

CANDIDATE  
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**MARINE SCIENCE**

**9693/23**

Paper 2 AS Data-Handling and Free-Response

**May/June 2019**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

**Section A**

Answer **both** questions in this section.

Write your answers in the spaces provided on the Question Paper.

**Section B**

Answer **both** questions in this section.

Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **11** printed pages and **1** blank page.

**Section A**

Answer **both** questions in this section.

**1** Predator-prey relationships are important to maintain a healthy balance of populations within ecosystems.

**(a)** Define the term *predator*.

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.....  
..... [2]

**(b)** Researchers measured the percentage live coral cover in a representative area of the Great Barrier Reef, eastern Australia, each year between 1987 and 2017.

They also measured the abundance of the crown-of-thorns starfish (COTS), which feeds on coral. This was done by towing a diver behind a boat over a measured distance. The diver recorded the number of COTS seen per tow. This was not carried out every year.

The results are shown in Fig. 1.1.

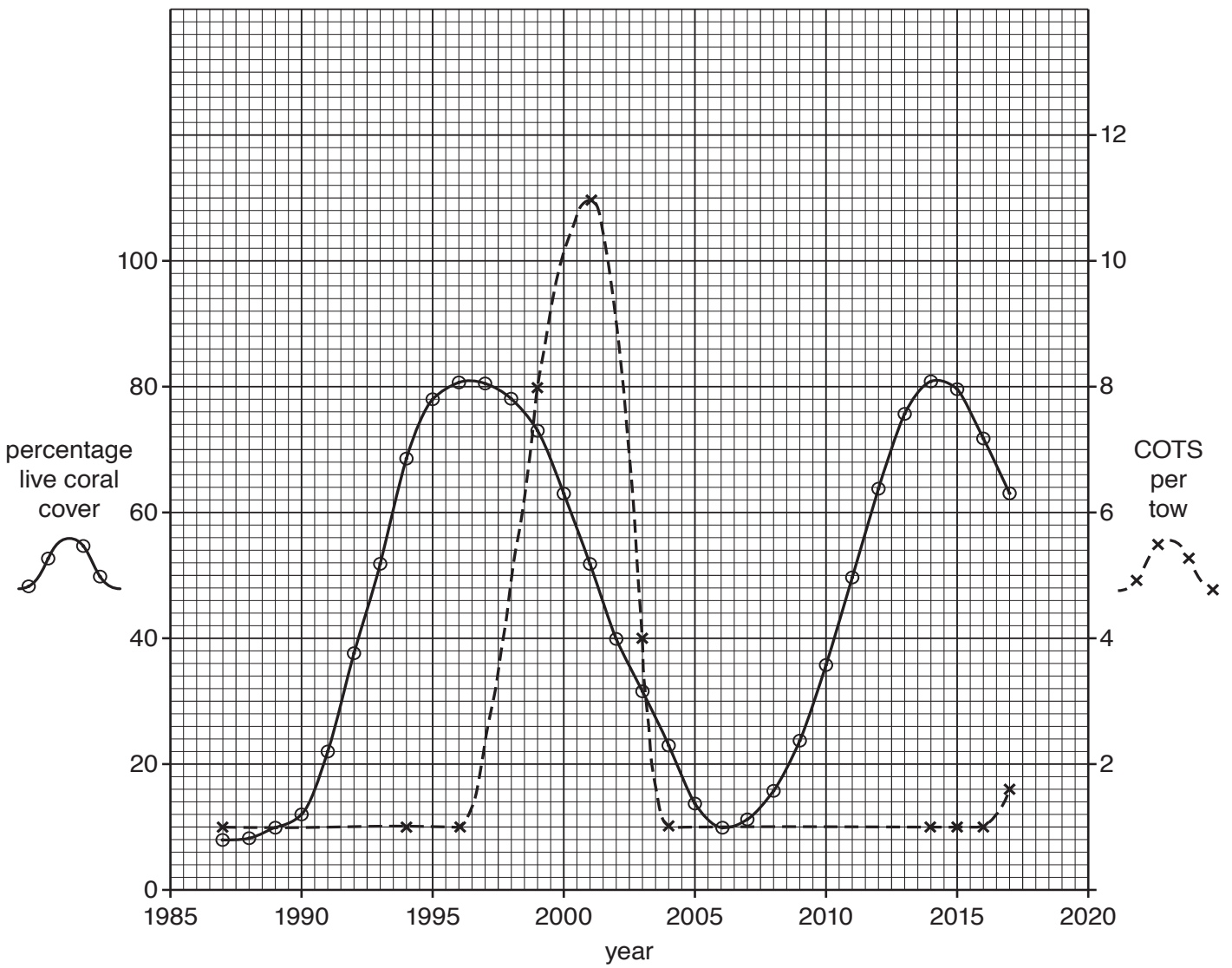


Fig. 1.1

- (i) Use Fig. 1.1 to describe the changes in percentage live coral cover between 1996 and 2005.

