Past-paper walk-through

Disruptions in Ecosystems ▪ 8.7

eXercise

Questions in this set

- 2026 Q6
- 2025 Q3
- 2024 Q4
- 2022 Q5
- 2017 Q2
- 2016 Q6
- 2014 Q3
- 2014 Q5

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 6

2026 ▪ Q6

Many raptors in Africa are top predators and keystone species in their ecosystems. Raptor population sizes have been declining in recent years.

Scientists studied the relationship between the conversion of the raptors' natural habitat into farmland and the population sizes of raptors in those regions. They compiled raptor population size data from three different regions of Africa: Region 1, Region 2, and Region 3. In each of the regions, the scientists compared the annual percent change in the raptor population size in areas that were protected from farming (protected) with the annual percent change in areas where farming occurred (unprotected). Their results are shown in the box and whisker plot.

Median Annual Percent Change in the Population Size of Raptors in Protected and Unprotected Areas

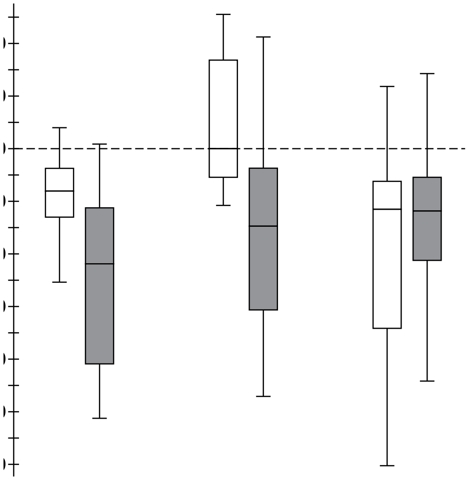
Question 6

[Box-and-whisker plot; y-axis "Annual Percent Change in Population Size" from -14.0 to 6.0 in increments of 2.0; x-axis groups: Region 1, Region 2, Region 3, each with two boxes (white = Protected area, gray = Unprotected area); a dashed horizontal reference line at $y = 0$.
Region 1 - Protected area: whiskers from about -5.0 to 0.8, box (IQR) from about -2.3 to -0.8, median line at about -1.7. Region 1 - Unprotected area: whiskers from about -10.3 to 0.2, box from about -8.2 to -2.3, median line at about -4.3.
Region 2 - Protected area: whiskers from about -2.2 to 5.2, box from about -1.2 to 3.4, median line at about 0.0. Region 2 - Unprotected area: whiskers from about -9.4 to 4.3, box from about -6.1 to -0.8, median line at about -3.0.
Region 3 - Protected area: whiskers from about -12.1 to 2.3, box from about -7.0 to -1.2, median line at about -2.3. Region 3 - Unprotected area: whiskers from about -8.8 to 2.9, box from about -4.2 to -1.1, median line at about -2.4.]

Question 6

(a) Based on the box and whisker plot, **identify** the median annual percent change in population size in the unprotected area of Region 2.
(b) Based on the box and whisker plot, **identify** the region and area that experienced the greatest median annual percent change in population size.
(c) Researchers hypothesize that if farming is eliminated in Region 2, there will no longer be a decline in the raptor population size. Based on the data in the box and whisker plot, **evaluate** the researchers' hypothesis.
(d) Based on the information provided, **explain** why ecosystem resilience in unprotected areas may decline over time.

Question 6



Question 3

2025 ▪ Q3

Buffelgrass, an invasive grass species in southwestern desert ecosystems, is threatening the saguaro cactus, a keystone species in these ecosystems. Buffelgrass is drought-tolerant and can survive wildfires. However, the dry buffelgrass also acts as fuel for wildfires, causing the fires to be more severe. Older saguaro cacti can survive wildfires; however, many of the young cacti cannot.

Scientists conducted an experiment to determine whether they could control the abundance of the buffelgrass population. The scientists identified several native grass species that, when grown with buffelgrass, might reduce the abundance of buffelgrass. They grew buffelgrass in the presence of several different native grass species in greenhouses, in either nondrought (watered every 3 days) or drought (watered every 9 days) conditions. After twelve weeks, they measured the height and dry weight of the buffelgrass in each treatment group.

