Past-paper walk-through

Endangered Species ▪ 9.9

eXercise

Questions in this set

- 2026 Q1
- 2026 Q3
- 2021 Set 2 Q2
- 2019 Q1
- 2018 Q3
- 2017 Q2

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

2026 ▪ Q1

The following information applies to parts A, B, C, D, and E.

Climate change can affect both terrestrial and marine organisms. Researchers studying the effect of climate change on bird distribution mapped elevation zones at which five bird species lived within a tropical mountain range. Birds are distributed in part according to climate-related adaptations. Researchers modeled where the birds would most likely live in the future based on climate change predictions.

The results of this study are shown in the following diagram. Each unique shape in the diagram represents a different bird species, labeled A through E. Current distribution is shown on the left side of the figure, and predicted future distribution is shown on the right.

Bird Species Distribution

Question 1

[Diagram: a pyramid-shaped chart titled “Bird Species Distribution,” split into a “Current Distribution” half (left) and “Predicted Future Distribution” half (right), divided by a vertical center line. The pyramid is divided into four horizontal elevation bands, from top (narrowest) to bottom (widest): “High Elevations,” “Mid-High Elevations,” “Mid-Low Elevations,” and “Low Elevations,” separated by dashed lines. Each band shows bird-shape icons above the letters A, B, C, D, E (Current side) and A, B, C, D, E (Predicted Future side), indicating which species is present at that elevation. A legend defines a black bird silhouette = “Species present at elevation” and a gray bird silhouette = “Extinct species.”
Current Distribution:

- High Elevations: Species A and Species C present.
- Mid-High Elevations: Species A present.

Question 1

- Mid-Low Elevations: Species B and Species D present.
- Low Elevations: Species B, Species C, Species D, and Species E present.

Predicted Future Distribution:

- High Elevations: Species A present; Species E shown extinct (gray icon).
- Mid-High Elevations: Species B and Species D present.
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Question 1

The following information applies to parts F, G, and H.
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- Tank 1: 27°C and no sediment
- Tank 2: 32°C and no sediment

Question 1

- Tank 3: 37°C and no sediment

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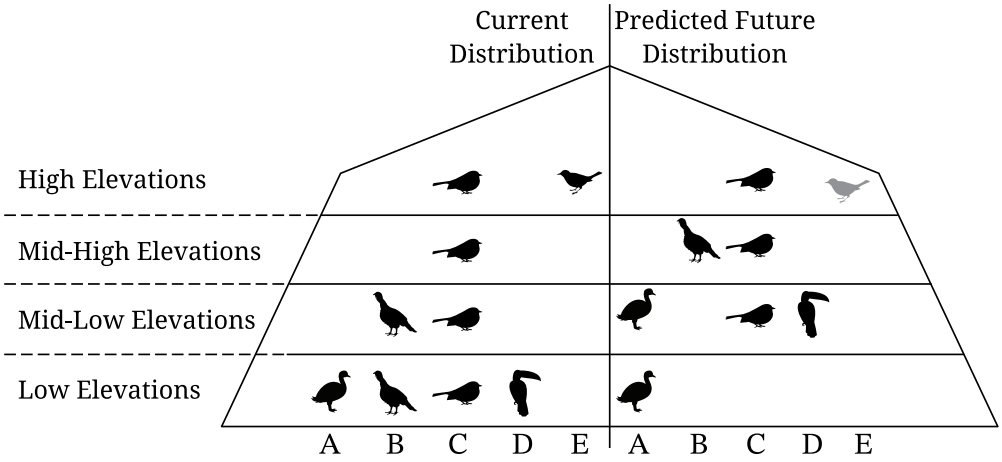
- Tank 3: 27°C and high sediment

1. Respond to parts A, B, C, D, E, F, G, H, I, and J.

(a) Based on the information in the diagram, **identify** the elevation zone that has the highest species richness for the current distribution.

Question 1


Current Distribution
Predicted Future Distribution
High Elevations
Mid-High Elevations
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A B C D E
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Question 1

2026 ▪ Q1

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- Mid-High Elevations: Species B and Species D present.
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Question 1

1. Respond to parts A, B, C, D, E, F, G, H, I, and J.

(b) Describe a climate condition at high elevations that is different than it is at low elevations.

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(c) A predator at low elevations currently feeds on Species C and D. Based on the information in the diagram, **describe** what could happen to the predator species in the future in response to the predicted changes in the prey community.

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(d) Species C is considered a generalist, while Species E is considered a specialist. **Explain** why Species C and E are predicted to respond differently to climate change.

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(e) Based on the information in the diagram, **explain** why the bird community at low elevations in the future would be less likely to recover from natural disruptions than the current low-elevation bird community.

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1. Respond to parts A, B, C, D, E, F, G, H, I, and J.

(f) Identify the independent variable in Experiment 1.

Question 1

2026 ▪ Q1

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(g) Identify a likely scientific question for Experiment 1.

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(h) In Experiment 2 the temperature of the tanks was held constant, while the amount of sediment was varied. **Explain** how this modification could affect the results of this experiment.

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(i) Changes in climate also affect Arctic ecosystems. One impact of climate change is the loss of ice and snow in polar regions. **Describe** a positive feedback loop that results from the loss of ice and snow in polar regions.

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Bird Species Distribution

[Diagram: a pyramid-shaped chart titled "Bird Species Distribution," split into a "Current Distribution" half (left) and "Predicted Future Distribution" half (right), divided by a vertical center line. The pyramid is divided into four horizontal elevation bands, from top (narrowest)

Question 1

to bottom (widest): “High Elevations,” “Mid-High Elevations,” “Mid-Low Elevations,” and “Low Elevations,” separated by dashed lines. Each band shows bird-shape icons above the letters A, B, C, D, E (Current side) and A, B, C, D, E (Predicted Future side), indicating which species is present at that elevation. A legend defines a black bird silhouette = “Species present at elevation” and a gray bird silhouette = “Extinct species.”
Current Distribution:

- High Elevations: Species A and Species C present.
- Mid-High Elevations: Species A present.
- Mid-Low Elevations: Species B and Species D present.
- Low Elevations: Species B, Species C, Species D, and Species E present.

