Past-paper walk-through

Pathogens and Infectious Diseases ▪ 8.15

eXercise

Questions in this set

- 2016 Q1

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 1

2016 ▪ Q1

Read the following article from the *Fremont New Tribune*.

Fremont New Tribune — May 2, 2016

As another winter concludes, biologists are alarmed by the continued spread of white nose syndrome (WNS) in bats. WNS is a fungal disease that is decimating bat populations across eastern North American forests, with mortality rates reaching up to 100 percent at many sites. WNS has been found in at least 25 states in the United States and 5 Canadian provinces.

The fungus (*Pseudogymnoascus destructans*) grows well in cool conditions such as those found in caves and has been observed as white patches on the muzzles, noses, ears, and wings of many cave-dwelling bats. WNS has caused significant population declines for several bat species, including once-numerous species such as the little brown bat (*Myotis lucifugus*).

Question 1

Little brown bats hunt using echolocation by emitting up to 200 high-frequency calls per second when pursuing their prey. When healthy, the little brown bat can live up to ten years and have one or two offspring (called pups) each year.
"Little brown bats provide tremendous value to the United States economy every year by the essential services they provide to farmers and other people. We need to understand how this deadly disease spreads and attempt to help reduce its impact on the little brown bat and other bat species," said Dr. Duke Serach of the Fremont office of the United States Fish and Wildlife Service. Dr. Serach concluded with, "It may yet be possible to save the little brown bats, but the remaining population will be alarmingly small."
(a) Diseases can devastate populations; however, most diseases do not drive their host to extinction. **Provide** one explanation for why diseases seldom cause extinction.

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Fremont New Tribune **May 2, 2016**

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(b)(i) Dr. Serach suggests that even if the impact of WNS on little brown bat populations can be reduced and the extinction of the species avoided, the bat populations are likely to remain alarmingly small.

Describe TWO threats (other than WNS) to the survival of the bat species if the total number of bats becomes very small.

Question 1

(b)(ii) If the little brown bat species does not become extinct and can potentially recover, the rate of recovery is likely to be slow. **Discuss** one aspect of bat biology that might slow the recovery of little brown bat populations to pre-WNS numbers.

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(c) Bats are found in ecosystems around the world. **Describe** TWO ways in which other organisms in an ecosystem could be affected by a decline in a bat population.

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(d) The Eastern deciduous forest in which the little brown bats live is an important ecosystem. **Identify** TWO ecosystem services that forests provide, and **explain** how each service benefits human society.

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(e) WNS is an emerging disease in bats. Humans are also subject to emerging diseases, such as Ebola. A recent study suggests that the number of emerging infectious diseases affecting human populations has been steadily increasing in recent decades. **Provide** a likely reason for the increase in emerging infectious diseases affecting human populations. Include an explanation for the reason you provided.

Solution 1

(a)

Mark scheme

- 1 point for any one valid explanation of why diseases seldom cause extinction: genetic diversity in wild populations lets some resistant individuals survive and reproduce; disease organisms often co-evolve with their hosts, allowing hosts to evolve resistance; pathogens/disease organisms that drive their host population to extinction jeopardize their own survival; initial deaths thin (reduce the density of) the population, making it less likely the disease will continue to spread.

Solution 1

(b)(i) Mark scheme

- 2 points: 1 point for each of TWO described threats (other than WNS) to a very small bat population — only the first two distinct threats given earn credit. Acceptable: difficulty finding mates when the population is small/widely dispersed or has a skewed sex ratio; competition from other species with a similar niche (e.g., nesting sites, food); problems from reduced genetic diversity (small gene pool, lack of hybrid vigor, a disease affecting all members, bottleneck effect); susceptibility to reduced fitness from decreased group protection (not enough individuals to create heat, less protection from predators, increased predation risk without safety-in-numbers); increased vulnerability to environmental disturbances (must name a specific disturbance).

Solution 1

(b)(ii)

Mark scheme

- 1 point for a correct discussion of one aspect of bat biology that would slow recovery to pre-WNS numbers: low fecundity/few babies per year; long generation times; advanced age at first reproduction; or increased parental care requirements.

Solution 1

(c) Mark scheme

- 2 points: 1 point for each of TWO described ways other ecosystem organisms could be affected by a bat population decline — only the first two given earn credit. Acceptable: increase in bat food sources (e.g., insect pest populations rise); increase in West Nile virus and other insect-borne diseases; decrease in the spread of rabies; decrease in the fungus that causes WNS; decrease in bat guano (affecting guano-dependent organisms); decline in plants that bats pollinate or disperse seeds for; decline in bat predators due to decreased food supply; increase in numbers of animals with similar food/habitat needs; a resulting trophic cascade.

Solution 1

(d) Mark scheme

- 2 points: 1 point for each of TWO correctly paired ecosystem services with their human benefit. Acceptable pairs — resource material (tree/forest): lumber, building materials, fuel, paper, food; oxygen production: human respiration; soil formation/protection: forestry, agriculture, flood control, water quality; protection of water supplies: drinking water, recreation, irrigation, fishing; habitat (specify, e.g., shade/temperature moderation): animals/plants humans use for fishing, hunting, food; biodiversity: food, medicine, gene diversity, breeding stock; carbon sink/sequestering: slows climate change; aesthetic/cultural/social value: inspiration for art/music/poetry, research, education, recreation, tourism.

Solution 1

(e) Mark scheme

- 2 points: 1 point for a valid reason for the increase in emerging infectious diseases, plus 1 point for a correctly linked explanation of how that reason increases disease emergence. Acceptable pairs — climate change/global warming: allows pathogens and disease vectors to survive in places previously too cold or dry; increase in global travel: increased likelihood of contracting/spreading disease; increased exposure to animals (zoonotic): changes in agricultural practices increase rodent exposure, trade in exotic species, intrusion into wild habitats, urban sprawl; increase in population density/distribution: increased likelihood of contracting/spreading disease from others; lack of vaccinations: increases human susceptibility, reduces herd immunity; antibiotic resistance: new

Solution 1

disease strains evolve; decrease in medical care/public health: poverty, war, migration, human behavior (refusing condoms, sharing needles, refusing aid).