

What are Predator-Prey Relationships?

Worksheet

A predator-prey relationship is a dynamic interaction where predators (hunters) and prey (hunted) influence each other's population sizes through a time-lagged cycle. Predators benefit by gaining energy; prey are harmed but populations persist through rapid reproduction and anti-predator adaptations.

$$\frac{dN_{\text{prey}}}{dt} = rN_{\text{prey}} - \alpha N_{\text{prey}} N_{\text{pred}}; \frac{dN_{\text{pred}}}{dt} = \beta N_{\text{prey}} N_{\text{pred}} - \delta N_{\text{pred}}$$

Questions

- In a predator-prey cycle, when prey population peaks, what typically happens next?
 - Predator population peaks immediately
 - Predator population peaks 1-2 years later
 - Prey population stays high indefinitely
 - No change to predator population
- What happens to the lynx population when snowshoe hare numbers crash?
 - Lynx population crashes 1-2 years later
 - Lynx population immediately increases
 - Lynx population stays constant
 - Lynx permanently disappear
- Which is an example of coevolution between predator and prey?
 - Predators evolve sharper teeth; prey evolve thicker skin
 - Both evolve to migrate at the same time
 - Prey evolve to stop reproducing
 - Predators and prey become the same species
- Why is the time lag important in predator-prey cycles?
 - It prevents predators from completely extinguishing prey
 - It makes the cycle shorter
 - It means predators are faster than prey
 - It has no biological significance
- Lynx and snowshoe hare populations in Canada show regular 10-year cycles. Explain.
- In the Serengeti, zebra population is 1.5 million and lion population 23,000. Predict what happens if zebra births suddenly drop 40%.
- A biologist observes that deer population peaks 1-2 years AFTER wolf reintroduction. Why not immediately crash?
- Define: What is a predator-prey relationship?
- Define: Why do predator and prey populations cycle?
- Define: Why is there a time lag in the predator-prey cycle?

Answer Key

1. B) Predator population peaks 1-2 years later - Predators lag behind prey; it takes time for predator births to increase due to abundant food.
2. A) Lynx population crashes 1-2 years later - With scarce prey, lynx starve; their population crashes after (not immediately with) the prey crash.
3. A) Predators evolve sharper teeth; prey evolve thicker skin - Evolutionary arms race: predators evolve better hunting tools; prey evolve better defenses.
4. A) It prevents predators from completely extinguishing prey - The lag allows prey to escape and recover before predators crash, preventing extinction.
5. Hares reproduce rapidly in summer; lynx numbers are initially low. Hare population booms to ~30,000; abundant food supports lynx population growth to ~2,000. Lynx predation intensifies; hares hunted heavily, population crashes to ~1,000 by year 8. Few hares remain; lynx starve, population crashes to ~200 by year 10. With few lynx, hares recover rapidly, starting a new 10-year cycle.
6. Year 1: Zebra population falls from 1.5M to 0.9M (births drop but lions continue hunting normally). Year 2-3: Lions face scarcer prey; lion hunting success declines, lion numbers drop to ~15,000 from starvation. Year 4-5: With fewer lions, surviving zebras reproduce rapidly; zebra population recovers to 1.2M. Year 5+: As zebra abundance increases, lion population also recovers; system stabilizes near equilibrium.
7. Year 0: Wolves introduced; initial deer population 500, wolves 20. Year 1: Wolves begin hunting; deer deaths rise but births still ~300, so population stays 400-450. Year 2: Wolf population grows to 35 from abundant prey; deer now face intense predation; births 150, deaths 200 population crashes to 250. Years 3+: Wolves starve, numbers drop to 10; deer recover. Cycle repeats with a 1-2 year lag between peak prey and peak predators.
8. An ecological interaction where predators (hunters) hunt and consume prey, creating coupled population cycles.
9. High prey predators feast and grow high predators prey decline predators starve and crash prey recover cycle repeats.
10. Predators don't immediately respond to prey changes; it takes time for predator populations to grow or crash due to reproduction rates.

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