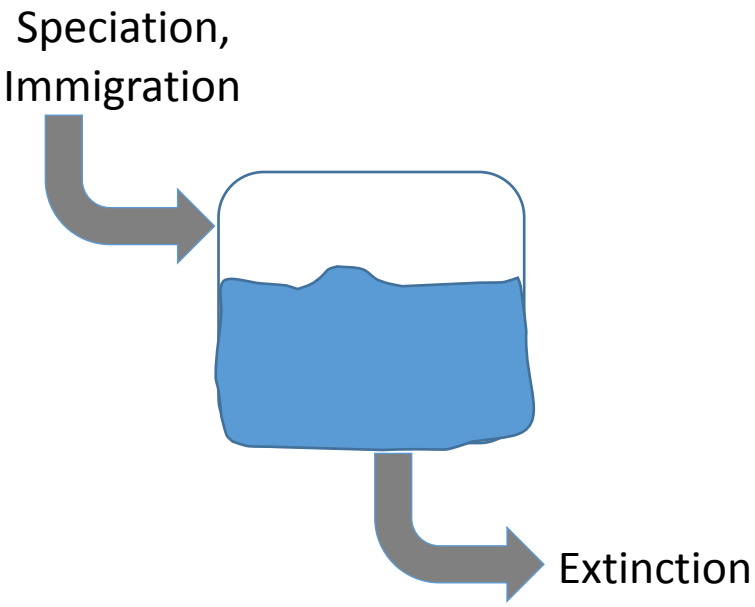

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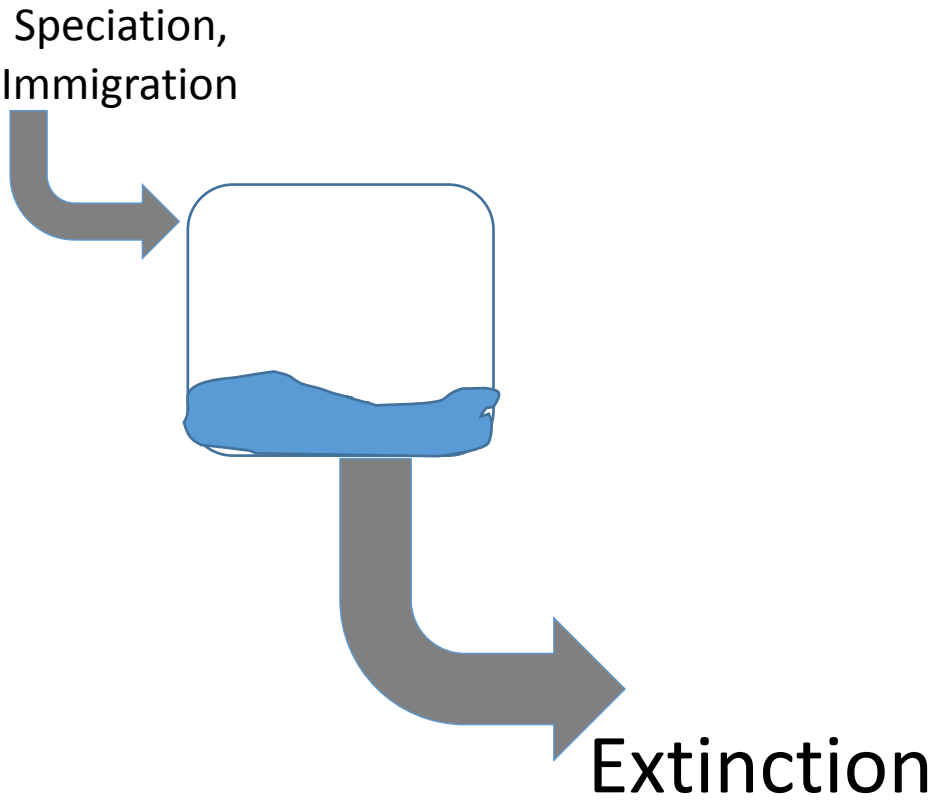


Clicker Question!

Cardston, AB receives less precipitation than Vancouver. Why?

