Practice Questions

Use the following to answer the next question.

The Amish are a group of people who rarely marry outside of their community. In one group of Amish in Ohio, the incidence of cystic fibrosis was 19 in 10 816 live births. A second group of Amish in Ohio had no affected individuals in 4448 live births. No members of either group are related. These data illustrate what population geneticists refer to as the "founder effect".

The "founder effect" seems to occur when

a. the environment favours one population over another population

b. a non-representative subpopulation forms the basis for an isolated population

c. inidividuals from one population move into and become part of a second population

d. two similar populations exist in the same community without being reduced in number

Jun 4-12:31 PM

Use the following information to answer the next question.

The fathead minnow, a small fish common in Alberta waters, is used as a food source by many predators. When injured, some minnows secrete a chemical (called *schrekstoff*) that bothe attracts predators and causes other monnows to huddle in large groups. Approaching predators tend to be distracted by the mass of minnows and by each other. Often, the injured minnow can escape.

2. In the future the frequency of the gene that controls the production of *schreckstoff* by minnows will likely

a. increase in the gene pool of the population

b. decrease in the gene pool of the population

c. stay the same in the gene pool of the population because natural selection is occurring

d. stay the same in the gene pool of the population because natural selection is not occurring

Use the following information to answer the next question.
Many elk live in and around an 80 km square area that includes the Jasper town site.

3. If a disease were to kill 90% of these elk (an epidemic), what would be the likely consequence?

a. the genetic variability in the population would decrease

b. the population's resistance to all diseases would increase

c. the mutation rate in genes for disease resistance would increase

d. the population's gene frequencies would return to pre-epidemic values through genetic drift

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Use the following information to answer the next question.

A community of Pima Indians in the American Southwest has a very high rate of diabetes in their adult population. Of the population of adults over the age of 35, 42% to 66% develop diabetes. The reccessive trait that causes diabetes in this population is a distinct disadvantage to individuals whose diets are rich in carbohydrates.

4. If 42% of the population has diabetes, then the percentage of the population who are carriers is calculated to be _____%. (Record your **answer as a whole number.**)

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Use the following information to answer the next two questions.
A high percentage of purebreed dogs have genetic defects. Some examples of these defects follow.

1 Hip dysplasia, a defect in the hip joints that can cripple a dog, occurs in 60% of golden retrievers.

2 Hereditary deafness, due to a recessive autosomal disorder, occurs in 30% of Dalmations.

3 Retinal disease, which may cause blindness, occurs in 70% of collies.

4 Hemophilia, an X-linked recessive disorder, is common in Labrador retrievers. Dwarfism is also common in this breed of dog.

5. What is the frequency of the abnormal allele that cuases hearing defects in Dalmations?
(**Answer: _____. (**Record your **answer as a value from 0 to 1, rounded to two decimal places.)**

6. The breeding of purebred dogs for certain characterisitics related to appearance is blamed for the disturbing number of genetic defects in these animals. These defects are **most likely** the result of

a. natural selection

b. non-random mating

c. geographic isolation

d. high rates of mutation

Use the following information to answer the next question.

Tay-Sachs disease is a hereditary disease that kills 1 in 360 000 individuals in the general population, but 1 in 4 800 among the Ashkenazi (Eastern European) Jews. The disease disrupts or halts proper formation of lysosomes and increases fat deposition around the nerve sheath. Individuals that are homozygous for the defective allele have Tay-Sachs disease and die at an early age. Studies suggest that heterozygous individuals have a higher survival rate against tuberculosis than the rest of the population. Biochemical tests can be done to determine if parents are carriers.

7. If tuberculosis regained its former role as one of the world's deadliest diseases, then the frequency of the Tay-Sachs allele over time would

a. decrease because of a decreased selective advantage

b. increase because of an increased selective advantage

c. decrease because of an increased selective advantage

d. remain the same as a result of Hardy-Weinberg equilibrium

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8. The flowers of the organ pipe cactus open during the night and close during the day to avoid dehydration during the heat of the day. This adaptation of the cacti to the desert climate **most likely** occurred as a result of

a. increased mutation rates in flowers stimulated by high temperatures

b. increased reproductive success of cacti with flowers that opened at night

c. the intense heat of the desert, which destroyed all flowers that opened during the day nad caused the cacti to open its flowers at night

d. the reaction of the cacti to the extreme heat, which caused it to close its flowers during the day and to gradually develop the behaviour of opening its flowers at night.

