Population size

CONCEPT REVIEW 37
Complete this concept review handout and keep it as a record of what you have learned.

Definitions

- In ecology, a population is _a group of individuals of the same species, living in a shared space at a specific point in time._

- Population size refers _to the number of individuals in a population._

Factors affecting population size

Births	Deaths
Immigration	Emigration

Methods for measuring the size of a population

Method	Description
Counting individuals tion.	Counting all the individuals within the area occupied by that popula-
Counting by sample area	Counting of the individuals in randomly selected sections of the study area and then estimating the total population size using a formula.

Formula:
$$\text{Population size} = \frac{(\text{Average number of individuals per section} \times \text{Total study area})}{\text{Area of a section}}$$

Mark and recapture	Installing cages or nets to capture individuals; counting and marking captured individuals; releasing the marked animals; second capture of individuals and counting of marked and unmarked animals; estimating the size of the population using a mathematical formula.

Formula:
$$\text{Population size} = \frac{(\text{Number of marked animals} \times \text{Total number of animals captured the second time})}{\text{Number of marked animals recaptured}}$$

INTEGRATION QUESTIONS
Population: size

1. Associate each of the statements with a change (decrease or increase) in the size of a Québec population. Support your answer by citing factors that affect population size.

   a) The black bear population in Québec experiences a 50-birth boom. At the same time, 60 black bears cross the border into Ontario.

   The black bear population is decreasing because emigration is more significant than the number of births.

   b) A number of sparrows in Québec City die because of drought, while others fly to the Maritimes.

   Mortality and emigration cause the sparrow population to fall.

   c) Thousands of monarchs fly to Mexico at the end of the summer. Many perish on the way. However, a similar number of monarchs returns in spring.

   The monarch population remains stable: emigration and immigration are equivalent.

2. What method of measurement would be most appropriate to count the following populations?

   a) The population of ants in the school yard.

   Counting by sample area with the use of quadrats, because ants are slow-moving animals.

   b) The number of maples in a park.

   Counting individuals.

   c) The squirrel population in the same park.

   Mark and recapture, because squirrels move too quickly to be counted by eye.

3. What is the size of the following populations? Show your calculations.

   a) There is an average of seven dandelions per m² in the local cemetery; the area of the cemetery is 5000 m².

   $$\frac{7 \text{ dandelions} \times 5000 \text{ m}^2}{1 \text{ m}^2} = 35\,000 \text{ dandelions}$$

   b) In the Grands-Jardins National Park in the Charlevoix region, scientists capture and mark 25 caribous. On a second capture the following year, they take 39, 15 of which are wearing a marking collar.

   $$\frac{25 \text{ caribous} \times 39 \text{ caribous}}{15 \text{ caribous}} = 65 \text{ caribous}$$

Population density and biological cycles

DENSITY AND DISTRIBUTION

Definitions

- Population density refers _to the number of individuals per unit of area or volume._

Mathematical formula:

$$\text{Population density} = \frac{\text{Number of individuals}}{\text{Space (area or volume) occupied}}$$

- Population distribution is _the way in which individuals are dispersed within their habitat._

Patterns of distribution

Pattern of distribution	Description	Example
Clumped distribution	Individuals form groups to provide some protection from predators and to feed themselves more efficiently. Most common pattern of distribution.	Fish that move around their habitat in schools.
Clumped distribution	Individuals are dispersed equally throughout the population's habitat due to competition for natural resources.	Northern gannets, which space their nests at regular intervals.
Uniform distribution Random distribution	Individuals are randomly and unpredictably dispersed across the population's habitat. Pattern of distribution rarely found.	Bushes growing in a field.