A. Adiabatic cooling

B. The rain shadow effect

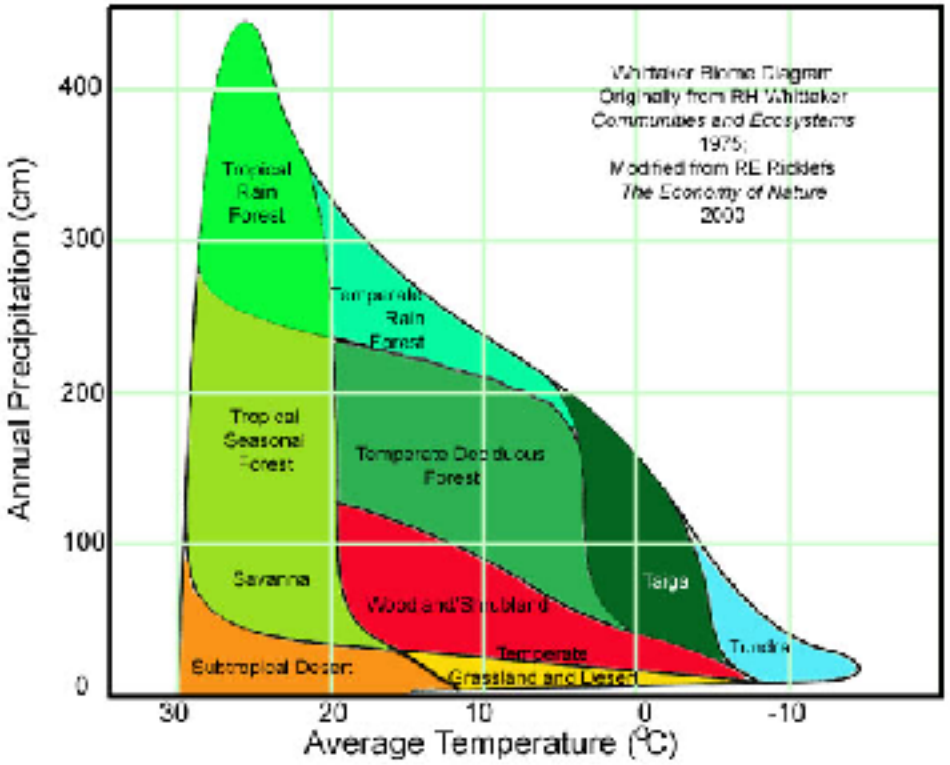
C. Proximity to the ocean

D. A & C

Clicker Question!

The two most important factors that affect the geographic distribution of species are _____ and _____.

A. animals and insects
B. temperature and precipitation
C. topography and soil
D. habitat connectivity and patch size
E. None of the above, it's all random

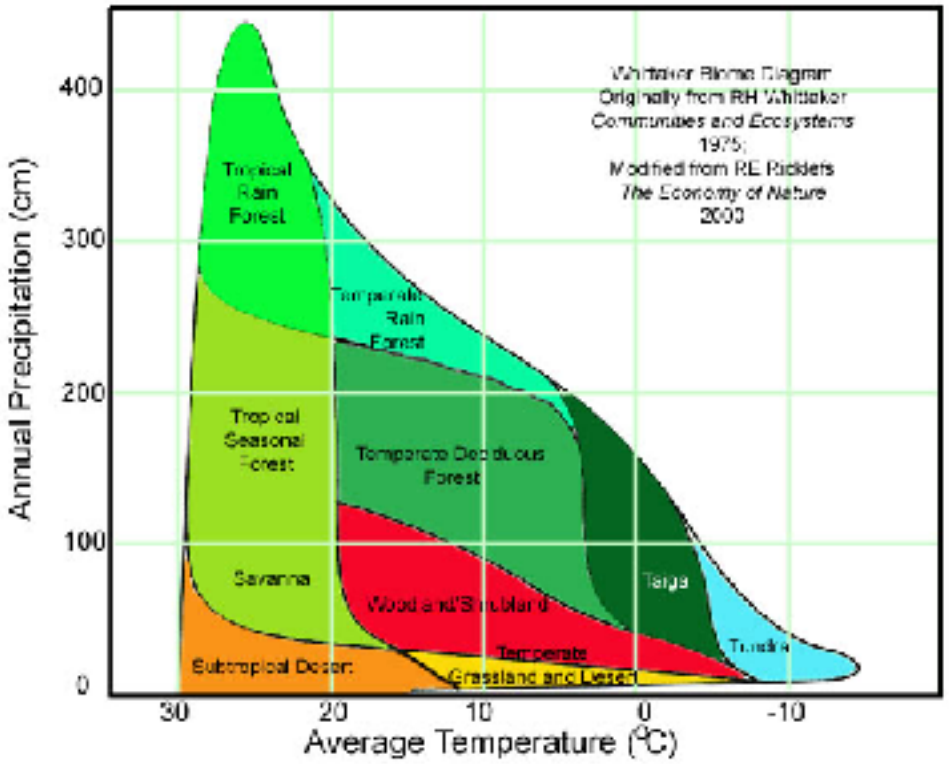


Clicker Question!