Predicted Future Distribution:

- High Elevations: Species A present; Species E shown extinct (gray icon).

Question 1

- Mid-High Elevations: Species B and Species D present.
- Mid-Low Elevations: Species A, Species C, and Species D present.
- Low Elevations: Species A present.]

The following information applies to parts F, G, and H.
Some organisms such as birds can move in response to environmental changes, while other organisms such as corals cannot. Researchers studying the effect of climate change on marine organisms conducted two experiments involving photosynthetic algae that have a symbiotic relationship with corals.
In Experiment 1, the researchers placed photosynthetic algal colonies living in corals in three different saltwater tanks. The temperature of Tank 1 was set to 27°C, the average temperature at which most corals live. Water circulation in each tank mimicked natural ocean currents. After 30 days, the researchers counted the number of bleached corals. The tank setups are shown in the following list.

Question 1

- Tank 1: 27°C and no sediment
- Tank 2: 32°C and no sediment
- Tank 3: 37°C and no sediment

In Experiment 2, the researchers used the same photosynthetic algae living in corals but modified the conditions of the tanks as shown in the following list. Water circulation kept the sediment in the tanks suspended. After 30 days, the researchers counted the number of bleached corals.

- Tank 1: 27°C and no sediment
- Tank 2: 27°C and moderate sediment
- Tank 3: 27°C and high sediment

Question 1

1. Respond to parts A, B, C, D, E, F, G, H, I, and J.

(j) Describe one problem that Arctic species, such as polar bears or ringed seals, face because of warming in polar regions.

Question 3

2026 ▪ Q3

The following information applies to parts A, B, C, D, E, and F.
Ocelots are small wildcats that were previously found in 25 counties in Texas where shrubland is prevalent. As a result of land use changes, only 74 ocelots remain in 4 counties in Texas today. Rodents such as pocket mice are the main source of food for ocelots, but ocelots also prey on other small animals such as snakes and lizards.

3. Respond to parts A, B, C, D, E, and F, and all subparts.

(a) Identify one environmental consequence that could result from having a smaller population of ocelots.

Question 3

2026 ▪ Q3

The following information applies to parts A, B, C, D, E, and F.
Ocelots are small wildcats that were previously found in 25 counties in Texas where shrubland is prevalent. As a result of land use changes, only 74 ocelots remain in 4 counties in Texas today. Rodents such as pocket mice are the main source of food for ocelots, but ocelots also prey on other small animals such as snakes and lizards.

3. Respond to parts A, B, C, D, E, and F, and all subparts.

(b) Calculate the percent change in the number of Texas counties where ocelots have been found historically as compared to today. **Show** your work.

Question 3

2026 ▪ Q3

The following information applies to parts A, B, C, D, E, and F.
Ocelots are small wildcats that were previously found in 25 counties in Texas where shrubland is prevalent. As a result of land use changes, only 74 ocelots remain in 4 counties in Texas today. Rodents such as pocket mice are the main source of food for ocelots, but ocelots also prey on other small animals such as snakes and lizards.

3. Respond to parts A, B, C, D, E, and F, and all subparts.

(c) Researchers expect the ocelot population to grow at a constant rate of 2.8% per year. **Calculate** the number of years it will take for the ocelot population to double based on a constant rate of growth. **Show** your work.

Question 3

2026 ▪ Q3

The following information applies to parts A, B, C, D, E, and F.
Ocelots are small wildcats that were previously found in 25 counties in Texas where shrubland is prevalent. As a result of land use changes, only 74 ocelots remain in 4 counties in Texas today. Rodents such as pocket mice are the main source of food for ocelots, but ocelots also prey on other small animals such as snakes and lizards.

3. Respond to parts A, B, C, D, E, and F, and all subparts.

(d) Pocket mice eat plants in the shrubland, while snakes are carnivores. **Explain** why the amount of primary production energy available to ocelots would change if ocelots ate only carnivores such as snakes and not pocket mice.

Question 3

2026 ▪ Q3

The following information applies to parts A, B, C, D, E, and F.
Ocelots are small wildcats that were previously found in 25 counties in Texas where shrubland is prevalent. As a result of land use changes, only 74 ocelots remain in 4 counties in Texas today. Rodents such as pocket mice are the main source of food for ocelots, but ocelots also prey on other small animals such as snakes and lizards.

3. Respond to parts A, B, C, D, E, and F, and all subparts.

(e) Ocelots need 720 grams of food per day. Pocket mice weigh an average of 43 grams each. If the ocelot diet consists of 46% pocket mice by weight, **calculate** how many pocket mice an ocelot would need to consume in one day, assuming each mouse weighs the average amount. **Show** your work.

Question 3

2026 ▪ Q3

The following information applies to parts A, B, C, D, E, and F.
Ocelots are small wildcats that were previously found in 25 counties in Texas where shrubland is prevalent. As a result of land use changes, only 74 ocelots remain in 4 counties in Texas today. Rodents such as pocket mice are the main source of food for ocelots, but ocelots also prey on other small animals such as snakes and lizards.

3. Respond to parts A, B, C, D, E, and F, and all subparts.

(f)(i) As urbanization has increased in southern Texas, motor vehicle collisions have become the main cause of death in ocelots, which poses an added threat to the remaining ocelots.

Propose a realistic solution to reduce the number of ocelots killed by vehicles.

(f)(ii) Justify the solution proposed in part F (i) by explaining an additional advantage, other than reducing the number of ocelots killed by vehicles.

