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MARINE SCIENCE

9693/03

Paper 3 A2 Structured Questions

October/November 2021

1 hour 30 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 75.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

Answer **all** the questions in the spaces provided.

- 1 (a) *Sargassum natans* and *Sargassum fluitans* are two species of brown seaweed found in the Sargasso Sea. These seaweeds gather in dense mats, which float on the surface, forming important ecosystems.

Fig. 1.1 shows a map of the seasonal movement of *Sargassum* from the coast of Brazil and Gulf of Mexico to the Sargasso Sea.

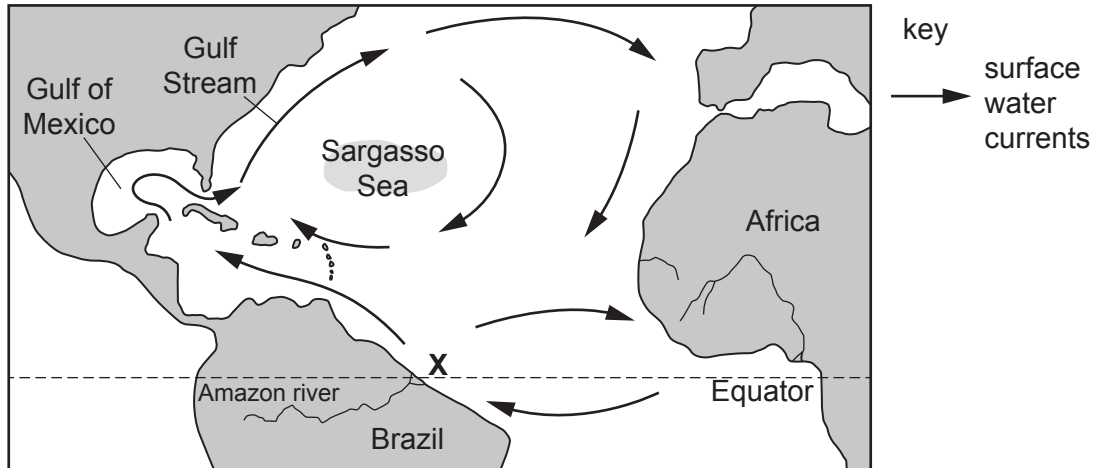


Fig. 1.1

- (i) State the habitat of *Sargassum* in the Sargasso Sea.

.....
 [1]

- (ii) Use Fig. 1.1 to explain why *Sargassum* is contained within the Sargasso Sea.

.....
 [1]

- (iii) *Sargassum* is important in providing a habitat, shelter and a food and energy source for marine animals in the Sargasso Sea. It also acts as a nursery area for a number of marine species.

State **two other** ways in which *Sargassum* in the Sargasso Sea is important in marine ecosystems.

1

.....

2

.....

[2]

- (b) In 2011, 2015 and again in 2018 there was a sudden and massive increase in *Sargassum* numbers. Huge piles, up to 2m high, were washed ashore along the African coastline, coast of Brazil and Caribbean islands in the Gulf of Mexico.

- (i) It was initially thought that the *Sargassum* had come from the Sargasso Sea, but its origins were traced back to a new, smaller area which had formed in the tropical coastal waters of Brazil. This new area is marked **X** on Fig. 1.1.

Use the information in Fig. 1.1 to suggest **and** explain why conditions at point **X** would favour rapid growth in comparison with conditions in the Sargasso Sea.

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..... [4]

- (ii) The build-up of *Sargassum* poses a threat to tourism, fisheries and wildlife. Sea turtle numbers decreased significantly in these areas.

Fig. 1.2 shows a female turtle laying eggs on a sandy beach.

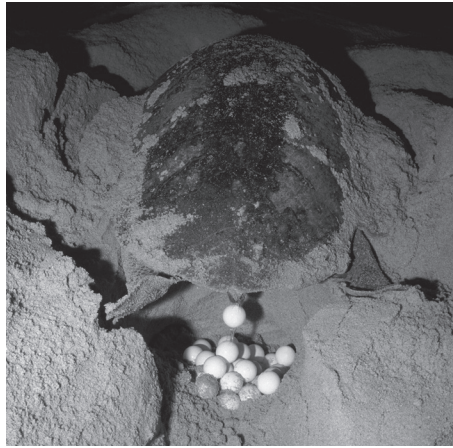


Fig. 1.2

Suggest **two** reasons why sea turtle numbers decreased.

- 1
- 2

[2]

[Total: 10]

2 (a) Fish such as tuna use ram ventilation to obtain oxygen from sea water.

Describe what is meant by the term ram ventilation.