ECOLOGICAL FACTORS
Definitions

- An ecological factor is *an aspect of a habitat that can affect the organisms living there.*

- Abiotic factors are *ecological factors of physical or chemical origin.*

- Biotic factors are *ecological factors related to the actions of living organisms.*

- A limiting factor is *an ecological factor that causes the density of a population to decrease.*

Examples of ecological factors

Abiotic factors	Biotic factors
Amount of light	Birth rate
Soil or water pH	Disease
Terrain	Amount of food
Depth of snow	Predation
Temperature	Competition
Air humidity	Human activity

BIOLOGICAL CYCLE
Definition

- The biological cycle of a population is composed of *alternating periods of rise and fall in its size. These periods are of fixed duration and are repeated continually.*
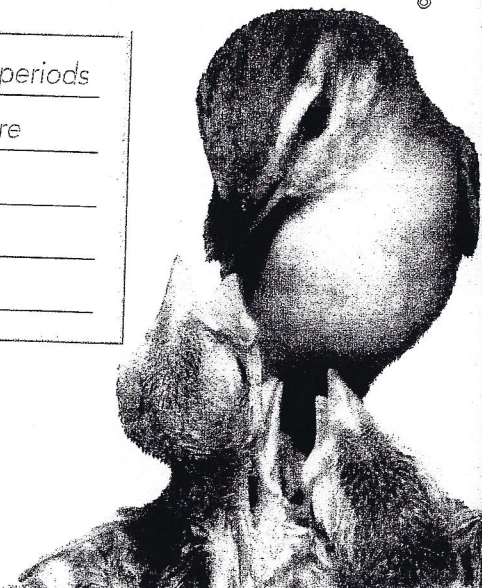
Name: _____ Class: _____ Date: _____

INTEGRATION QUESTIONS
Population density and biological cycles

1. Calculate the density of the following populations. Show your calculations.

   a) In an 80 000-litre pond, there are 5000 smallmouth bass. What is the density of smallmouth bass per litre of water?

 $$\frac{5000}{80\ 000} = 0.0625 \text{ fish per litre of water}$$

   b) In a 30 000-km² African wildlife park, there are 15 000 giraffes. What is the density of giraffes per km²?

 $$\frac{15\ 000}{30\ 000} = 0.5 \text{ giraffes per km}^2$$

   c) In a 24-hectare urban park, there are 4008 trees. What is the density of trees per hectare?

 $$\frac{4008}{24} = 167 \text{ trees per hectare}$$

2. The figures below illustrate the main patterns of population distribution. Specify which pattern depicted is in each of the figures. Explain your answer.

   a)
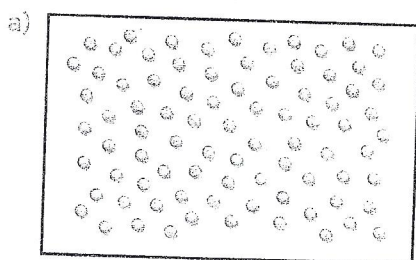
   This is a uniform distribution because individuals are dispersed equally throughout their habitat.

   b)
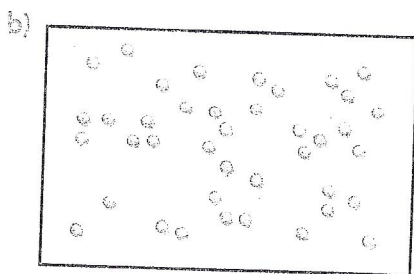
   This is a random distribution because individuals are randomly and unpredictably dispersed across their habitat.

   c)
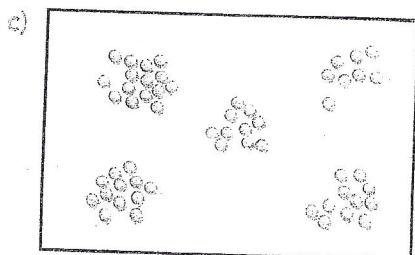
   This is a clumped distribution because individuals form groups within their habitat.