Question 2

2021 Set 2 ▪ Q2

Biodiversity around the world is changing as a result of anthropogenic influences.
[World map titled "GLOBAL AMPHIBIAN SPECIES RICHNESS", drawn in an oval (Robinson-style) projection with latitude lines labeled 60°, 30°, 0°, 30°, 60° (top to bottom) and longitude lines labeled 180°, 120°, 60°, 0°, 60°, 120°, 180° (left to right). A legend "Number of species" shows four shading categories: diagonal hatching = 0-20 species; light gray = 21-50 species; medium gray = 51-100 species; black = 101-136 species. The map shows the darkest shading (101-136 species, highest richness) concentrated in a band along the equator (0°) in South America (the Amazon basin) and a small patch in central Africa; medium-gray shading (51-100 species) in a broader band around the tropics in South America, Central America, sub-Saharan Africa, and parts of Southeast Asia/South Asia (e.g., India, Myanmar/Thailand region); lighter shading (21-50 species) in a band through central Africa and parts of South America;

Question 2

and diagonal-hatch shading (0-20 species, lowest richness) at higher latitudes including North America, Europe, northern Asia/Russia, and most of Australia.]

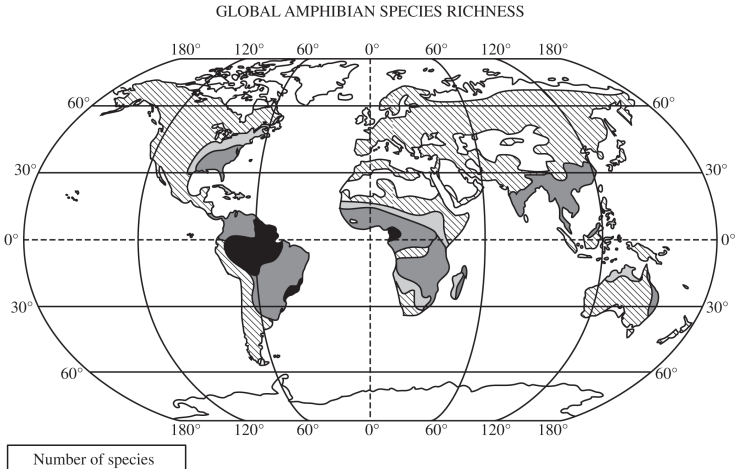
(a)(i) The map represents species richness of amphibians around the globe. Use the map to answer the following questions.

Identify the latitudinal range with the greatest amphibian species richness.

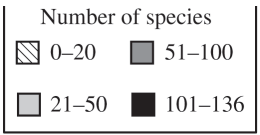
(a)(ii) Identify what biome this range most likely represents.

(a)(iii) Describe one reason amphibian species richness would tend to be highest in this region.

Question 2


GLOBAL AMPHIBIAN SPECIES RICHNESS
180° 120° 60° 0° 60° 120° 180°
60°
30°
0°
30°
60°
Number of species

Question 2



Question 2

2021 Set 2 ▪ Q2

Biodiversity around the world is changing as a result of anthropogenic influences.

[World map titled “GLOBAL AMPHIBIAN SPECIES RICHNESS”, drawn in an oval (Robinson-style) projection with latitude lines labeled 60°, 30°, 0°, 30°, 60° (top to bottom) and longitude lines labeled 180°, 120°, 60°, 0°, 60°, 120°, 180° (left to right). A legend “Number of species” shows four shading categories: diagonal hatching = 0-20 species; light gray = 21-50 species; medium gray = 51-100 species; black = 101-136 species. The map shows the darkest shading (101-136 species, highest richness) concentrated in a band along the equator (0°) in South America (the Amazon basin) and a small patch in central Africa; medium-gray shading (51-100 species) in a broader band around the tropics in South America, Central America, sub-Saharan Africa, and parts of Southeast Asia/South Asia (e.g., India, Myanmar/Thailand region); lighter shading (21-50 species) in a band through central Africa

Question 2

and parts of South America; and diagonal-hatch shading (0-20 species, lowest richness) at higher latitudes including North America, Europe, northern Asia/Russia, and most of Australia.]

(b) There are many environmental threats facing amphibians today, such as deforestation. Describe one possible anthropogenic reason for deforestation.

Question 2

2021 Set 2 ▪ Q2

Biodiversity around the world is changing as a result of anthropogenic influences.

[World map titled “GLOBAL AMPHIBIAN SPECIES RICHNESS”, drawn in an oval (Robinson-style) projection with latitude lines labeled 60°, 30°, 0°, 30°, 60° (top to bottom) and longitude lines labeled 180°, 120°, 60°, 0°, 60°, 120°, 180° (left to right). A legend “Number of species” shows four shading categories: diagonal hatching = 0-20 species; light gray = 21-50 species; medium gray = 51-100 species; black = 101-136 species. The map shows the darkest shading (101-136 species, highest richness) concentrated in a band along the equator (0°) in South America (the Amazon basin) and a small patch in central Africa; medium-gray shading (51-100 species) in a broader band around the tropics in South America, Central America, sub-Saharan Africa, and parts of Southeast Asia/South Asia (e.g., India, Myanmar/Thailand region); lighter shading (21-50 species) in a band through central Africa

Question 2

and parts of South America; and diagonal-hatch shading (0-20 species, lowest richness) at higher latitudes including North America, Europe, northern Asia/Russia, and most of Australia.]

(c)(i) Many factors influence biodiversity.
Explain how the species richness of an ecosystem influences its response to environmental stressors.

(c)(ii) Explain why amphibian biodiversity is declining globally, other than from deforestation.

Question 2

2021 Set 2 ▪ Q2

Biodiversity around the world is changing as a result of anthropogenic influences.

