

CCT Weekly Practice Science

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Unit 1 - Great White Sharks



Source: <https://bit.ly/3u2Rhjz>

A study that looked at the stomach contents of juvenile Great White Sharks found that these marine animals ate dolphins, rays and other sharks that dwell at the bottom of the sea. However, recent years saw a significant drop in shark populations. There was also an extensive decline in the United States shellfish industry due to the increased consumption of molluscs by rays.

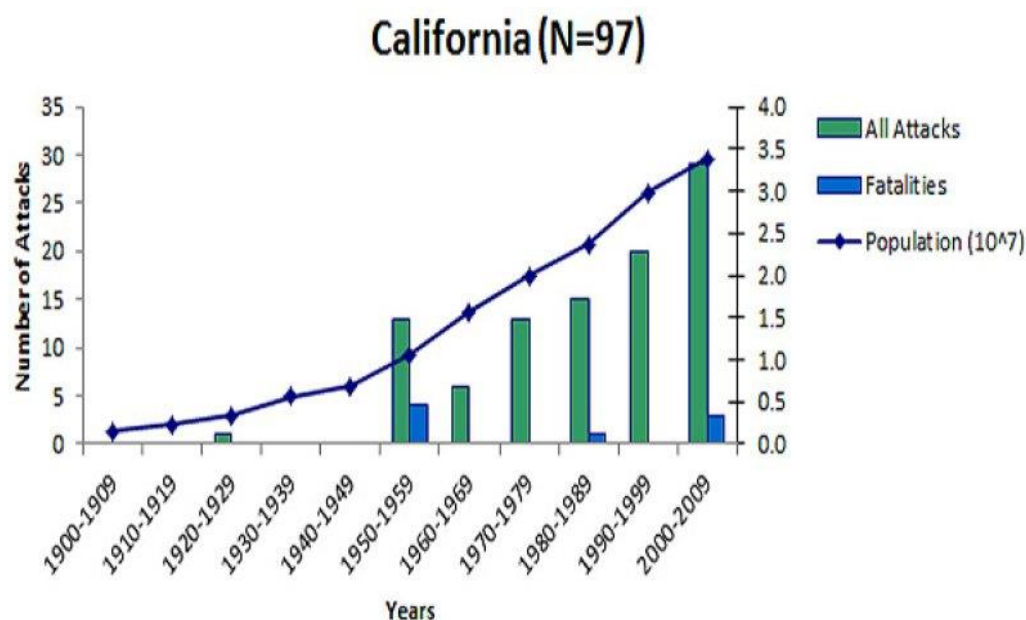
Question 1

With the information given, what can be inferred about the root cause for this decline of the shellfish industry?

- a) The loss of ecological balance due to the decline in the predator population caused an increase in the population of rays, which led to decrease in shark's prey- i.e., shellfish.
- b) The loss of predator competition, between sharks and rays, to feed on shellfish led to increased feeding by rays.
- c) The loss of the symbiotic relationship between shellfish and sharks due to the falling shark population, led to the decrease of shellfish populations.
- d) The changing diet of the juvenile sharks led to the decline of the shellfish population.

Question 2

Graphs of Shark Attacks vs. Population Growth Over the Past Decade



© International Shark Attack File
 Florida Museum of Natural History, University of Florida

Based on the information given in the graph above, what can be said about the effect of rising shark population on human fatalities?

- Shark population and human fatalities grew at an exponential rate between 1980 and 2009.
- A growing shark population is directly related to an increase in the number of human fatalities.
- There is no conclusive relationship between a growing shark population and the number of human fatalities.
- Human fatalities initially increase and then decrease gradually as shark populations continue increasing.

Unit 2 - Vehicular Emission Standards

Car emissions, including carbon dioxide and a number of pollutants, have negative consequences for climate change and health. Regulatory standards for the approval of new vehicles have become increasingly tighter. However, air quality remains a problem in many cities. Long-term exposure to nitrogen dioxide is estimated to result in 75,000 premature deaths in 40 European countries.

Source: The United Nations Economic Commission for Europe, 2016, Emissions testing for cars and environmental regulations, Brief 4

The European regulatory standards for vehicular emissions, Euro 4 (2005) are listed below.

Euro 4 emission limits (petrol)

- **CO** – 1.0 g/km
- **HC** – 0.10 g/km
- **NO_x** – 0.08
- **PM** – no limit

Euro 4 emission limits (diesel)

- **CO** – 0.50 g/km
- **HC+ NO_x** – 0.30 g/km
- **NO_x** – 0.25 g/km
- **PM** – 0.025 g/km

CO - Carbon monoxide

HC - Hydrocarbons

NO_x - Oxides of Nitrogen

PM - Particulate Matter

Source: <https://bit.ly/3nVXQCe>

Question 3

Based on the information given above, which of the following is true?

- To reduce premature deaths, NO_x emissions from diesel vehicles should be less than 0.25 g/km.
- NO_x emissions from diesel vehicles can exceed the 0.25 g/km limit if they are in a mixture with hydrocarbons.
- It is not necessary to control carbon dioxide if carbon monoxide emissions are limited.
- Particulate Matter has no negative effects on air pollution.

Question 4

What is the most probable scientific explanation behind the Euro 4 standards having “no limit” on the particulate matter (PM) emitted by vehicles that run on petrol?

- Petrol vehicles did not emit PM.
- PM emitted by petrol vehicles was less harmful than diesel vehicles.
- PM from petrol vehicles was not likely to have harmful effects.
- Car manufactures had designed petrol engines that did not emit PM.

Question 5

A diesel car uses a catalytic converter that converts the CO emitted in the exhaust into CO₂ by combusting the CO in air. Assume that this vehicle emits CO to the maximum possible limit allowed by the European regulatory standards. How many moles of oxygen will be required to completely convert all the CO emitted by this vehicle into CO₂ if it runs for 5600 km?

- 50
- 100
- 1400
- Not enough information available to calculate

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Answers

Unit 1 - Great White Sharks

1. (a) It explains how the predator-prey relationship maintains the balance in an ecosystem.
2. (c) The graph does not show any clear relationship between shark populations and human fatalities.

Unit 2 - Vehicular Emission Standards

3. (a) This is because the table shows this emission limit for NO_x.
4. (c) The most likely scientific explanation is that the PM from petrol vehicles did not have harmful effects.
5. (a) Combustion reaction of CO is as follows:
$$2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$$

The car produced 0.5 g/km X 5600 km = 2800 g of CO, that is $2800 \div 28$ (molecular mass of CO) = 100 moles of CO. In order to completely convert this CO, number of moles of O₂ required will be 50 moles.

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