



Cambridge International AS & A Level

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MARINE SCIENCE

9693/02

Paper 2 AS Data-Handling and Free-Response

October/November 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 The distribution of seven different species of mangrove tree, **A** to **G**, along several Australian estuaries was investigated.

In each estuary, locations were classified as upper, middle and lower. This is shown in Fig. 1.1.

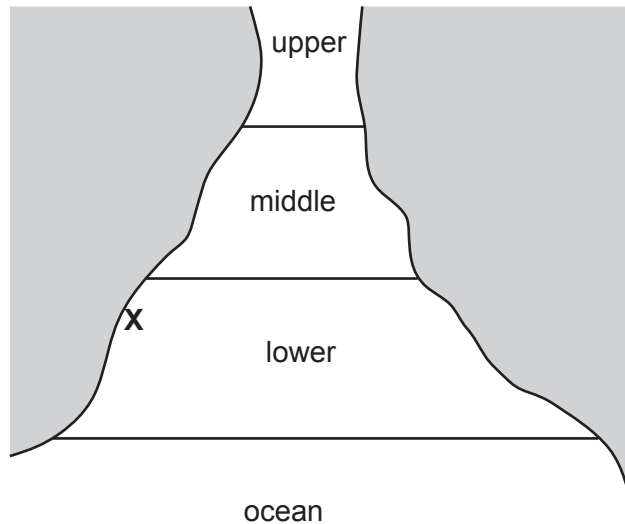


Fig. 1.1

The intertidal zones on the shore of each estuary were classified as high, medium and low. This is shown in Fig. 1.2.

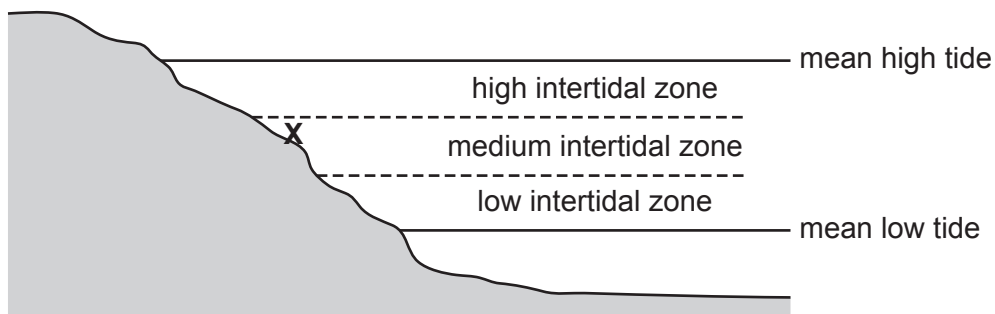


Fig. 1.2

The researchers counted the number of each species of mangrove tree in the three locations in each estuary. They calculated the mean percentage of each species in each location.

They recorded the presence or absence of each species in each intertidal zone.

Their results are shown in Table 1.1.

Table 1.1

species	mean percentage of each species at each location in the estuary			presence of each species at each intertidal zone		
	upper	middle	lower	high	medium	low
A	82	14	4		✓	✓
B	70	26	4	✓	✓	
C	25	39	36		✓	✓
D	35	46	19			✓
E	30	57	13		✓	✓
F	3	43	54		✓	
G	4	4	92		✓	

(a) Use Fig. 1.1, Fig. 1.2 and Table 1.1 to state **and** explain which species, **A** to **G**:

(i) is most tolerant of the widest range of salinities

.....

 [2]

(ii) is most tolerant of long periods exposed to air

.....

 [2]

(iii) is most likely to be found at position **X**, which is shown in Fig. 1.1 and Fig. 1.2.

.....

 [2]

(b) (i) Explain why the scientists collected data from more than one estuary.

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

(ii) Suggest **one** other variable that may affect the distribution of mangrove tree species, other than salinity or time exposed to air.

..... [1]

[Total: 9]

- 2 An investigation was carried out to compare the effect of cleaner fish on a species of damselfish. The cleaner fish remove external parasites from the damselfish at cleaning stations.

Damselfish live in shallow-water fringing reefs. They defend their exclusive territories from other damselfish.

A number of damselfish were observed at sites around each of six different islands, H to M. At each island site half of the damselfish had a cleaning station in their territory. The other half of the damselfish had no cleaning station in their territory. This is shown for one island in Fig. 2.1.