Question 3

(a) Describe the effect that removing a keystone species will have on an ecosystem.
(b) Identify a control group the scientists should include in their experiment.
(c) State the null hypothesis of the experiment in which buffelgrass is grown in the presence of native grass species.
(d) Scientists have found that the population growth rates of native grasses are much slower than the population growth rate of buffelgrass following a wildfire. The scientists claim that wildfires will therefore increase the abundance of buffelgrass plants in the ecosystem. Based on the information given, justify the scientists' claim.

Solution 3

(a)

Mark scheme

- Removing a keystone species reduces biodiversity/diversity/resilience of the ecosystem, and can cause the ecosystem to collapse.

Solution 3

(b)

Mark scheme

- A control group with only buffelgrass planted (no native grass species) — i.e., buffelgrass grown alone under each water condition, to compare against buffelgrass grown together with native grasses.

Solution 3

(c)

Mark scheme

- Null hypothesis: there will be no difference in / effect on the abundance/dry weight/height/size of buffelgrass when grown alone compared with when grown together with native grass species (equivalently: no difference in these measures of buffelgrass grown under drought vs nondrought conditions).

Solution 3

(d)

Mark scheme

- With fewer native plant species surviving after a wildfire (since native grasses regrow much more slowly than buffelgrass), buffelgrass will face less/no competition for resources and so will have more resources available for growth, development, and reproduction — supporting the claim that wildfires increase buffelgrass abundance.

Question 4

2024 ▪ Q4

The common wild oat is native to regions of Europe and Asia but is an invasive species in central California grasslands. In California, the common wild oat has almost completely replaced some species of native bunchgrass. Researchers found that aphids, a type of small insect that often carries plant viruses, have a much higher reproductive rate in grasslands that include the common wild oat than in grasslands composed of only native bunchgrass species. Additionally, the viruses carried by the aphids appear to affect only the native bunchgrasses and not the common wild oat. Native bunchgrasses infected by the virus have much higher death rates than do native bunchgrasses that are not infected.

(a) Describe the change in the resilience of an ecosystem when there is a decrease in the number of species.

Question 4

(b) Explain how the addition of the common wild oat affects the number of native bunchgrass plants that can be supported by the California grasslands ecosystem.
(c) Researchers suggest adding ladybugs, predators of aphids, to the California grasslands. **Predict** the effect of adding ladybugs on the abundance of the native bunchgrass population.
(d) Justify your prediction in part (c).

Solution 4

(a)

Mark scheme

- The resilience of the ecosystem will decrease when the number of species decreases.

Solution 4

(b)

Mark scheme

- Accept either: the addition of the wild oat limits the resources available to native bunchgrass, resulting in a decrease in bunchgrass population size; or the addition of the wild oat enables the aphid population to increase (more aphids feeding on/carrying viruses) and increases bunchgrass exposure to plant viruses, resulting in a decrease in the native bunchgrass population size (since infected bunchgrass has a much higher death rate).

Solution 4

(c)

Mark scheme

- The native bunchgrass population will increase in abundance if ladybugs are added.

Solution 4

(d)

Mark scheme

- Adding ladybugs (predators of aphids) will decrease the number of aphids, which will decrease the transmission of/infection by the plant viruses that raise bunchgrass death rates — so fewer bunchgrass plants die of infection and the native bunchgrass population increases.

Question 5

2022 ▪ Q5

The following models represent all the interacting species in two different communities with some of the same species and feeding relationships. These models assume that both communities have the same initial biomass. The models can be used to understand the effects of human activities on the communities.
[Figure 1: two food-web diagrams side by side, "Community A" and "Community B", arranged in four horizontal trophic-level rows (top to bottom): Tertiary Consumers (TC), Secondary Consumers (SC), Primary Consumers (PC), Primary Producers (PP). Community A: PP1, PP2, PP3 at the base; arrows go PP1→PC1, PP1→PC2, PP2→PC2, PP2→PC3, PP3→PC3, PP3→PC4; then PC1→SC1, PC2→SC1, PC2→SC2, PC3→SC2, PC3→SC3, PC4→SC3; then SC1→TC1, SC2→TC1, SC2→TC2, SC3→TC2. Community B: PP1 and PP3 at the base (no PP2); arrows go PP1→PC2, PP3→PC3; then PC2→SC2, PC3→SC2; then SC2→TC2.]