Summary from last class:

The Hardy-Weinberg equation is used to detect microevolution (changes in the diversity of a gene pool). Microevolution in a population is caused by one or more of the following five processes:

- inheritable mutations
- gene flow
- non-random mating
- genetic drift
- founder effect
- bottleneck effect
- natural selection

Jun 5-12:10 AM

Today you will:

- **explore growth and decline of populations**
- **explore distribution of their members**
- **and explain population patterns using mathematical models and graphs**

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Density and Distribution of Populations

- all populations can be described in terms of density and distribution

Population density (D_p) - the number of individual organisms (N) in a given area (A) or volume (V).

$$D_p = \frac{N}{A} \quad \text{or} \quad D_p = \frac{N}{V}$$

Sample Problem

ex) 10, 892 snow shoe hares in 35 hectares of land around Red Deer in 1999. The population Density is:

$$D_p = \frac{N}{A} = \frac{10\,892}{35} = 311.2 \text{ hares/hec.}$$

ex) Suppose that a 200.0 ml sample of stagnent pond water contains 54 wrigglers (mosquito larvae). The density of the sample is:

$$D_p = \frac{N}{V} = \frac{54 \text{ wrigglers}}{200.00 \text{ ml}} = 0.27 \text{ wrigglers/ml}$$

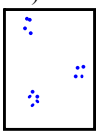
- this information can be used to estimate the size of a mosquito population in an aquatic community at a given time.
- mosquitos can carry various infectious diseases, large numbers can pose a threat to health
- local authorities need to consider controls to keep mosquitos in check based on the size of the population.

You need to know how a population is distributed within its habitat before taking samples to determine population size.
- unequal distribution can give you false results ex) Banff snails and spring water

Population Distribution

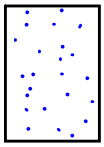
• influenced by distribution of resources in a habitat and the interactions among members of a population or a community

1) Clumped Distribution: (more common)



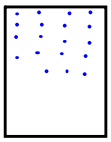
- individuals congregate in area where food, water or shelter is most abundant
ex) Banff spring snails clump where spring water emerges from the ground, grasses on a beach, humans

2) Random distribution



- organisms that are found in many different locations
- weeds grow just as well in a lawn as they do in a parking lot
- resources are abundant
- pop. do not have to compete w/ eachother or group to survive
ex) summertime, individual bull moose or female moose

3) Uniform distribution



ex) artificial populations such as plants growing in orchards or agricultural crops

• most populations do not perfectly fit any one pattern of distribution
• ex) mosquito larvae = clumped, then when mature and fly off = random
• ex) moose = random, however, clump near food and shelter for periods of time in the winter

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Population Density to Changes in Population Growth:

I: How does a population change in size over time?

- when individuals are added or removed in populations
- **4 factors**:
  - natality: number of births in a population (b)
  - mortality: number of deaths in a population (d)
  - immigration: number of individuals that move **into** a population (i)
  - emigration: number of individuals that move **out of** a population (e)

↑ pop.

↓ pop.

- population growth is expressed as:

ΔN = (factors that ↑ pop.) − (factors that ↓ pop.)

[b + i] − [d + e]

- in a mature ecosystem the population remains stable over time with subtle peaks and valleys.
- THIS IS CALLED DYNAMIC EQUILIBRIUM

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Rate of Population Growth

Just as important as the change in the size of a population is the speed at which the change occurs.

population explosion: - dramatic increase in the size of a pop. over a short period of time

population crash: - a dramatic decrease in the size of a population over a short period of time

Growth rate - change in # of individuals in a population (ΔN) over a specific time frame (Δt)

$$gr = \frac{\Delta N}{\Delta t}$$

- measures increases or decreases
(-) = ↓ pop.
(+) = ↑ pop.

ex) Determine the growth rate if there were 12, 456 hares in Red Deer in 1989 and 10, 892 hare in 1999.

$$gr = \frac{\Delta N}{\Delta t} = \frac{10892 - 12456}{1999 - 1989} =$$

$$-156.4 \text{ hares/yr}$$

• Now scientists can ask, why are the numbers falling? habitat loss, predators, disease, hunters,.....?

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per capita growth rate (cgr) = change in population size per individual over a given time frame

$$cgr = \frac{\Delta N}{N}$$

- allows you to compare growth rate of two pop. of diff. size.

ex) Suppose that, in a town of 1000 people, there are 50 births, 30 deaths, and no immigration or emigration in a year.

During this time interval

$$cgr = \frac{\Delta N}{N} = \frac{50-30}{1000}$$

$$= 0.02$$

p576

Biotic Potential vs Environmental Resistance!

Every environment has a specific "K" but each species has a unique Biotic Potential! (r)

carrying capacity

* **Biotic Potential** - the max # of offspring that can be produced by a species under ideal conditions.
-> BUILDS UP A POPULATION!