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.....
.....
.....
.....
..... [3]

(b) Fish such as grouper use pumped ventilation to obtain oxygen from sea water.

Outline what happens during **outflow** of water over the gills.

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..... [3]

(c) Nurse sharks are a slow-moving benthic species found in tropical and sub-tropical seas. They are nocturnal hunters and rest in crevices and under ledges during the day.

Suggest **and** explain why nurse sharks use pumped ventilation and not ram ventilation.

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

[Total: 8]

3 (a) (i) State the type of fertilisation used by whales and tuna.

whales

tuna

[1]

(ii) State how the spawning habits of tuna might increase the chances of fertilisation.

.....

..... [1]

(iii) State **and** explain **two** ways in which a female whale increases the chances of her calf surviving to adulthood.

1

.....

2

.....

[2]

- (b) The North Atlantic right whale is one of the most endangered of all large whales. The population around the east coast of North America is thought to be around 400 individuals, while the population around Northern Europe is thought to be almost extinct.

Read the information about the North Atlantic right whale along the east coast of America.

During late autumn and winter, whales breed in temperate waters, just off the coast of the southern states of Georgia and Florida. In spring they migrate northwards to the coastal waters of northern states and Canada. Here they feed on zooplankton, krill and other invertebrates over the summer months.

Whales migrate alone, or in small groups of 2 to 3. When feeding, groups of up to 12 or more can be seen.

Adult whales can live for 30 years or more and start breeding at the age of 9 or 10 years. Breeding takes place every 3 to 6 years and gestation lasts for a year. Mating pairs do not maintain long-term bonds.

Right whales emit a number of low frequency sounds, mostly during courtship, but also to maintain contact with other individuals and to communicate threats.

- (i) The North Atlantic right whale population reached critically low levels due to whaling. Since 1930 it has been protected from whaling, but shows no sign of recovery.

Use the information provided to identify **two** reasons why the population has not recovered.

1

.....

2

.....

[2]

- (ii) The coastal waters around the east coast of America are important fishing and shipping areas.

Suggest how these two activities have influenced the lack of recovery in North Atlantic right whale numbers.

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..... [2]

(d) Scientists are trialling the use of satellites to locate, identify and count whales.

Suggest the advantages of using satellite images rather than traditional methods such as spotter planes, or counting from boats.

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..... [2]

(e) In 2012 a decision was made to build an undersea sonar station just off the coast of Georgia/northern Florida.

Use the information provided to suggest **and** explain the likely impact of this sonar station on the North Atlantic right whales.

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..... [2]

(f) No North Atlantic right whales were born in 2018, but seven were born by March 2019.

Suggest why the conservation measures put in place should remain for several years at least.

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..... [1]

[Total: 16]

4 (a) Tuna stocks in the Indian Ocean are monitored annually. Information required to monitor stocks includes natural mortality, fishing mortality and age of reproductive maturity.

State **two other** pieces of information used to monitor fish stocks.

1

.....

2

..... [2]

- (b) Table 4.1 shows albacore and yellowfin tuna catch from the Indian Ocean between 2014 and 2018. It also shows an assessment of stock sustainability in each of those years. Three classes are used to assess stock sustainability: good, intermediate and needs improving.

Table 4.1

year	albacore tuna		yellowfin tuna	
	catch / 1000 tonnes	stock sustainability	catch / 1000 tonnes	stock sustainability
2014	34	good	366	good
2015	38	good	402	good
2016	40	good	409	intermediate
2017	35	good	407	needs improving
2018	36	good	422	needs improving

- (i) Describe what is meant by the term sustainable fishing.

.....
 [1]

- (ii) Albacore tuna stocks were good in all years from 2014 to 2018.

Use the information in Table 4.1 to suggest the reason why yellowfin tuna stocks are not sustainable.

.....
 [1]

- (iii) State **two** methods that can be introduced to conserve yellowfin tuna stocks to make them more sustainable.

1

 2
 [2]

(c) Fig. 4.1 shows the fishing methods and percentage share of total catch for albacore tuna and yellowfin tuna in 2018.