[World map titled “GLOBAL AMPHIBIAN SPECIES RICHNESS”, drawn in an oval (Robinson-style) projection with latitude lines labeled 60°, 30°, 0°, 30°, 60° (top to bottom) and longitude lines labeled 180°, 120°, 60°, 0°, 60°, 120°, 180° (left to right). A legend “Number of species” shows four shading categories: diagonal hatching = 0-20 species; light gray = 21-50 species; medium gray = 51-100 species; black = 101-136 species. The map shows the darkest shading (101-136 species, highest richness) concentrated in a band along the equator (0°) in South America (the Amazon basin) and a small patch in central Africa; medium-gray shading (51-100 species) in a broader band around the tropics in South America, Central America, sub-Saharan Africa, and parts of Southeast Asia/South Asia (e.g., India, Myanmar/Thailand region); lighter shading (21-50 species) in a band through central Africa

Question 2

and parts of South America; and diagonal-hatch shading (0-20 species, lowest richness) at higher latitudes including North America, Europe, northern Asia/Russia, and most of Australia.]

(d)(i) Currently, wildlife species are going extinct at an alarming rate. To combat this threat, governments around the world have enacted legislation and signed treaties to protect species threatened by extinction.

Identify one specific piece of legislation that has been designed to protect species threatened by extinction.

(d)(ii) Explain how the requirements of the legislation identified in part (d)(i) specifically protect species threatened by extinction.

Question 2

2021 Set 2 ▪ Q2

Biodiversity around the world is changing as a result of anthropogenic influences.

[World map titled “GLOBAL AMPHIBIAN SPECIES RICHNESS”, drawn in an oval (Robinson-style) projection with latitude lines labeled 60°, 30°, 0°, 30°, 60° (top to bottom) and longitude lines labeled 180°, 120°, 60°, 0°, 60°, 120°, 180° (left to right). A legend “Number of species” shows four shading categories: diagonal hatching = 0-20 species; light gray = 21-50 species; medium gray = 51-100 species; black = 101-136 species. The map shows the darkest shading (101-136 species, highest richness) concentrated in a band along the equator (0°) in South America (the Amazon basin) and a small patch in central Africa; medium-gray shading (51-100 species) in a broader band around the tropics in South America, Central America, sub-Saharan Africa, and parts of Southeast Asia/South Asia (e.g., India, Myanmar/Thailand region); lighter shading (21-50 species) in a band through central Africa

Question 2

and parts of South America; and diagonal-hatch shading (0-20 species, lowest richness) at higher latitudes including North America, Europe, northern Asia/Russia, and most of Australia.]

(e)(i) A town is considering selling an undeveloped parcel of land along its border for residential developments. The square parcel of land consists of approximately 30% wetland and 70% pasture. The wetland runs through the middle of the property for its entire width and is home to three native frog species.

Propose a viable solution that will result in the protection of the native frog species while still allowing for maximum profit of the property development.

(e)(ii) Justify the solution proposed in (e)(i) by describing a potential advantage of the plan, other than frog protection.

Solution 2

(a)(i)

Mark scheme

- The greatest amphibian species richness occurs in the latitudinal range between the Tropic of Cancer and the Tropic of Capricorn (equivalently, roughly 30 degrees N to 30 degrees S, or more narrowly about 10 degrees N to 15 degrees S).

(a)(ii)

Mark scheme

- This latitudinal range most likely represents the tropical rainforest biome.

Solution 2

(a)(iii)

Mark scheme

- Amphibian species richness tends to be highest here because year-round rainfall and warm temperatures are the preferred conditions for amphibians, and greater biodiversity/higher net primary productivity (NPP) provides more habitat, food sources, and niches.

Solution 2

(b)

Mark scheme

- A possible anthropogenic reason for deforestation is human demand for agriculture, housing, firewood, or other forest products (e.g., medicine, food, lumber).

Solution 2

(c)(i)

Mark scheme

- An ecosystem with greater species richness/diversity is more resilient/resistant to environmental stressors, because even if some species are harmed, other species will survive and help restore/stabilize the ecosystem.

Solution 2

(c)(ii) Mark scheme

- Amphibian biodiversity is declining globally (aside from deforestation) for reasons such as: increasing water pollution (pharmaceutical pollution harming reproduction, pesticide pollution absorbed through the skin being toxic, endocrine disruptors such as atrazine altering reproductive development); pesticide use reducing insect food sources; microclimatic changes from global climate change (warmer/drier conditions, loss of wetlands) reducing available habitat; illegal amphibian trafficking removing individuals from populations; introduced invasive species competing for niche space; habitat fragmentation limiting range and access to resources; or fungal infections such as chytridiomycosis causing skin to dry out so amphibians cannot breathe. Any one such reason earns the point.

Solution 2

(d)(i)

Mark scheme

- One specific piece of legislation designed to protect species threatened by extinction: the Endangered Species Act (ESA), the Convention on International Trade in Endangered Species (CITES), or the Lacey Act.

Solution 2

(d)(ii) Mark scheme

- Explanation depends on the legislation named in (d)(i). ESA: lists endangered/threatened plant and animal species and prevents them from being killed or harmed; designates/protects critical habitat to promote survival and recovery; creates plans to restore populations to healthy sizes; identifies species as threatened before they become endangered. CITES: a global agreement that protects endangered/threatened plants and animals (including goods such as ivory, shark fins, or rhinoceros' horns) by banning/regulating their trade. Lacey Act: prohibits the trade of wildlife, fish, and plants that have been illegally taken, possessed, transported, or sold.

Solution 2

(e)(i)

Mark scheme

- A viable solution: move/transplant the frog populations to an adjacent undeveloped area before development; designate a portion of the wetland as a park/preserve; build wildlife corridors (land or bridges) across a portion of the wetland; restrict development within a minimum setback away from the wetland; or group/cluster the buildings together (build up, not out) to leave the wetland undisturbed.

