



Cambridge International AS & A Level

CANDIDATE
NAME

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MARINE SCIENCE

9693/21

Paper 2 AS Data-Handling and Free-Response

May/June 2021

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Any blank pages are indicated.

Section A

Answer **both** questions in this section.

1 Cleaner fish feed on parasites attached to other fish.

(a) State why this interrelationship is an example of mutualism.

.....

..... [1]

Sharknose gobies, *Elacatinus evelynae*, are a species of cleaner fish that are found around tropical coral reefs.

Scientists investigated the cleaning behaviour of sharknose gobies on one reef over eight years.

Each year they recorded:

- the total number of reef fish species present
- the number of fish species that were cleaned by sharknose gobies.

From the data, they calculated the percentage of species on the reef that were cleaned by sharknose gobies.

The results are shown in Fig. 1.1.

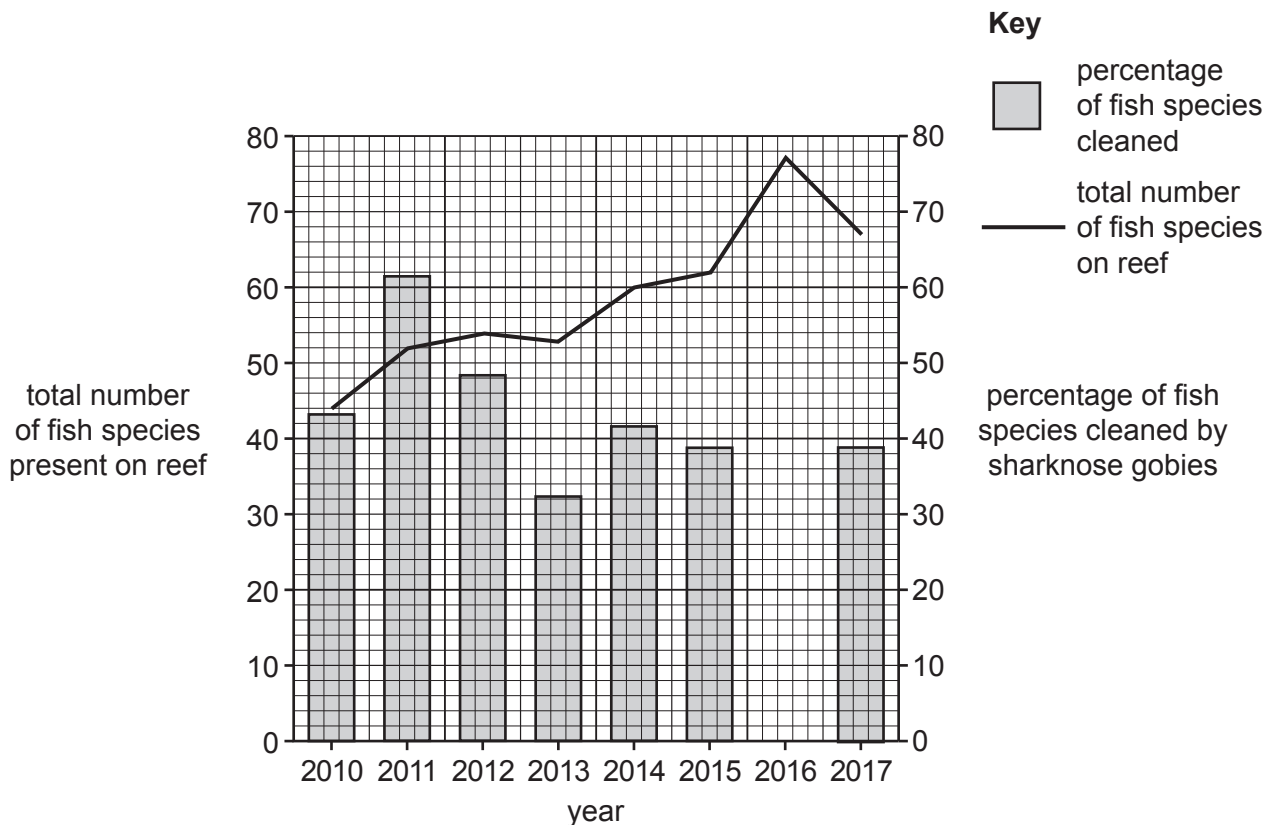


Fig. 1.1

(b) Describe the changes in the number of fish species on the reef between 2010 and 2017.

Use the data shown in Fig. 1.1 to support your answer.

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..... [3]

(c) (i) In 2016, 24 fish species were cleaned by sharknose gobies on the reef.

Use Fig. 1.1 to calculate the percentage of fish species on the reef that were cleaned by sharknose gobies in 2016.

.....% [3]

(ii) Use your answer to **(c)(i)** to draw a bar on Fig. 1.1 to show the percentage of fish species cleaned in 2016. [1]

(d) (i) The scientists were investigating the following hypothesis:

When the total number of fish species present on the reef increases, the percentage of fish species cleaned by sharknose gobies increases.

Use Fig. 1.1 to explain why this hypothesis was **rejected**.