3. The underlined words in the sentences below correspond to ecological factors. Indicate whether the factors are limiting or non-limiting, and biotic or abiotic by ticking the appropriate box in the table.

a) In a community garden, the tomatoes do not get enough sun and fail to ripen.

b) The mosquito population has risen this year, to the delight of spiders that catch them in their webs.

c) So much snow fell this winter that caribous had difficulty digging through the thick snow cover to find moss and other greenery to graze on.

d) In the Gulf of St. Lawrence, seals are more numerous and cod shoals are nearly empty.
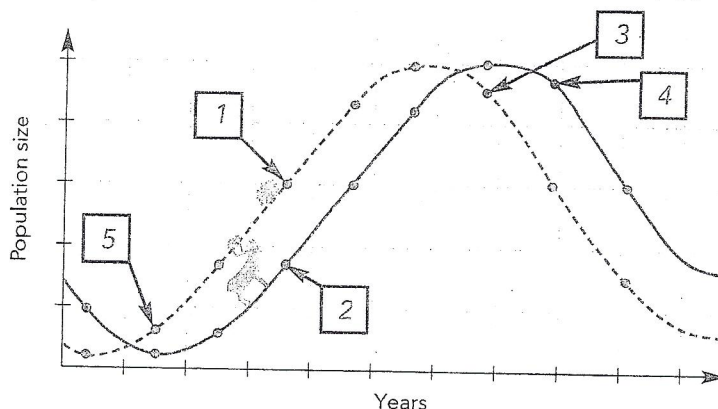
	Limiting	Non-limiting	Biotic	Abiotic
a)	✓			✓
b)		✓	✓	
c)	✓			✓
d)	✓		✓	

4. Study the diagram carefully.

a) The statements below correspond to different periods in the biological cycles of lichen and caribou. Put the periods in order by numbering them.

b) Mark the figures corresponding to the statements in the appropriate boxes in the diagram.

BIOLOGICAL CYCLES OF LICHEN AND CARIBOU

A. When climatic conditions are ideal, lichen grows in abundance on Arctic lands. Caribou can easily eat and reproduce. [1]

B. The number of caribou is such that the lichen does not have enough time to regenerate. The lichen population begins to decrease. [3]

C. Eventually, since there are fewer caribou, the lichen is better able to grow and spread. The amount of lichen increases and the cycle begins anew. [5]

D. The well-fed caribou herd begins to grow. Individuals eat more and more lichen. [2]

E. When there is not enough lichen to eat, the caribou find it difficult to survive and reproduce. Their population begins to decline. [4]

Communities and biodiversity

📖 PAGES 308 TO 309

CONCEPT REVIEW 39

Remplissez cette fiche synthèse pour conserver une trace de vos apprentissages.

Definitions

- A community is *a set of populations of different species sharing the same habitat.*

- Biodiversity describes *the variety of species living in a community.*

Main components of biodiversity

Component	Description
Species richness of a community	*Number of species in the community.*
Relative abundance of a species	*Number of individuals of a particular species in relation to the total number of individuals in the community.*

Main types of interaction between individuals of a community

Interaction	Description
Competition	*Interaction between living organisms that seek access to the same resource in their habitat.*
Predation	*Interaction between two living organisms in which one feeds on the other.*
Mutualism	*Interaction between two living organisms that benefits both organisms.*
Commensalism	*Interaction between two living organisms in which one organism benefits from the relationship, while the other remains unaffected.*
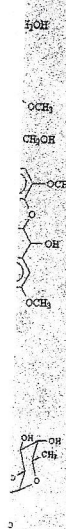
INTEGRATION QUESTIONS
Communities: biodiversity

1. What is the relative abundance (as a percentage) of the species (underlined words) in question?

   a) In a forest, there are 5,000 trees, including 450 <u>pines</u>.
   450/5000 = 0.09, namely 9%

   b) In a field, there are 150 small mammals, including 50 <u>ground hogs</u>.
   50/150 = 0.33, namely 33.33%

