1.3.2 Exploratory Quiz: D'Ancona's Observation

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Here is D'Ancona's data on predator and prey fish in the net catches in Fiume, Italy for the years between 1914 and 1923. Use this data to answer the next 3 questions.

Let's look more closely at the biological phenomenon that D'Ancona observed when looking at fish populations in the Adriatic sea during World War I.

Note: 'Total catch' is the number of predator fish and the number of prey fish caught.

Year	**1914**	**1915**	**1916**	**1917**	**1918**	**1919**	**1920**	**1921**	**1922**	**1923**
% of predator fish in the total catch	11.9	21.4	22.1	21.2	36.4	27.3	16.0	15.9	14.8	10.7

Question 1

1/1 point (graded)

As Ethan mentioned, the Italian biologist D'Ancona studied fluctuations in fish populations. Here fishermen used nets and would catch both prey fish (like sardines) and predators (like marlin) in their nets.

During the years 1914-1918 (World War I), would you say the **percent of predator fish in the total catch** tended to increase, decrease or remain about the same?

- tended to decrease
- tended to increase ✔
- tended to remain the same

Explanation

The percent of predator fish in the total catch increased each year of this period with the exception of a small decrease from 1916 to 1917.

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Question 2

1/1 point (graded)

What happened to the percent of prey fish in the total catches during the years 1914 to 1918?

- tended to increase
- tended to decrease ✔
- tended to remain about the same
- not enough information to say

Explanation

The total catch is the sum of the predators caught and the prey caught. Thus the percent of prey in the total catch each year is 100 minus the percent of predator fish in the total catch. Thus as the percent of predator fish increased, the percent of prey fish decreased.

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Question 3: Think About It...

1/1 point (graded)

As you may have noticed, there was a large increase in the percentage of predators in the total catches from 1914 to 1918. This is roughly the period of World War I (1914 to 1918).

At first, D'Ancona explained this by the following argument: *There was less fishing because more fishermen were at war, and less fishing by humans meant more prey for the predators to eat. Thus the predators were able to thrive and reproduce more so their population increased.*

Does this argument explain why the percent of predator fish in total catches increased? Why or why not?

No, since less fishing will also imply more predators surviving and they will need still more prey to eat.

✔

Thank you for your response.

Explanation

Just because the number of predators increased doesn't mean their percent of the total catch would necessarily increase. This is because the number of prey fish may also have increased. Since total catch includes prey and predator fish, it could be that the percent of predator fish actually decreased.

For example, consider some simple numbers. Let's say the numbers of predator and prey were 3 and 7 before and 5 and 15 after. Assuming all fish end up in the total catch, the percent of predators before is 3/10 (30%) and after is 5/20 (20 %). Even though the predators increased, the percent of predators in total catch did not.

Why might the prey fish increase? Note that less fishing means more prey in the sea too. Even with the increase of predators, it may have been that the prey fish population thrived and reproduced even more. It's precisely this complicated interaction between predator and prey that requires a clearer examination, one that Volterra was able to offer.

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Question 4

5/5 points (graded)

Here's Volterra's system, where x represents the prey population and y the predator population at time t, and $\mathbf{a, b, c}$ and $\mathbf{d}$ are constants.

$$\frac{dx}{dt} = \mathbf{a}x - \mathbf{b}xy,$$

$$\frac{dy}{dt} = -\mathbf{c}y + \mathbf{d}xy.$$

Match the most appropriate interpretation to each term in the system. **Note: $-\mathbf{c}y$ has 2 interpretations.**

Term	Interpretation

ax	◉ A. The rate of reproduction of prey is proportional to the size of the population of prey (exponential growth). ✔ ○ B. The rate of reproduction of predators is proportional to the size of the population of predators (exponential growth) ○ C. A constant proportion of the population of predators dies of natural causes each year (exponential decay). ○ D. A constant proportion of the population of prey dies of natural causes each year (exponential decay). ○ E. The proportion of prey dying each year depends on both the number of prey and the number of predators. ○ F. The rate of increase of the population of predators depends on both the number of predators breeding and the supply of food (prey) available.
$-bxy$	○ A. The rate of reproduction of prey is proportional to the size of the population of prey (exponential growth). ○ B. The rate of reproduction of predators is proportional to the size of the population of predators (exponential growth) ○ C. A constant proportion of the population of predators dies of natural causes each year (exponential decay). ○ D. A constant proportion of the population of prey dies of natural causes each year (exponential decay). ◉ E. The proportion of prey dying each year depends on both the number of prey and the number of predators. ✔ ○ F. The rate of increase of the population of predators depends on both the number of predators breeding and the supply of food (prey) available.

$-cy$	○ A. The rate of reproduction of prey is proportional to the size of the population of prey (exponential growth). ○ B. The rate of reproduction of predators is proportional to the size of the population of predators (exponential growth) ◉ C. A constant proportion of the population of predators dies of natural causes each year (exponential decay). ✔ ○ D. A constant proportion of the population of prey dies of natural causes each year (exponential decay). ✔ ○ E. The proportion of prey dying each year depends on both the number of prey and the number of predators. ○ F. The rate of increase of the population of predators depends on both the number of predators breeding and the supply of food (prey) available.
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The term ax represents that the rate of reproduction of prey is proportional to the size of the population of prey (exponential growth).

The term $-bxy$ represents that the proportion of prey dying each year depends on both the number of prey and the number of predators.

The term $-cy$ represents that a constant proportion of the population of predators dies of natural causes each year (exponential decay).

The term dxy represents that the rate of increase of the population of predators depends on both the number of predators breeding and the supply of food (prey) available.

This is discussed in the next video.

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