Question 5

Figure 1. Models of two different communities with some of the same species

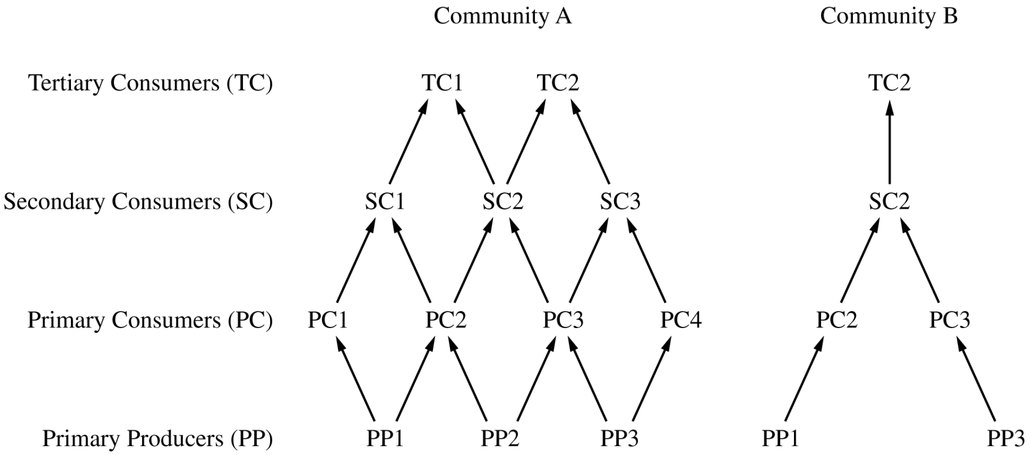
(a) Describe a characteristic of a community that makes a species invasive in that community but not invasive in a different community.

(b) Explain why removing species PP1 will have a greater effect on community B than on community A.

(c) An invasive species (INV) that eats individuals of species SC2 is introduced into community B. Using the template in the space provided for your response, for community B, indicate the feeding relationship for this invasive species by correctly placing INV to represent the invasive species and an arrow to represent the feeding relationship within community B.

(d) Explain how human activities that add toxins to the soil could change a community with many species at each trophic level, such as community A, into a community with few species at each trophic level, such as community B.

Question 5


Community A
Community B
Tertiary Consumers (TC)
Secondary Consumers (SC)
Primary Consumers (PC)
Primary Producers (PP)
TC1
TC2
SC1
SC2
SC3
PC1
PC2
PC3
PC4
PP1
PP2
PP3
TC2
SC2
PC2
PC3
PP1
PP3

Solution 5

(a)

Mark scheme

- A species is invasive in a community where there are no/reduced natural predators of the species, no/reduced competitors of the species, or no/reduced diseases to which the species is susceptible - conditions that may not hold in a different community, where the species is therefore not invasive.

Solution 5

(b)

Mark scheme

- Removing species PP1 has a greater effect on community B than on community A because in community B there will be decreases in PC2, SC2, and TC2 (PC2, SC2, and PC3), whereas in community A, PC2 has alternative food sources (other primary producers, PP2/PP3) to rely on. More generally, with fewer/less diverse primary producers (and primary consumers) there are fewer paths for energy to move through community B, so with fewer species/feeding interactions/less diversity, community B is less resilient to future environmental change.

Solution 5

(c)

Mark scheme

- On the Community B diagram, INV should be added in a position horizontally aligned with TC2 (i.e. at the tertiary-consumer level), with an arrow drawn from SC2 pointing to INV, representing that the invasive species (INV) feeds on SC2.

Solution 5

(d)

Mark scheme

- Human activities that add toxins to the soil could eliminate primary producers, which reduces species diversity at higher trophic levels; alternatively, the toxins could biomagnify up the food chain, becoming more concentrated and toxic at higher trophic levels and reducing species diversity there - either mechanism could transform a many-species-per-trophic-level community like A into a few-species community like B.