Solution 2

(e)(ii) Mark scheme

- Justification depends on the solution proposed in (e)(i). Move/transplant frogs: only a one-time disruption during removal rather than continued disruption (e.g., population growth, fertilizer/pesticide use), and the developer gets the maximum amount of usable land. Park/preserve: more food and space availability increases wildlife survival rates; a nearby park/preserve is an educational/environmental draw that may let the developer charge higher rents; the wetland has aesthetic value for residents; and the preserved wetland helps prevent flooding. Wildlife corridors: other species are less affected by habitat fragmentation and can keep moving for food, shelter, and reproduction. Setback: creates a buffer zone that filters runoff into the wetland and adds resident privacy. Clustered/grouped

Solution 2

development: species are less affected by multiple habitat fragments because the apartments are developed in groups while wetlands are preserved.

Question 1

2019 ▪ Q1

The piping plover is a globally threatened species, with perhaps as few as 2,000 nesting pairs remaining in the Atlantic population of these migratory shorebirds. Plovers were nearly hunted to extinction in the nineteenth century.

Plovers prefer to nest and search for food on open sandy beaches between sparsely vegetated sand dunes. Washovers, where sand is washed up from the beach and buries vegetated areas during big storms, are also important to plovers because they provide moist and undisturbed habitat for plover adults and their chicks. Ecologists with the Elliott Oceanographic Institute mapped the distribution of plover nests during two seasonal surveys of nesting sites over a ten-year period on Assateague Island. This is a barrier island, a long, narrow island running parallel to the Atlantic coast of Virginia.

SPRING PIPING PLOVER NESTING SITES ON ASSATEAGUE ISLAND, VIRGINIA

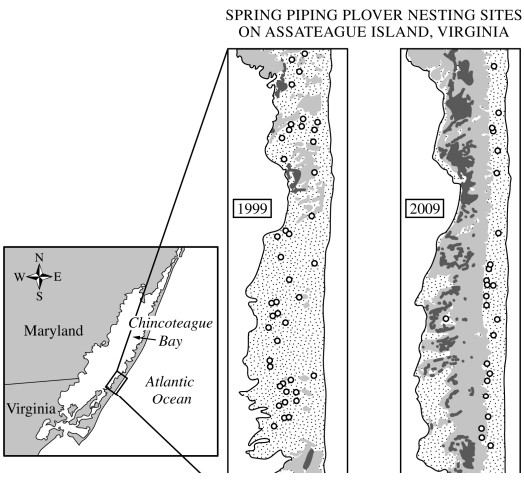
Question 1

[Two side-by-side maps of the barrier island Assateague Island, Virginia, labelled "1999" and "2009", each showing the shoreline with symbols marking piping plover nest locations. A small inset locator map at left shows Maryland and Virginia with Chincoteague Bay, the Atlantic Ocean, and a compass rose (N, S, E, W), with a box indicating the zoomed-in region of Assateague Island. Legend: hatched/dotted pattern = Unvegetated sand; light gray = Sparsely vegetated sand; dark gray = Densely vegetated sand; open circle (o) = Piping plover nest. The 1999 map shows nests scattered mainly in the unvegetated/sparsely vegetated (lighter) areas along the shoreline, with relatively little densely vegetated (dark gray) area. The 2009 map shows a similar shoreline but with a much larger area of densely vegetated (dark gray) sand covering the interior of the island, and nests still concentrated in the narrower band of unvegetated/sparsely vegetated sand along the coast.]

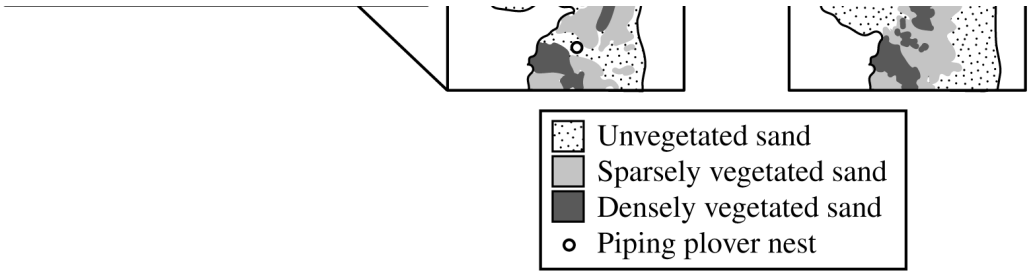
Question 1

Approximately 40% of the United States population resides in coastal areas, such as areas near Assateague Island, where sea level rise and shoreline erosion is occurring.
(a)(i) Use the maps provided to answer the following questions.
Identify the preferred nesting habitat for piping plovers.
(a)(ii) Describe the change in the number of piping plover nests on Assateague Island between 1999 and 2009.
(a)(iii) Describe one likely reason for the change in the number of piping plover nests between 1999 and 2009.

Question 1


SPRING PIPING PLOVER NESTING SITES
ON ASSATEAGUE ISLAND, VIRGINIA
1999
2009
N
W
E
S
Maryland
Virginia
Chincoteague
Bay
Atlantic
Ocean

Question 1


Unvegetated sand
Sparsely vegetated sand
Densely vegetated sand
Piping plover nest

Question 1

2019 ▪ Q1

The piping plover is a globally threatened species, with perhaps as few as 2,000 nesting pairs remaining in the Atlantic population of these migratory shorebirds. Plovers were nearly hunted to extinction in the nineteenth century.

Plovers prefer to nest and search for food on open sandy beaches between sparsely vegetated sand dunes. Washovers, where sand is washed up from the beach and buries vegetated areas during big storms, are also important to plovers because they provide moist and undisturbed habitat for plover adults and their chicks. Ecologists with the Elliott Oceanographic Institute mapped the distribution of plover nests during two seasonal surveys of nesting sites over a ten-year period on Assateague Island. This is a barrier island, a long, narrow island running parallel to the Atlantic coast of Virginia.

