ANSWER KEY.

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Population Sampling

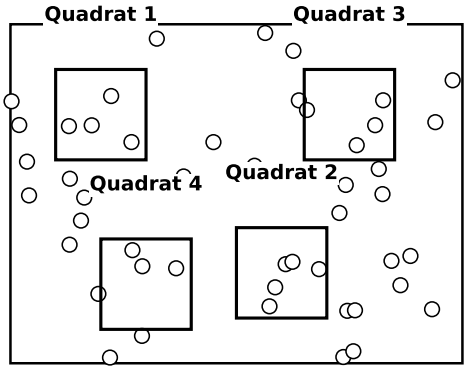
Biology | ANSWER KEY

Answer in complete sentences. Show your work for calculations. Use the graphs and tables as evidence.

1. Is each situation a census or a sample?

Situation	Census or sample?
(a) A researcher counts every tree in a 5 m × 5 m plot.	**Census**
(b) A student counts the insects in five quadrats and scales up.	**Sample**
(c) A team marks 30 fish, releases them, and later catches 40 fish.	**Sample**

2. Students counted plants in four quadrats in a field. Each quadrat is 1 m².



Each quadrat is 1 m² (1 m × 1 m).

The whole field is 400 m².

Each circle is one plant.

(a) Count the plants in each quadrat.

(b) Find the mean number of plants per quadrat, and the density in plants per m².

(c) The whole field is 400 m². Estimate the number of plants in the field.

(a) **Quadrat 1: 4, quadrat 2: 5, quadrat 3: 4, quadrat 4: 3**

(b) (4 + 5 + 4 + 3) plants ÷ 4 quadrats = **4.0 plants per quadrat**; 4.0 plants ÷ 1 m² = **4.0 plants per m²**

(c) 4.0 plants/m² × 400 m² = **1,600 plants**

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3. Researchers mark 40 beetles and release them. Later they catch 50 beetles, and 5 of them are marked.

(a) Estimate the number of beetles in the area. Show the setup with units.

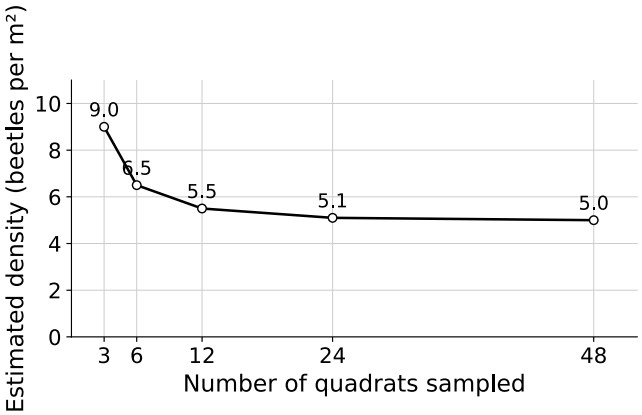
(b) Name one assumption that must be true for this estimate to be reliable.

(a) N ≈ (40 beetles × 50 beetles) ÷ 5 beetles = **400 beetles**

(b) **Marked beetles mixed evenly; none were born, died, or left.**

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4. Students estimated beetle density (beetles per m²) in a field using different numbers of random quadrats.



(a) What happens to the estimate as more quadrats are sampled?

(b) A student says, "3 quadrats are enough." Write a claim, evidence, and reasoning statement that supports or disagrees with the student. Use data.

(a) **It decreases from 9.0 to 5.0 beetles per m² and levels off near 5.**

(b) **Claim:** 3 quadrats are not enough. **Evidence:** the estimate from 3 quadrats was 9.0 beetles/m², but the estimate from 48 quadrats was 5.0 beetles/m², so the 3-quadrat estimate was 80% too high. **Reasoning:** with only a few quadrats, a crowded or empty one can change the mean a lot, so larger samples give more reliable estimates.

Must include: (1) a claim that 3 is not enough; (2) data with units from the graph; (3) the idea that larger samples are more reliable.

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5. Is each sampling plan good or poor? Give a reason.

Sampling plan	Good or poor, and why?
(a) Place quadrats along a trail where the plants are easiest to reach.	**Poor: biased toward the trail**
(b) Place quadrats at locations chosen with random numbers.	**Good: random placement**
(c) Count one quadrat and multiply by the whole area.	**Poor: sample is too small**

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