Arctic tundra soils are very moist due to high precipitation.

A. True

B. False



Clicker Question!

You are examining marine snail fossils deposited over the last 20 million years. You find that:
110 genera first occurred in the tropics
35 genera first occurred outside the tropics

This supports:

A. Cradle hypothesis
B. Museum hypothesis
C. Both hypotheses
D. Neither hypothesis

Clicker Question!

Why would more productive regions be able to support more species?

A. More productive regions can support more individuals, which can represent more species

B. More productive regions have more rare resources, which can support additional specialist species

C. More productive regions have higher population growth rates, allowing species to recover quickly from disturbance

D. More productive sites have higher speciation rates

E. All of the above

The More Individuals Hypothesis

- **If** more productive regions (e.g. tropics) have more individuals

>

The more individuals hypothesis

- **If** more productive regions (e.g. tropics) have more individuals
- **And if** a species requires a certain population size to persist over time

Minimum viable population sizes

Mammals 3876
Fish 1,239,727
Birds 3742
Plants 4824

Trail et al. 2007 Biol Cons.

The more individuals hypothesis

- **If** more productive regions (e.g. tropics) have more individuals
- **And if** a species requires a certain population size to persist over time
- **Such that** the number of species is limited by the number of individuals
- **Then** regions with fewer individuals should have fewer species.

Clicker Question!

What is the beta diversity for the region?

A. 2
B. 3
C. 4
D. 5
E. a lot!

	Forest	Savanna	Grassland
Species A	X		
Species B	X		
Species C	X	X	
Species D		X	
Species E		X	X
Species F			X
Species G			X

Many ways to measure, easiest is:

Beta diversity =
regional diversity ("gamma diversity") – average local diversity ("alpha diversity")

Clicker Question!

What is affect of area on immigration rate?:

Yes: Passive dispersers

A. Larger areas receive more seeds and other propagules

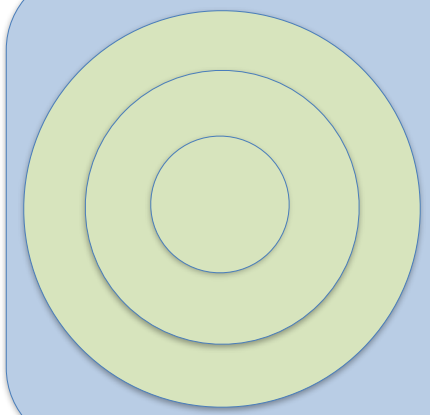
B. Larger areas have more resources **Post-immigration process**

C. Larger areas have more births **Post-immigration process**

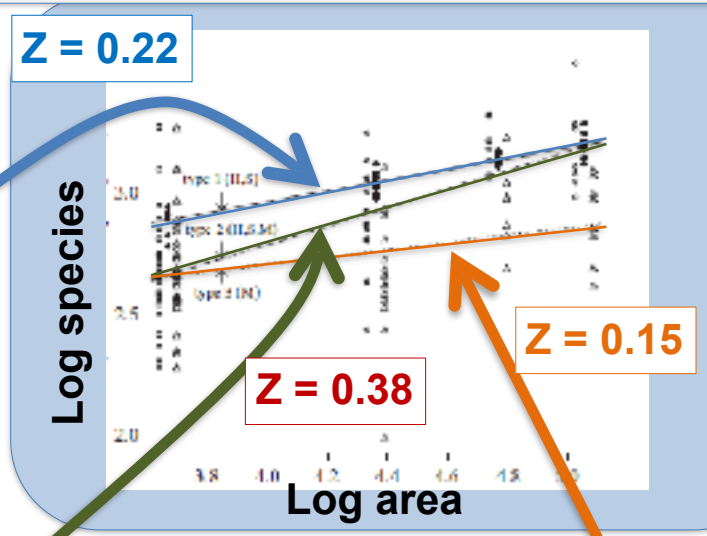
D. Larger areas are more detectable by colonists **Yes: Active dispersers**

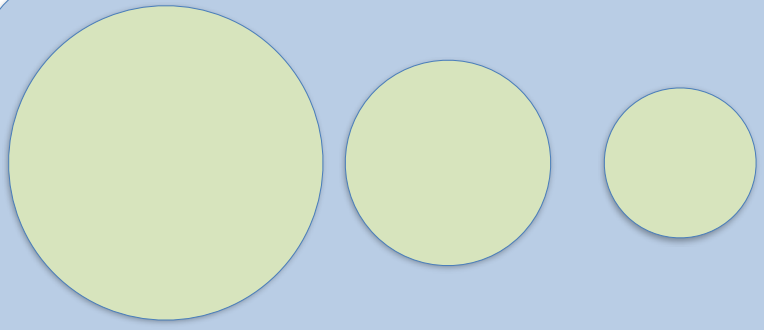
E. A & D

Which processes are more important in determining effect of area on species? Sampling+habitat effects? Island-biogeography effects?