SPRING PIPING PLOVER NESTING SITES ON ASSATEAGUE ISLAND, VIRGINIA

[Two side-by-side maps of the barrier island Assateague Island, Virginia, labelled “1999” and “2009”, each showing the shoreline with symbols marking piping plover nest locations. A small

Question 1

inset locator map at left shows Maryland and Virginia with Chincoteague Bay, the Atlantic Ocean, and a compass rose (N, S, E, W), with a box indicating the zoomed-in region of Assateague Island. Legend: hatched/dotted pattern = Unvegetated sand; light gray = Sparsely vegetated sand; dark gray = Densely vegetated sand; open circle (o) = Piping plover nest. The 1999 map shows nests scattered mainly in the unvegetated/sparsely vegetated (lighter) areas along the shoreline, with relatively little densely vegetated (dark gray) area. The 2009 map shows a similar shoreline but with a much larger area of densely vegetated (dark gray) sand covering the interior of the island, and nests still concentrated in the narrower band of unvegetated/sparsely vegetated sand along the coast.]

Approximately 40% of the United States population resides in coastal areas, such as areas near Assateague Island, where sea level rise and shoreline erosion is occurring.

(b)(i) Coastal species are affected by more than just natural events.

Question 1

Special beach restrictions can help piping plovers during nesting season. Describe one restriction that could reasonably be implemented to help prevent the destruction of plover nests by human actions.

(b)(ii) In addition to providing habitat for piping plovers, barrier islands (and closely related landforms) are important for other reasons. Explain one way that these features help to preserve and protect the environment in coastal regions.

(b)(iii) Identify one human action that directly threatens coastal habitats and describe one impact on species, other than the piping plover, that use the habitat.

Question 1

2019 ▪ Q1

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SPRING PIPING PLOVER NESTING SITES ON ASSATEAGUE ISLAND, VIRGINIA

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Approximately 40% of the United States population resides in coastal areas, such as areas near Assateague Island, where sea level rise and shoreline erosion is occurring.

(c) Identify one economic impact on coastal communities that has resulted from rising sea levels.

Question 1

2019 ▪ Q1

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SPRING PIPING PLOVER NESTING SITES ON ASSATEAGUE ISLAND, VIRGINIA

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Question 1

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Approximately 40% of the United States population resides in coastal areas, such as areas near Assateague Island, where sea level rise and shoreline erosion is occurring.

(d) Describe TWO methods that may be used locally to protect coastal communities from rising sea levels.

Solution 1

(a)(i)

Mark scheme

- Preferred nesting habitat for piping plovers: unvegetated sand / sandy areas / open sandy beaches / washovers. Full credit for identifying any one of these habitat types.

Solution 1

(a)(ii)

Mark scheme

- The number of piping plover nests decreased by almost half (about 43%) between 1999 and 2009 — from 44 nests in 1999 to 25 nests in 2009 (a decrease of 19 nests). Full credit for correctly describing this decrease (exact numbers not required).

Solution 1

(a)(iii)

Mark scheme

- One likely reason: the preferred nesting habitat (unvegetated sand) was reduced — either because of a decrease in unvegetated sandy areas, or because of an increase in vegetation/revegetation of the island. Full credit for identifying either cause of habitat loss.

Solution 1

(b)(i)

Mark scheme

- One reasonable restriction to prevent destruction of plover nests by human actions, e.g.: post warning signs/fencing/barrier tape/boardwalks around the nesting area; place wire enclosures/other barriers over active nests; limit specified recreational activity on beaches with plover nests (prohibit kite flying, fireworks, etc.); implement motor vehicle restrictions (limit times, size of vehicles, raking, etc.); require pets to remain indoors or on leashes. Full credit for any one reasonable restriction.

Solution 1

(b)(ii)

Mark scheme

- One way barrier islands help preserve/protect the coastal environment, e.g.: they block/buffer wind and/or waves, mitigating beach erosion; they reduce storm surge, protecting the interior coastline from flooding; they block/buffer waves and create wetland ecosystems/pools that serve as habitat for many species (fish, turtles, migratory birds); they trap sediments/pollutants in wetland habitats/marsh grasses, filtering the water. Full credit for any one correct explanation.

Solution 1

(b)(iii) Mark scheme

- 2 points — 1 point for identifying a human action that directly threatens coastal habitats, 1 point for describing a matching impact on a coastal species other than the piping plover. Acceptable paired examples: Tourism/Recreation → beachgoers step on/crush nests, unleashed pets disrupt nesting/survival, vehicles disrupt nesting/survival, litter attracts predators/harbors pathogens, sunscreen washes off and is toxic to coral/marine organisms; Coastal Development → loss of suitable habitat, noise/light pollution disrupts nesting/migration/survival, food/garbage attracts predators/harbors pathogens; Littering/Solid Waste Disposal → species get tangled in trash, or ingest trash which fills/blocks the respiratory/digestive tract; Offshore Oil Drilling → spilled oil coats coastal marine organisms impacting

Solution 1

survival, or is toxic if ingested; Commercial Fishing $\rightarrow$ dredging/trawling destroys coral/habitat for bottom-dwelling organisms, overharvesting decreases populations, species get trapped in fishing gear. Award 1 point for a valid human action, 1 point for a correctly linked impact on a non-plover species.

Solution 1

(c) Mark scheme

- One economic impact on coastal communities from rising sea levels, e.g.: decrease of tourist revenue; decrease of property value; increase in damage to property/land/infrastructure requiring repair or replacement; increase in insurance costs; loss of agricultural land or aquaculture operations resulting in financial loss; loss of fish nurseries in wetland areas leading to less revenue for commercial fisheries; increase in jobs in infrastructure/construction to repair damaged structures/properties; increase in costs associated with preventative measures (building sea walls, raising buildings, etc.). Full credit for any one valid economic impact.