Biotic Potential depends on:

1) *Fecundity* - the max # of offspring a female can produce/pregnancy
2) *Sexual Maturity Age*: earlier, more babies in its lifetime. (Elephants mature @ 14 yrs, mice @ 6 mo)
3) *Length of Gestation*: 9 months vs 9 days
4) *Length of Reproductive life*: 30 years vs 30 days
5) *Capacity for Survival*: chance offspring live to reproductive age.
6) *Number of times / year the organism reproduces*!

biotic and abiotic factors

Environmental Resistance - ~~factors~~ that slow down population growth! à KNOCKS DOWN A POPULATION

Many resources become scarce as populations grow

- lack of food, oxygen water
- lack of heat, light
- lack of territory
- Parasites, predators, Poisoning, waste accumulation
- Weather changes (*frost, flood, drought, fire etc*)
- disease increases
- competition increases
- Overcrowding increases

Law of Minimum: A minimum level of resources necessary for an individual to survive!

* limiting factors prevent populations from achieving their biotic potential; and determine the carrying capacity of the populations

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Biotic potential (r) - the maximum number of offspring that a species could produce with unlimited resources

Carrying capacity (k) - represents the # of individuals in a population that can live in a given environment without depleting the resources they need or harming their habitat or themselves

r vs K selected populations:
What is an organism's advantage of producing many or few offspring at a time?

- If a population lives in an unpredictable environment (seasonal, volatile) it may choose to produce many offspring in the hope that some survive.
- Predict the BIOTIC POTENTIAL!

-> This is considered an r-selected population
(*r for rapid population growth*)

- Some populations live in stable environments and have time to produce few BUT more competitive offspring!
- Predict the BIOTIC POTENTIAL!

-> This is considered a K-selected population
(*K for carrying capacity is maintained*)

Characteristics of r & K selected populations!

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II: Population Types

open - a natural setting where natality, mortality and migrations can occur. --> any place wild and free

closed - where a population is isolated reducing migrations -> game preserve, island, aquarium, petri dish etc

↳ winter time animals can migrate

III: Population Growth Curves

- population change over time is best shown in GRAPH form
- there are 2 kinds of growth curves -> **J and S shaped curves**

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A) J-Shaped Growth Curve

- typical of CLOSED or DENSITY INDEPENDENT populations

* r-selected pop.*

↳ abiotic factor that limits a habitat's carrying capacity

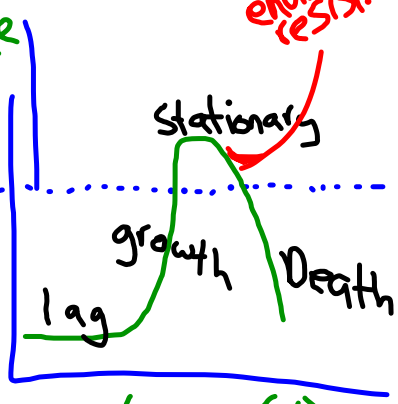
impact not affected by density of pop.

pop. vs time

carrying capacity

ex) fire, flood

- 4 regions of the GROWTH CURVE



- lag phase- pop. introduction or beginning season

-few individuals so growth is low.

- growth phase-

natality exceeds mortality

- stationary phase -

natality = mortality

*exponential growth

- death phase - mort. exceeds nat.

Logistic growth

B) S-shaped Growth Curve

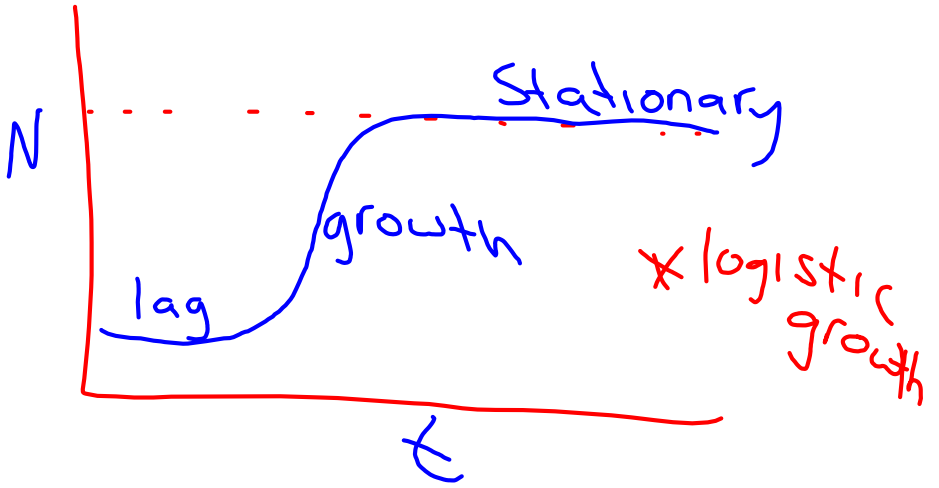
- typical of OPEN or DENSITY DEPENDENT populations

K-selected → biotic factor that limits a habitats carrying capacity

ex) parasites, disease, competition, predation

→ the impact ↑ with the density of the pop.

- label the following curve:



*logistic growth

- the stationary phase continues called plateau.

→ carry capacity → the maximum # of individuals that can be sustained by a given supply of resources

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