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..... [2]

(ii) Use Fig. 1.1 to explain how populations of coral and COTS are interrelated.

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..... [2]

(c) Lionfish are predators that normally live in the Indo-Pacific Ocean. They have recently been introduced to Caribbean coral reefs. Their populations have increased and spread greatly, partly because they have no natural predators in these areas. Lionfish have reduced the number of small reef fish by up to 95% on some reefs.

Attempts to eradicate the lionfish have all failed.

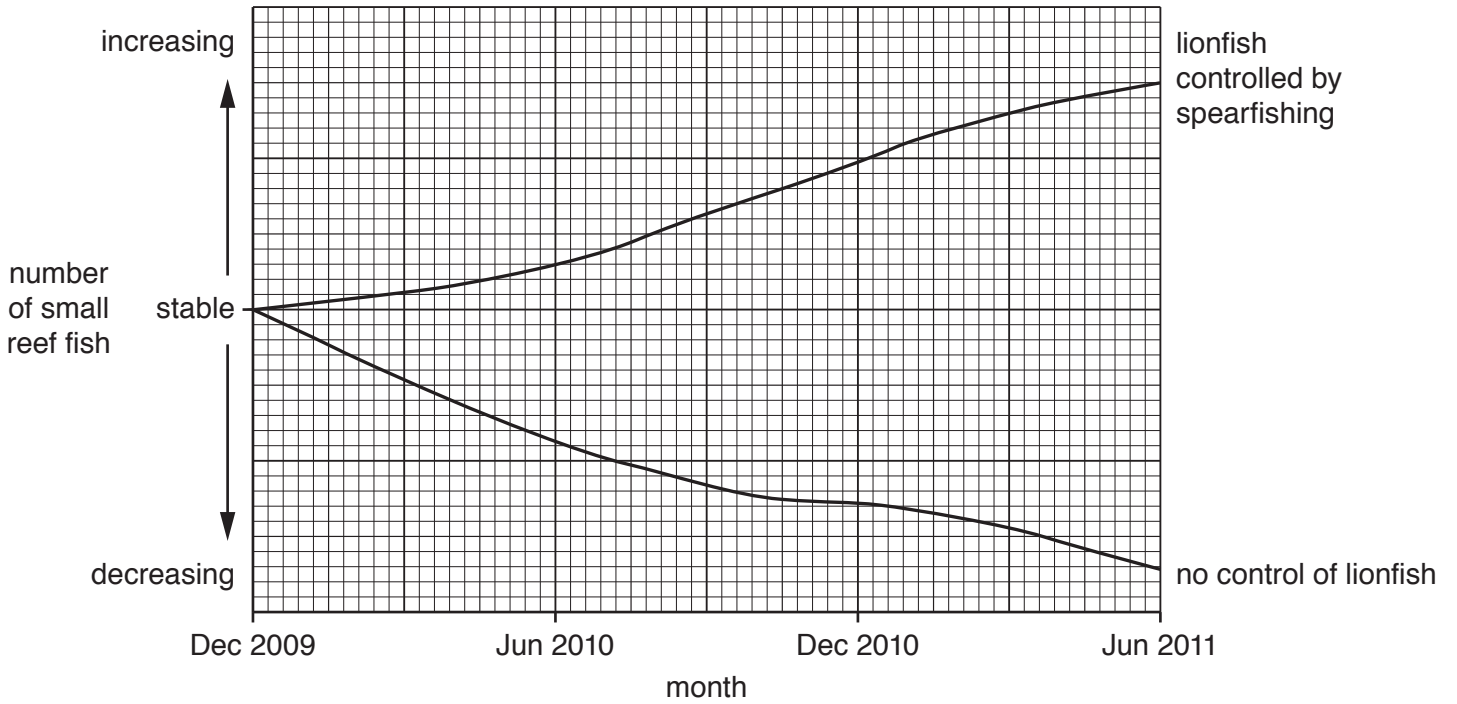
(i) Suggest the outcomes if there was no attempt to control the number of lionfish.

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(ii) A group of biologists have suggested the following hypothesis.