Solution 1

(d) Mark scheme

- Describe TWO methods that may be used locally to protect coastal communities from rising sea levels, 1 point per correct distinct method (max 2), e.g.: raise structures to reduce/prevent water damage; move/build structures back from the beach (setbacks) to reduce/prevent water damage; install pumps to reduce flooding; build structures such as sea walls to protect the area from wave action/storm surge/flooding/erosion; plant vegetation along the shoreline to decrease erosion; replenish sand to address erosion problems or increase beach width; build jetties/groins to act as a barrier from waves.

Question 3

2018 ▪ Q3

An Arctic food web includes the following organisms.

[Food-web diagram showing organisms connected by arrows pointing from prey to predator (from what is eaten to what eats it), labeled: "Orca", "Polar Bear", "Arctic Cod", "Ringed Seal", "Krill (zooplankton)", "Diatom (phytoplankton)". Arrows: Diatom (phytoplankton) → Krill (zooplankton); Diatom (phytoplankton) → Ringed Seal; Krill (zooplankton) → Arctic Cod; Arctic Cod → Orca; Arctic Cod → Polar Bear; Ringed Seal → Polar Bear; Ringed Seal → Orca; Polar Bear → Orca. Note: Figures not drawn to scale.]

(a)(i) Refer to the food web above to complete the following table.

Question 3

	Organism from Arctic food web
(i) Identify a primary producer	
(ii) Identify a primary consumer	
(iii) Identify a secondary consumer	

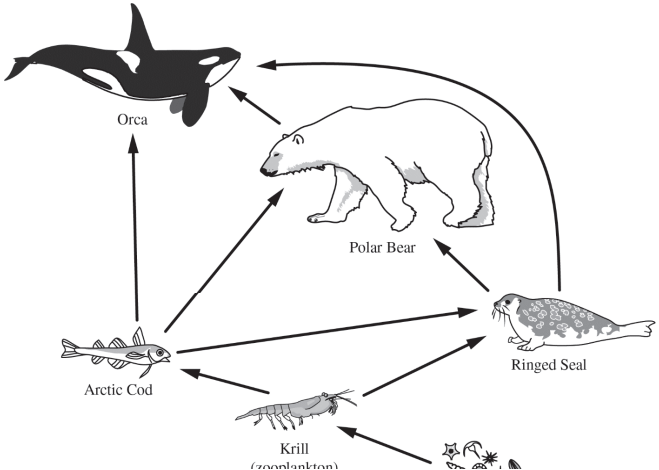
Identify a primary producer.

(a)(ii) Identify a primary consumer.

Question 3

(a)(iii) Identify a secondary consumer.

Question 3



Question 3

(zooplankton)

Diatom
(phytoplankton)

Note: Figures not drawn to scale.

Question 3

	Organism from Arctic food web
(i) **Identify** a primary producer	
(ii) **Identify** a primary consumer	
(iii) **Identify** a secondary consumer	

Question 3

2018 ▪ Q3

An Arctic food web includes the following organisms.

[Food-web diagram showing organisms connected by arrows pointing from prey to predator (from what is eaten to what eats it), labeled: "Orca", "Polar Bear", "Arctic Cod", "Ringed Seal", "Krill (zooplankton)", "Diatom (phytoplankton)". Arrows: Diatom (phytoplankton) → Krill (zooplankton); Diatom (phytoplankton) → Ringed Seal; Krill (zooplankton) → Arctic Cod; Arctic Cod → Orca; Arctic Cod → Polar Bear; Ringed Seal → Polar Bear; Ringed Seal → Orca; Polar Bear → Orca. Note: Figures not drawn to scale.]

(b) Other than showing which organisms are consumed by other organisms, describe what is indicated by the direction of the arrows in the diagram.

Question 3

2018 ▪ Q3

An Arctic food web includes the following organisms.

[Food-web diagram showing organisms connected by arrows pointing from prey to predator (from what is eaten to what eats it), labeled: “Orca”, “Polar Bear”, “Arctic Cod”, “Ringed Seal”, “Krill (zooplankton)”, “Diatom (phytoplankton)”. Arrows: Diatom (phytoplankton) → Krill (zooplankton); Diatom (phytoplankton) → Ringed Seal; Krill (zooplankton) → Arctic Cod; Arctic Cod → Orca; Arctic Cod → Polar Bear; Ringed Seal → Polar Bear; Ringed Seal → Orca; Polar Bear → Orca. Note: Figures not drawn to scale.]

(c) As the amount of sea ice has decreased, larger expanses of the Arctic Ocean are now completely free of sea ice for several weeks each summer. Ringed seals, the preferred prey of polar bears, come to holes in the sea ice to breathe.

Describe how the change in sea ice habitat is affecting polar bears’ ability to hunt and feed.

Question 3

2018 ▪ Q3

An Arctic food web includes the following organisms.

[Food-web diagram showing organisms connected by arrows pointing from prey to predator (from what is eaten to what eats it), labeled: “Orca”, “Polar Bear”, “Arctic Cod”, “Ringed Seal”, “Krill (zooplankton)”, “Diatom (phytoplankton)”. Arrows: Diatom (phytoplankton) → Krill (zooplankton); Diatom (phytoplankton) → Ringed Seal; Krill (zooplankton) → Arctic Cod; Arctic Cod → Orca; Arctic Cod → Polar Bear; Ringed Seal → Polar Bear; Ringed Seal → Orca; Polar Bear → Orca. Note: Figures not drawn to scale.]

(d) Explain how melting sea ice leads to a feedback loop that increases Arctic warming.

Question 3

2018 ▪ Q3

An Arctic food web includes the following organisms.