Question 2

2017 ▪ Q2

[Figure 1: Line graph titled "The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent $\pm 2SE_{\bar{X}}$." Y-axis: "Seed Germination (- KAR (solid line, open squares): 0- Control (solid line, filled circles): 0- KAR + TMB (dashed line, open circles): 0- TMB (solid line, filled squares): 0All curves start at 0

Fires frequently occur in some ecosystems and can destroy all above-ground vegetation. Many species of plants in these ecosystems respond to compounds in smoke that regulate seed germination after a major fire. Karrikins (KAR) and trimethylbutenolides (TMB) are water-soluble compounds found in smoke that are deposited in the soil as a result of a fire. KAR and TMB bind to receptor proteins in a seed. In a study on the effects of smoke on seeds, researchers recorded the timing and

Question 2

percent of seed germination in the presence of various combinations of KAR and TMB. The results are shown in Figure 1.

In a second investigation into the effect of available water on seed germination after a fire, researchers treated seeds with KAR or TMB. The treated seeds were then divided into two treatment groups. One group received a water rinse and the other group received no water rinse. The seeds were then incubated along with a group of control seeds that were not treated. The results are shown in the table.

EFFECT OF CHEMICAL TREATMENT AND WATER RINSE ON GERMINATION

Treatment Group	Chemical Treatment — KAR	Chemical Treatment — TMB	Water	Germination Result
1 (control)	−	−	−	Control result
2	+	−	−	Different from control
3	−	+	−	Different from control
4 (control)	−	−	+	Control result
5	+	−	+	Different from control
6	−	+	+	Same as control

Question 2

(a) The researchers made the following claims about the effect of KAR and the effect of TMB on seed germination relative to the control treatment.

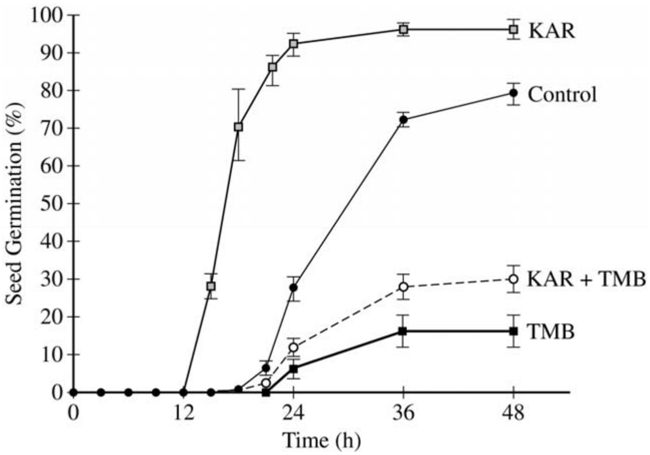
- KAR alone affects the timing of seed germination.
- KAR alone affects the percentage of seeds that germinate.
- TMB alone affects the timing of seed germination.
- TMB alone affects the percentage of seeds that germinate.

Provide support using data from Figure 1 for each of the researchers' claims.

Question 2

Treatment Group	Chemical Treatment		Water	Germination Result
	KAR	TMB		
1 (control)	−	−	−	Control result
2	+	−	−	Different from control
3	−	+	−	Different from control
4 (control)	−	−	+	Control result
5	+	−	+	Different from control
6	−	+	+	Same as control

Question 2



Seed Germination (%)
100
90
80
70
60
50
40
30
20
10
0
0
12
24
36
48
Time (h)
KAR
Control
KAR + TMB
TMB

Question 2

2017 ▪ Q2

[Figure 1: Line graph titled "The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent $\pm 2SE_{\bar{X}}$." Y-axis: "Seed Germination (- KAR (solid line, open squares): 0- Control (solid line, filled circles): 0- KAR + TMB (dashed line, open circles): 0- TMB (solid line, filled squares): 0All curves start at 0

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In a second investigation into the effect of available water on seed germination after a fire, researchers treated seeds with KAR or TMB. The treated seeds were then divided into two

Question 2

treatment groups. One group received a water rinse and the other group received no water rinse. The seeds were then incubated along with a group of control seeds that were not treated. The results are shown in the table.