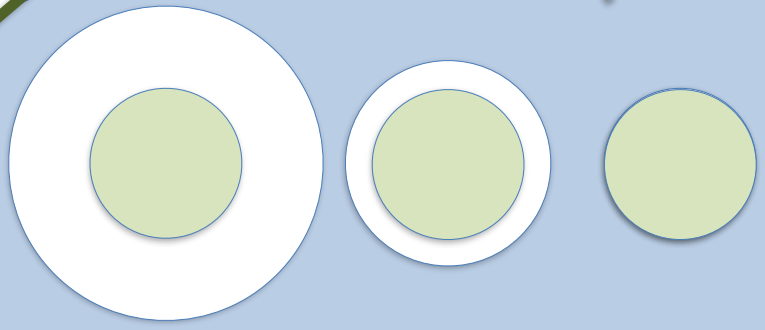


Within region (sampling, habitat)





Between regions (island biogeography, sampling, habitat)



Between region, equal sample area (island biogeography)

Clicker Question!

In this scenario, what is the approximate equilibrium number of species for the large island and the small island, respectively?

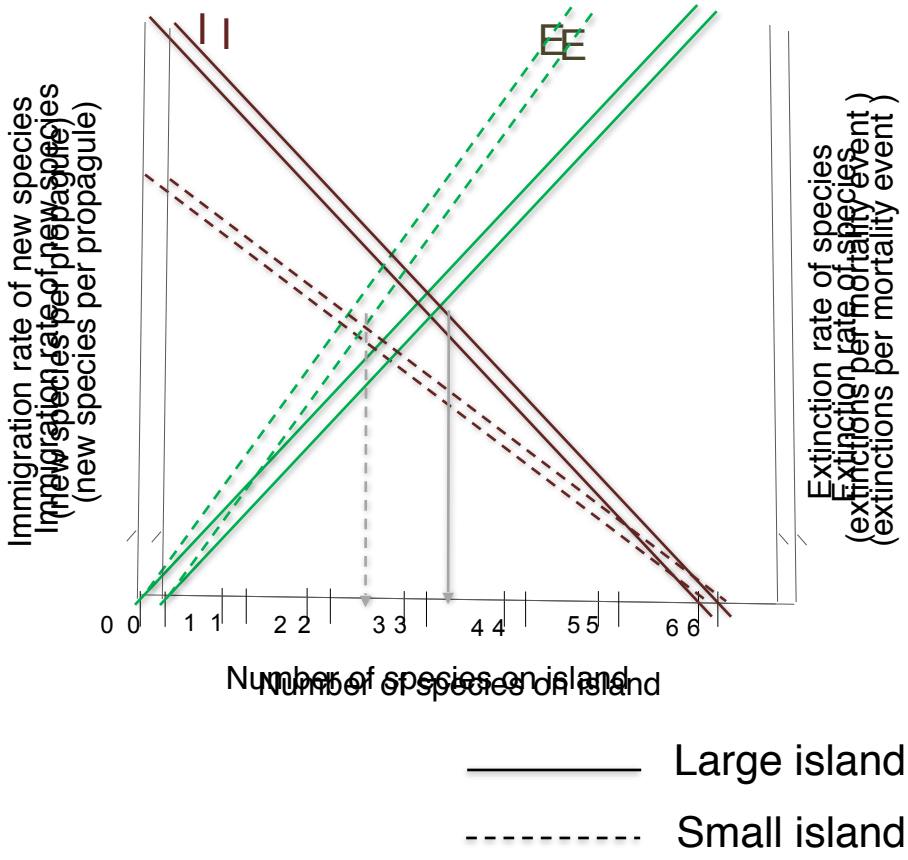
A. 0.0, 6.0

B. 2.4, 3.2

C. 4.0, 1.8

D. 3.2, 2.4

E. a lot, a little



Mid-term 1

- Tuesday, Feb. 14
- In-class
- 60 minutes
- Non-graphing calculators only
- No regrades if written in pencil
- You are allowed a 8.5” x 11” cheat sheet
  - **1 side only**