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..... [2]

(ii) Suggest why there are differences in the percentage of fish species cleaned by sharknose gobies each year.

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..... [2]

[Total: 12]

- 2 Fig. 2.1 shows a Galapagos penguin, *Spheniscus mendiculus*, diving for fish. These penguins inhabit several of the Galapagos Islands in the eastern tropical Pacific Ocean.



Fig. 2.1

Fig. 2.2 shows the location of the Galapagos Islands in the Pacific Ocean.



Fig. 2.2

Scientists investigated whether there was a relationship between sea temperature variation and changes in the population size of Galapagos penguins.

The sea temperature variation and population size of Galapagos penguins were monitored over 17 years.

Sea temperature variation is the difference between the mean sea temperature for a particular year and the long-term sea temperature mean.

Fig. 2.3 shows the percentage change in population size of Galapagos penguins plotted against the sea temperature variation for each year. Each plotted point represents a different year.

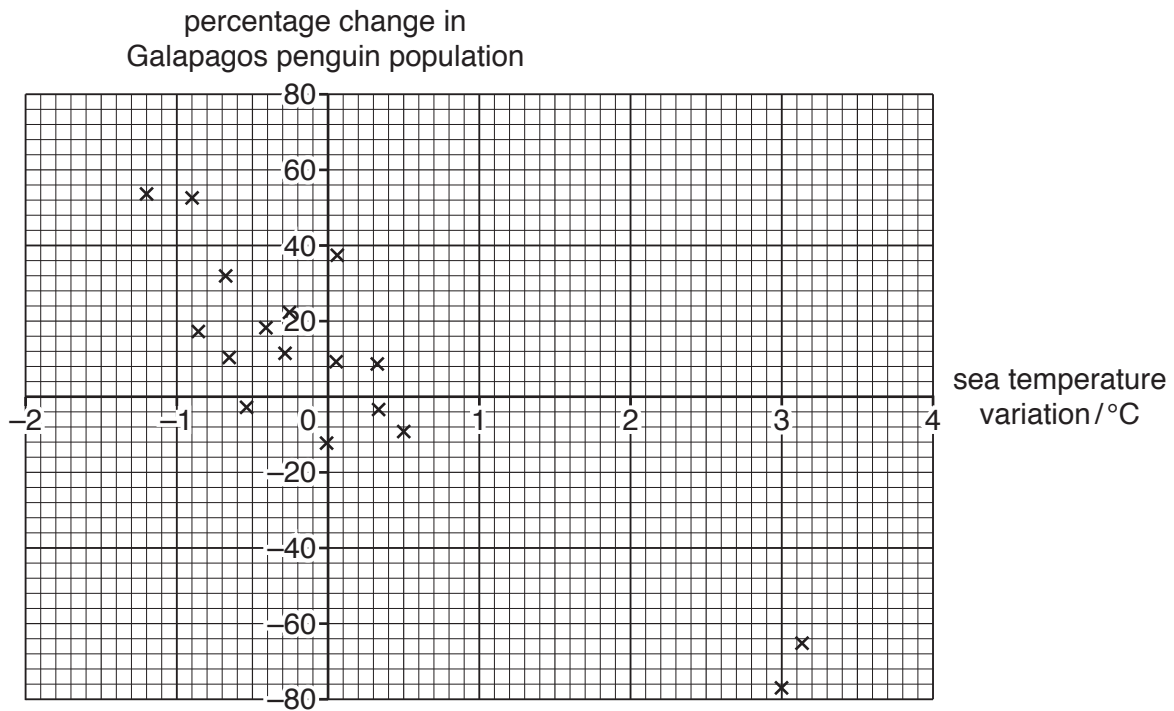


Fig. 2.3

(a) Use a ruler to draw one straight line of best fit through the data in Fig. 2.3. [1]

(b) Use Fig. 2.3 to describe the effect of sea temperature variation on percentage change in the Galapagos penguin population.

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..... [2]

(c) Use your line to predict the percentage change in the Galapagos penguin population when there is a sea temperature variation of +2°C.

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..... [1]

(d) When the sea temperature variation was +2 °C or higher, an El Niño event had occurred.

Explain why this caused the percentage change in Galapagos penguin population observed.

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..... [4]

[Total: 8]

Section B

Answer **both** questions in this section.

3 (a) (i) Explain why hydrothermal vents are described as extreme environments.

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..... [3]

(ii) Explain the meaning of the term succession. Use examples from hydrothermal vent communities in your answer.

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(b) Describe the theory of plate tectonics. Include evidence that supports the theory.

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..... [7]

[Total: 15]

4 Mangrove ecosystems are a feature of tropical river deltas.

(a) Describe the importance of mangroves for the morphology of deltas.

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..... [4]

(b) After long periods of rain, the volume of water passing through a delta increases.

(i) Suggest impacts of this increase on the environmental conditions for organisms living in the delta.

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..... [5]

(ii) Suggest why an increased volume of river water entering the ocean may decrease coral reef productivity.

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..... [6]

[Total: 15]

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