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1 (control)	–	–	–	Control result
2	+	–	–	Different from control
3	–	+	–	Different from control
4 (control)	–	–	+	Control result
5	+	–	+	Different from control
6	–	+	+	Same as control

(b) Make a claim about the effect of rinsing on the binding of KAR to the receptor in the seed and about the effect of rinsing on the binding of TMB to the receptor in the seed. Identify the appropriate treatment groups and results from the table that, when compared with the controls, **provide support** for each claim.

Question 2

2017 ▪ Q2

[Figure 1: Line graph titled "The effect of karrikins (KAR) and trimethylbutenolides (TMB) on seed germination in *Lactuca* plants. Error bars represent $\pm 2SE_{\bar{X}}$." Y-axis: "Seed Germination (- KAR (solid line, open squares): 0- Control (solid line, filled circles): 0- KAR + TMB (dashed line, open circles): 0- TMB (solid line, filled squares): 0All curves start at 0

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Question 2

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2	+	–	–	Different from control
3	–	+	–	Different from control
4 (control)	–	–	+	Control result
5	+	–	+	Different from control
6	–	+	+	Same as control

(c) There is intense competition by plants to successfully colonize areas that have been recently cleared by a fire. **Describe** ONE advantage of KAR regulation and ONE advantage of TMB regulation to plants that live in an ecosystem with regular fires.

Solution 2

(a)

Mark scheme

- Using Figure 1 data, 1 point per claim. KAR affects timing: germination starts earlier/sooner/faster/quicker with KAR than in Control. KAR affects percentage: a higher percentage of seeds germinate in the presence of only KAR than in Control. TMB affects timing: germination starts later/slower with TMB than in Control. TMB affects percentage: a lower percentage of seeds germinate in the presence of only TMB than in Control.

Solution 2

(b)

Mark scheme

- KAR claim (1 point): KAR remains bound to the receptor after rinsing (rinsing does not affect KAR binding). KAR support (1 point): both KAR-no-rinse (Group 2) and KAR-with-rinse (Group 5) give results different from the controls (Group 1 and Group 4) — rinsing does not remove the KAR effect. TMB claim (1 point): TMB does not remain bound after rinsing (rinsing affects/removes TMB binding). TMB support (1 point): TMB-no-rinse (Group 3) differs from Control (Group 1), but TMB-with-rinse (Group 6) is the same as Control (Group 4) — rinsing removes the TMB effect.

Solution 2

(c)

Mark scheme

- 1 point per row. Advantage of KAR regulation: germination occurs at times of increased resource availability, OR plants with KAR regulation can outcompete other plants (without KAR regulation), OR germination occurs when fewer competitors are present / land is barren (shortly after a fire). Advantage of TMB regulation: plants with TMB regulation do not germinate / can maintain seed dormancy until (enough) water is available, OR plants with TMB regulation do not germinate in a dry environment.

Question 6

2016 ▪ Q6

[Figure 1. Detectability of eDNA fragments of varying lengths. Bar graph with y-axis “Days that eDNA is Detectable after Shedding” from 0 to 5, x-axis “Amplified eDNA Fragment Length” with two categories: “Short” (bar height approximately 4.2 days) and “Long” (bar height approximately 2.7 days).]
[Figure 2. Map of the waterways that connect a nearby river system to Lake Michigan. A map showing a river system on the left connecting to Lake Michigan on the right, with numerous open circles (labeled “No silver carp eDNA detected”) scattered mostly within Lake Michigan and a few in the connecting rivers, and five filled/solid circles (labeled “Silver carp eDNA detected”) clustered along the connecting river/waterway near where it meets the lake, with one filled circle located just inside the lake boundary near the river mouth. Legend: filled circle = Silver carp eDNA detected; open circle = No silver carp eDNA detected; solid line = Rivers connected to Lake Michigan.]

Question 6

Living and dead organisms continuously shed DNA fragments, known as eDNA, into the environment. To detect eDNA fragments in the environment, the polymerase chain reaction (PCR) can be used to amplify specific eDNA fragments. eDNA fragments of different lengths persist in the environment for varying amounts of time before becoming undetectable (Figure 1).