**Spearfishing of lionfish will reduce their number and therefore prevent the decline in the number of small reef fish.**

Fig. 1.2 shows the results of lionfish control by spearfishing on the number of small reef fish, on a small experimental area of reef from December 2009 to June 2011.



**Fig. 1.2**

Explain how the results of the experiment support the hypothesis.

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..... [2]

[Total: 10]

- 2 Fish in the open ocean ecosystems are dependent on complex plankton-based food webs with many trophic levels.

Periodic upwelling of nutrient-rich water leads to plankton blooms, with high productivity.

- (a) Explain the meaning of the term *productivity*.

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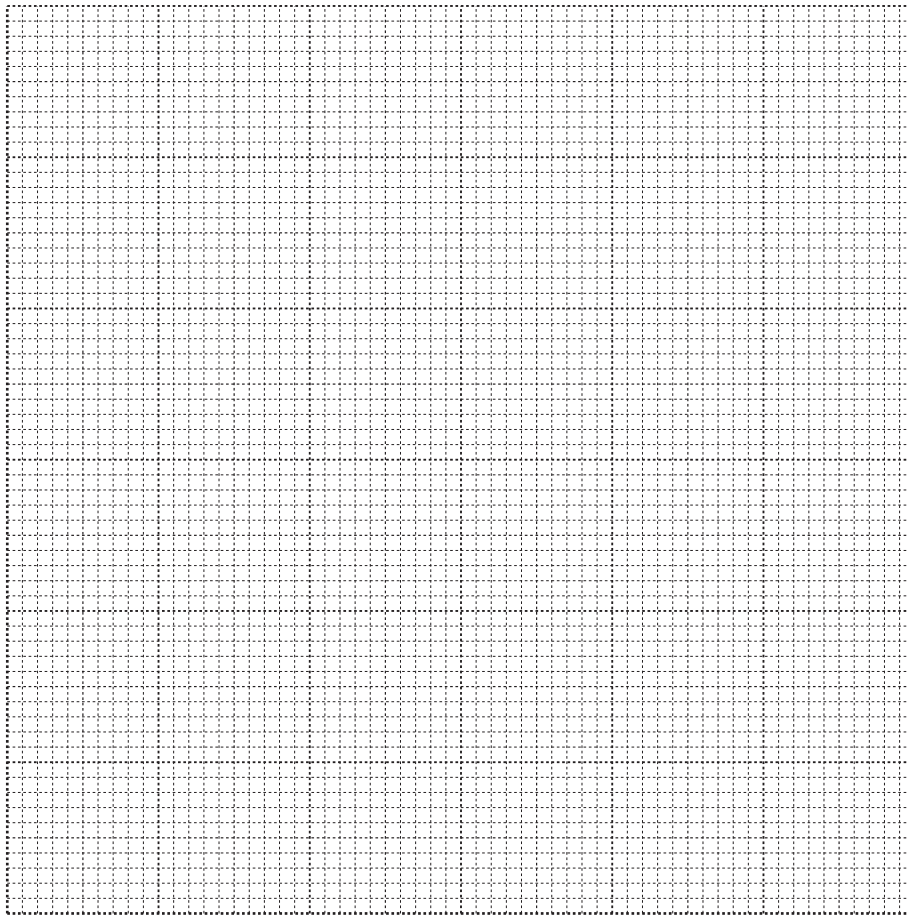
..... [2]

- (b) The efficiency of energy transfer between each trophic level in a plankton-based food chain in the Bay of Naples was measured during a plankton bloom and during a normal period. The results are shown in Table 2.1.

**Table 2.1**

trophic level transfer	percentage efficiency of energy transfer	
	during plankton bloom	during normal period
from 1 to 2	22	22
from 2 to 3	20	24
from 3 to 4	20	13
from 4 to 5	21	12

(i) Plot a bar graph of the data shown in Table 2.1.



[5]

(ii) Use Table 2.1 and your bar graph to describe the changes in efficiency of energy transfer between trophic levels as energy flows along the food chain during a **normal period**.

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..... [2]

(iii) Suggest why there is a lower efficiency of energy transfer from trophic levels 4 to 5 during a normal period compared to during a plankton bloom.

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..... [1]

[Total: 10]

**Section B**

Answer **both** questions in this section.

- 3 (a) Explain the effect of volcanic activity on the chemical composition of sea water.

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..... [5]

- (b) Describe **and** explain the effects of evaporation and precipitation on the salinity of sea water.

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..... [4]







(c) Explain, with reference to marine examples, why habitats with high biodiversity tend to contain narrow ecological niches.

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..... [4]

[Total: 15]

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