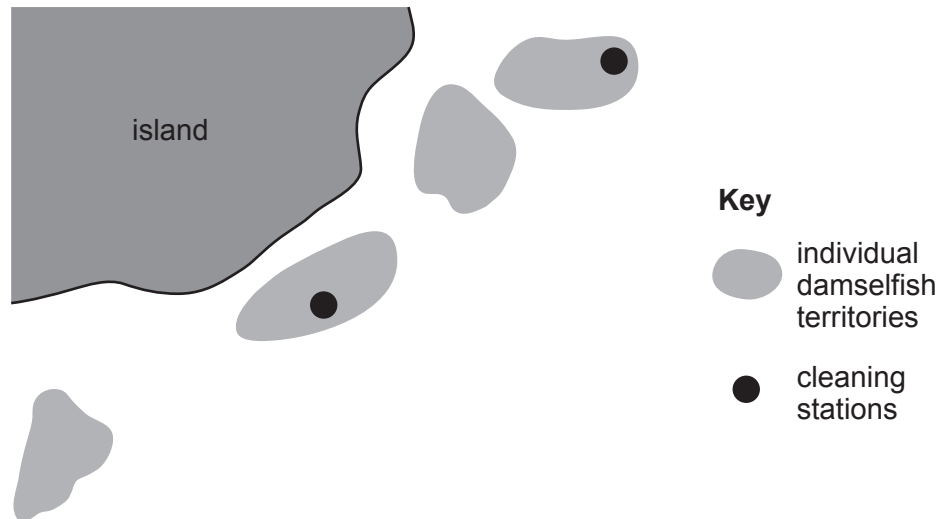


Fig. 2.1

The damselfish were collected for examination and the number of external parasites on each damselfish was counted. The mean number of external parasites per damselfish was calculated.

Fig. 2.2 shows the results of the investigation.

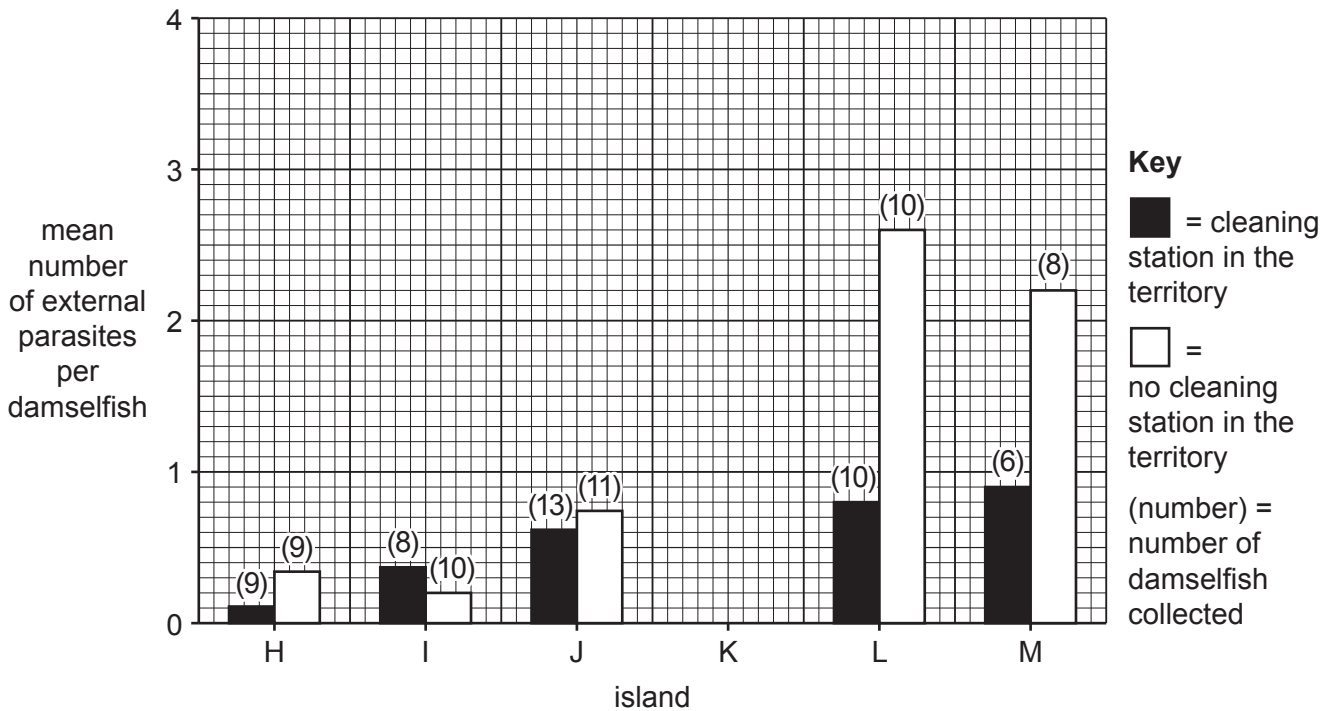


Fig. 2.2

(a) The data for island K are shown in Table 2.1.

Table 2.1

	total number of damselfish collected	total number of external parasites found	mean number of external parasites per damselfish
damselfish with cleaning stations	12	8
damselfish without cleaning stations	13	22

- (i) Calculate the mean number of external parasites per damselfish for damselfish with cleaning stations and damselfish without cleaning stations.

Add this information to Table 2.1.

[1]

- (ii) Use your calculated numbers from (i) to complete the graph for island K in Fig. 2.2.

[2]

- (b) Use Fig. 2.2 to calculate the percentage difference between the mean number of external parasites on damselfish that do not have a cleaning station and those that do, for island M.

Show your working.

.....% [3]

- (c) Discuss the extent to which these data support the theory that cleaner fish reduce the number of external parasites on damselfish.

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..... [3]

- (d) Suggest **two** other variables that may affect external parasite numbers on damselfish.

1
2 [2]

[Total: 11]

(b) Describe the cycling of calcium within the marine environment.

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[8]
[Total: 15]

4 (a) Coral polyps have a symbiotic relationship with zooxanthellae.

Name **and** describe this relationship.

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..... [4]

(b) Productivity is the rate of production of biomass in an ecosystem.

Explain why coral reefs typically have a high productivity.

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..... [5]

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