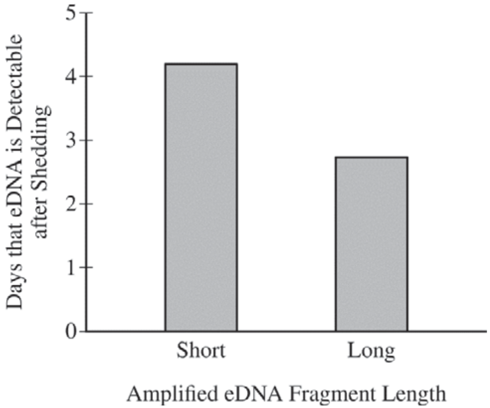
To investigate whether silver carp, an invasive fish, have moved from a nearby river system into Lake Michigan, researchers tested water samples for the presence of eDNA specific to silver carp (Figure 2).

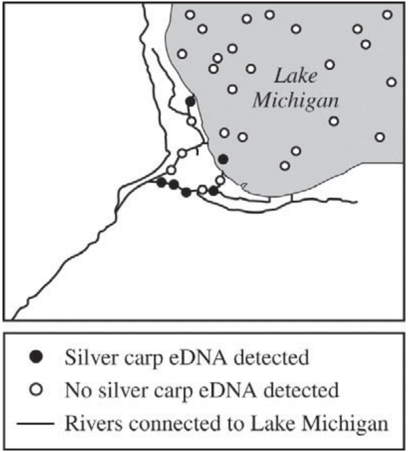
(a) Justify the use of eDNA sampling as an appropriate technique for detecting the presence of silver carp in an environment where many different species of fish are found. **Propose** ONE advantage of identifying long eDNA fragments as opposed to short fragments for detecting silver carp.

Question 6

(b) The researchers tested a large number of water samples from Lake Michigan and found eDNA specific to silver carp in a single sample in the lake, as indicated in Figure 2. The researchers concluded that the single positive sample was a false positive and that no silver carp had entered Lake Michigan. **Provide reasoning** other than human error to support the researchers' claim.

Question 6


Days that eDNA is Detectable after Shedding
0
1
2
3
4
5
Short
Long
Amplified eDNA Fragment Length


Lake Michigan
Silver carp eDNA detected
No silver carp eDNA detected
Rivers connected to Lake Michigan

Solution 6

(a) Mark scheme

- Justify use of eDNA sampling (1 point): eDNA sampling allows detection of the fish's presence without needing to visually identify or physically catch the fish, and eDNA sequences can be matched specifically to silver carp even among a mixed community of many fish species. Proposed advantage of long fragments over short fragments (1 point, any one): longer eDNA fragments indicate a more recent presence of the fish (they degrade faster than persisting for long periods); longer fragments are more likely to contain a sequence that is uniquely specific to silver carp; OR longer sequences/more base pairs increase the accuracy/specificity/confidence that the eDNA truly comes from a silver carp rather than a related species.

Solution 6

(b)

Mark scheme

- Reasoning other than human error (1 point): the silver-carp eDNA could have entered Lake Michigan by a means other than a live fish being present - e.g., carried in by river flow, transported on boats, or present in waste/feces from a predator that had eaten a silver carp elsewhere - so a positive eDNA sample does not necessarily mean a living silver carp is in the lake.

Question 3

2014 ▪ Q3

As part of a new suburban development, a sports complex consisting of athletic fields and buildings is constructed in a formerly wooded area.

(a) Predict ONE ecological consequence on the local plant community that is likely to result during the site preparation and construction of the sports complex. **Justify** your prediction.

(b) To maintain the playing fields, large quantities of water and chemicals are applied regularly to the grass-covered areas. **Predict** ONE effect on the local animal community that might result from regular use and maintenance of the playing fields. **Justify** your prediction.

Solution 3

(a) Mark scheme

- 1 point for a predicted consequence on the plant community, 1 point for a matching justification, drawn from a single row. Examples: Plant death/loss of plant biomass — justified by removing trees/shrubs, pollution from construction equipment, fewer individuals for reproduction, or altered habitat (e.g. change in sunlight, obstruction by buildings, isolation of populations). Reduced number of plant species/loss of biodiversity — justified by removal of trees/shrubs, reduced habitat, or pollution from construction killing local species. Decreased genetic diversity — justified by reduction in population size/bottleneck. Habitat loss — justified by removal of trees/shrubs or soil loss due to lack of ground cover. Increased success of sun-tolerant plants — justified by removal of shading trees.