2. In each case, specify which habitat (A or B) has the greatest biodiversity. Justify your answer.

   a) Forest A has maples, birch and pines. Forest B includes only pines. Both forests have the same number of trees.
   Forest A since there are more species.

   b) Pond A has trout, perch and green algae. The algae cover 80 percent of the water body, whereas the trout and the perch cover 10 percent each. In Pond B, there are also trout, perch and green algae. However, the relative abundance of each species is similar.
   Pond B since, even though there are the same number of species in Pond A, their relative abundance is similar.

   c) The species richness of Park A is greater than the species richness of Park B.
   Park A since it has more species.

3. True or false?

   a) In order for there to be competition, the resource in a habitat must be limited.
   True.

   b) Fish are in competition for lake water.
   False.

   c) Plants are in competition for the nutrients in the soil.
   True.

   d) For predation to occur, an organism must die.
   False.

   e) The parasite does not harm its host.
   False.

   f) Mutualism characterizes bees that gather pollen from flowers.
   True.

   g) A human being who gives bird seed to birds maintains a relationship based on comensalism with them.
   True.

ADDITIONAL QUESTIONS

○ **Populations: size** ○ **Populations: density and biological cycles**
○ **Communities: biodiversity**

1. Read the following text and then answer the questions.

Addo Elephant National Park in South Africa was created in 1931 to preserve the region's surviving elephants, which were being hunted by farmers tired of having their crops ravaged by local herds. Recently, using aerial photographs, scientists have counted 300 elephants in this 120 km² park.

a) What is the size of the elephant population in Addo Elephant National Park?
300 elephants.

b) What method did the scientists use to determine the number of elephants?
Counting individuals.

c) Why did the scientists choose this method of measurement?
Because it is a population of large animals living in an open habitat.

d) What is the density of the elephant population living in the park?

$$\frac{300}{120} = 2.5 \text{ elephants per km}^2$$

e) What would be the size of the elephant herd population if 4 adult elephants that died of old age, 10 elephant calves were born and the park accepted 15 new elephants from another reserve?

300 elephants − 4 + 10 + 15 = 321 elephants

f) The elephants travel in a group. What is the elephants' distribution mode?
Clumped distribution.

The elephants share the park with buffalo and antelopes. During a period of drought, water is much less abundant and the animals fight over sources of water. What type of relationship do these three species have with respect to water?

Competition (interspecific).

Considering the previous statement, what type of relationship do the elephants have among themselves with respect to water?

Competition (intraspecific).

In a period of drought, water is a specific ecological factor. What is it?

A limiting ecological factor.

Is water a biotic or an abiotic factor? Why?

Water is an abiotic factor since it is a physical element of the habitat.

Name the biotic and abiotic factors that could have an effect on the elephant population. *Answers will vary. Examples.*

Abiotic factors	Biotic factors
Terrain.	*Competition.*
Temperature.	*Disease.*
Brush fire.	*Birth rate.*
Temperature of the sand.	*Amount of food.*

The Addo Elephant National Park serves as a refuge for elephants, buffalo, antelopes and birds. If the Addo park sheltered 30 percent elephants, 30 percent buffalo, 20 percent antelopes and 20 percent birds, and the neighbouring park sheltered 60 percent giraffes, 30 percent elephants and 10 percent birds, which of the two parks would have the greatest biodiversity with respect to these species? Explain your answer.

The Addo park would have the greatest diversity because it would have a larger number of species (their relative abundance would be similar to that of the animals in the second park).

Lady bugs reproduce in large numbers in the springtime. Since you know that these insects feed on aphids, what will happen to the two populations? Comment on the biological cycle of lady bugs and aphids.

The aphid population will decrease as a result of the predation of the lady bugs. When there are fewer aphids, the lady bugs will find it hard to find food and their population will start to decline. The aphids will take advantage of the drop in the number of lady bugs to reproduce and increase their population. Then the cycle will start over again.