[Food-web diagram showing organisms connected by arrows pointing from prey to predator (from what is eaten to what eats it), labeled: “Orca”, “Polar Bear”, “Arctic Cod”, “Ringed Seal”, “Krill (zooplankton)”, “Diatom (phytoplankton)”. Arrows: Diatom (phytoplankton) → Krill (zooplankton); Diatom (phytoplankton) → Ringed Seal; Krill (zooplankton) → Arctic Cod; Arctic Cod → Orca; Arctic Cod → Polar Bear; Ringed Seal → Polar Bear; Ringed Seal → Orca; Polar Bear → Orca. Note: Figures not drawn to scale.]

(e)(i) Many species, including some whales and birds, will travel thousands of kilometers during annual migrations.

Provide one reason a species may migrate a long distance.

(e)(ii) The North Atlantic right whale migrates between subtropical and polar waters annually. Nearly 50 percent of right whale deaths are due to human activities.

Question 3

Describe one commercial activity, other than whaling, that may result in the death of right whales.

(e)(iii) Describe one strategy that could reasonably be implemented to decrease right whale deaths caused by the commercial activity you described in part (ii).

Solution 3

(a)(i)

Mark scheme

- 1 point for correctly identifying a primary producer from the Arctic food web: Diatom (phytoplankton).

(a)(ii)

Mark scheme

- 1 point for correctly identifying a primary consumer from the Arctic food web: Krill (zooplankton).

Solution 3

(a)(iii)

Mark scheme

- 1 point for correctly identifying a secondary consumer from the Arctic food web: Cod or seal.

Solution 3

(b)

Mark scheme

- 1 point for a correct description of what the arrow direction indicates, other than which organisms are consumed by others. Accept: shows the flow of energy among trophic levels; OR shows the flow of matter through trophic levels.

Solution 3

(c) Mark scheme

- 1 point for a correct description of how the changing sea ice habitat affects polar bears' ability to hunt/feed. Accept any one of: decreasing area of hunting ground (fewer seal breathing holes/less ice for hauling out) makes it more difficult for polar bears to get food; increasing distance between hunting grounds means polar bears must exert more energy to swim to find food, causing physical exhaustion and less energy available for hunting; increasing physiological stress (dehydration, exhaustion, cub mortality) because polar bears are not physiologically adapted to warmer temperatures; increasing the time between successful kills means bears spend more time waiting/hunting for prey.

Solution 3

(d)

Mark scheme

- 2 points: 1 point for explaining the connection between melting ice and increased absorption of the sun's energy, and 1 point for explaining that this increased absorption leads to further ice melt (completing the positive feedback loop). Melting of sea ice leads to a decrease in albedo/reflectivity, causing water surfaces to absorb more of the sun's energy; AND this increasing absorption of the sun's energy warms the water surface further, which leads to further ice melt (completes the positive feedback loop).

Solution 3

(e)(i)

Mark scheme

- 1 point for a correct reason a species may migrate a long distance. Accept any one of: limited food/water supply leads to migration to locations with more food/water supply; food supply migrates and the species follows its prey; more hospitable climate during certain seasons; availability of mates/breeding/birthing occurs in a different location; protection of offspring from predators.

Solution 3

(e)(ii)

Mark scheme

- 1 point for a correct description of a commercial activity, other than whaling, that may result in right whale deaths. Accept any one of: fishing nets entangle whales as by-catch/fishing gear can accidentally trap whales; ships and whales use the same channels, which can increase the number of ship strikes; noise pollution from seismic surveys/sonar/engine noise can disrupt a whale's internal navigational system.

Solution 3

(e)(iii) Mark scheme

- 1 point for a correct strategy linked to the activity named in part (ii). If fishing gear/by-catch was named: require a change of fishing method (location, timing, or materials) that traps whales, to reduce the number of whales trapped in nets/gear; OR fines for discarded fishing gear so less gear is discarded, reducing whales trapped in gear. If ship strikes were named: improved navigational technology to spot whales close to ships to avoid collisions; OR increased education of ship captains/crews about whale habitat/migration routes/feeding behaviors; OR expansion of low-speed navigational zones around ports. If noise pollution was named: reduction of seismic survey activity/sonar use in coastal areas; OR installation of quieter motors to reduce/eliminate noise pollution.

Question 2

2017 ▪ Q2

Populations of large terrestrial animals, such as African elephants and snow leopards, are in decline around the world. Many of these large animals are now on the verge of extinction.

ESTIMATED AFRICAN ELEPHANT POPULATION ON THE AFRICAN CONTINENT

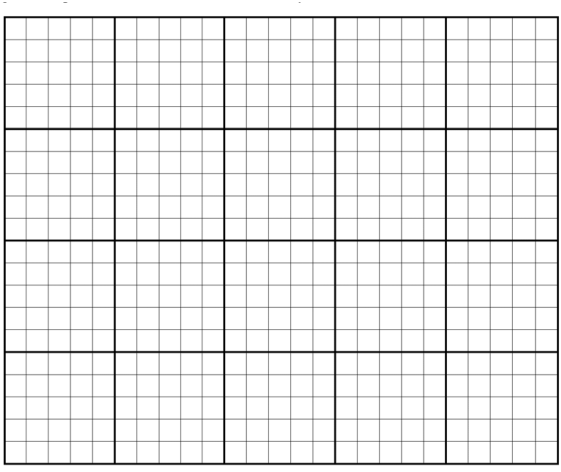
Year	Population
1970	2,000,000
1980	1,300,000
1990	600,000
1995	550,000
2000	400,000
2005	550,000
2010	650,000
2015	600,000

Question 2

(a) Using the data provided in the table above, plot the elephant population data as points on the grid below, placing the independent variable on the x-axis. Clearly label the axes.

[Blank grid for plotting; a large graph-paper grid divided into a 4×4 arrangement of bold-outlined blocks, each subdivided into finer squares, with no axes, labels, or values printed — intended for the student to draw and label the axes and plot the points from the table above.]

Question 2



Question 2

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