Solution 3

Introduction/immigration of new plant species — justified by creation of new habitat and landscaped environments.

Solution 3

(b) Mark scheme

- 1 point for a predicted effect on the local animal community, 1 point for a matching justification, drawn from a single row. Examples: Harm/death to animals — justified by exposure to toxic chemicals, toxic chemicals accumulating through the food chain/persisting in the environment, or contaminated groundwater. Emigration/displacement — justified by loss of habitat and/or food, loss of access, or exposure to toxic chemicals. Loss of native animal biodiversity — justified by loss of plants the animals depend on or loss of habitat. Mutations — justified by chemicals' effect on DNA. Improved conditions for animals — justified by increased food sources. Immigration of new animal species — justified by formation of new habitat. Less potable/drinking water for animals — justified

Solution 3

by increased salinity in the water reservoir, removal of water from the reservoir/wells, or contamination of water with chemicals.

Question 5

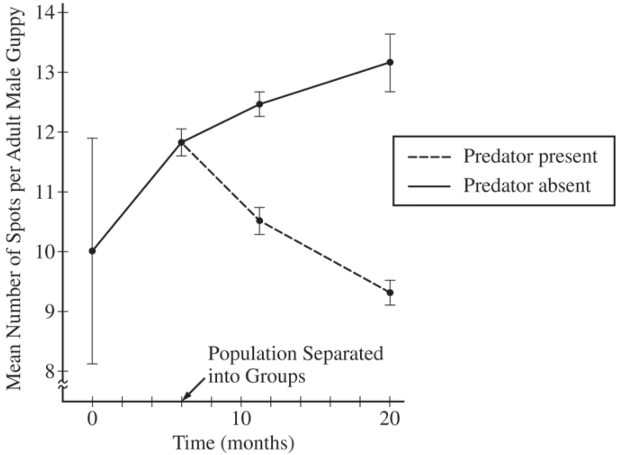
2014 ▪ Q5

Genetically modified crops have been developed that produce a protein that makes the plants resistant to insect pests. Other genetic modifications make the crops more resistant to chemicals that kill plants (herbicides).

(a) Describe TWO potential biological risks of large-scale cultivation and use of such genetically modified plants.

(b) For each of the risks you described in part (a), **propose** a practical approach for reducing the risk.

Question 5


Mean Number of Spots per Adult Male Guppy
14
13
12
11
10
9
8
0
10
20
Time (months)
Population Separated into Groups
Predator present
Predator absent

Solution 5

(a)

Mark scheme

- 2 points maximum, 1 point per described risk (describe TWO). Accepted risks include: unknown human/other-animal health risk from consuming GM proteins; disruption within the food chain; developed resistance in pest species; spread of genetic modifications to non-GM plants; GM plants out-competing native species; reduced numbers of pollinators; loss of biodiversity; use of herbicides harming non-target species; invasive disease wiping out the monoculture.

Solution 5

(b) Mark scheme

- 2 points maximum, 1 point per box, for a practical mitigation matched to each risk named in part (a) — mitigation must be practical for the risk given; proposing non-use of GM plants is acceptable for any risk. Example pairings: health risk $\rightarrow$ testing/labeling product packaging or isolating animals from crops; disruption within food chain $\rightarrow$ interspersing GM plants with non-GM plants in culture or providing an alternative food source; developed pest resistance $\rightarrow$ increased use of effective pesticides, introducing pest predators, further engineering the GMO for more resistance protein, or rotating GM and non-GM crops; spread of genetic modification $\rightarrow$ containing pollen of GM plants or disabling GM plants' ability to produce viable seeds; GM plants out-competing native species $\rightarrow$

Solution 5

containing/isolating GM plants or disabling viable-seed production; reduced pollinators or loss of biodiversity $\rightarrow$ contain/isolate GM plants or intersperse GM with non-GM plants; herbicide harm to non-target species $\rightarrow$ rotate GM and non-GM crops or use organic/alternative herbicides; invasive disease wiping out monoculture $\rightarrow$ intersperse GM plants with non-GM plants in culture.