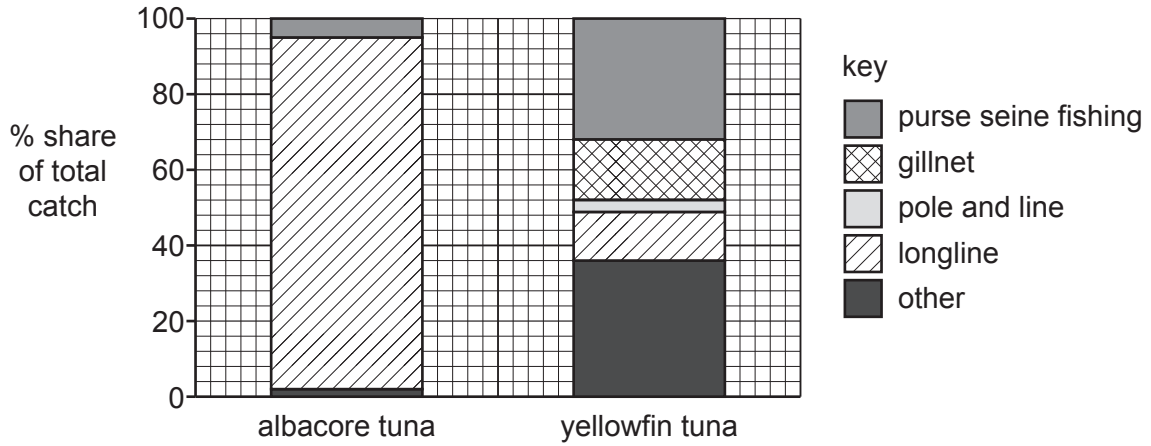


Fig. 4.1

(i) Explain why benthic trawling is unlikely to be an example of 'other' fishing method.

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..... [2]

(ii) Use Fig. 4.1 and Table 4.1 to discuss the impact of different fishing methods on albacore and yellowfin tuna catch and sustainability.

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..... [4]

- (d) Conservation programmes involve the management of ecosystems in order to protect and preserve the species and habitats present.

Outline why marine conservation must sustain ecological linkages to be successful.

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..... [3]

[Total: 15]

- 5 (a) Marine food fish such as seabass are often cultured in sea cages.

Fig. 5.1 shows a typical sea cage containing seabass.

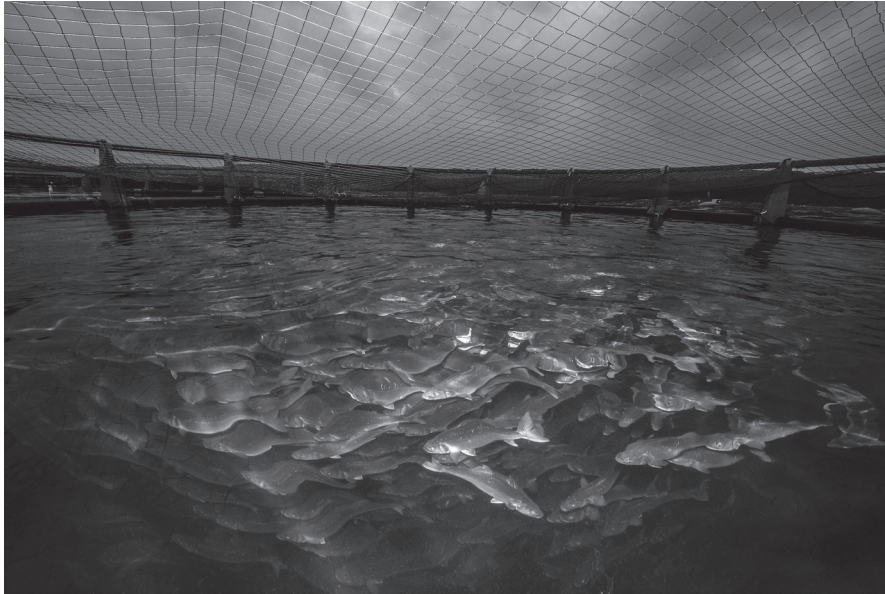


Fig. 5.1

This type of aquaculture is partly intensive and partly extensive.

- (i) State **one** feature which makes this type of aquaculture partly intensive.

.....
..... [1]

- (ii) State **one** feature which makes this type of aquaculture partly extensive.

.....
..... [1]

- (iii) Suggest **one** reason why the top of the cage is netted.

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..... [1]

- (iv) Stocking densities for cage culture of seabass range from 15 to 40 kg m⁻³ although some may be as high as 60 kg m⁻³. At very high stocking densities oxygen levels inside sea cages can fall to lower levels than in the surrounding water.

Suggest **and** explain **one other** potential negative impact on the seabass of these high stocking densities.

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..... [2]

- (v) Oxygen concentration inside the sea cages is usually monitored.

Explain why the oxygen concentration needs to remain high.

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..... [1]

- (vi) Describe why the oxygen concentration underneath sea cages is usually much lower than the surrounding water.

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..... [3]

- (b) Benthic monitoring usually occurs below sea cages to check on water quality. The animals collected in the sediment are identified and compared with a biotic index. The biotic index identifies the number of key species, which are used to classify water quality.

Fig. 5.2 shows the stages involved in benthic monitoring.

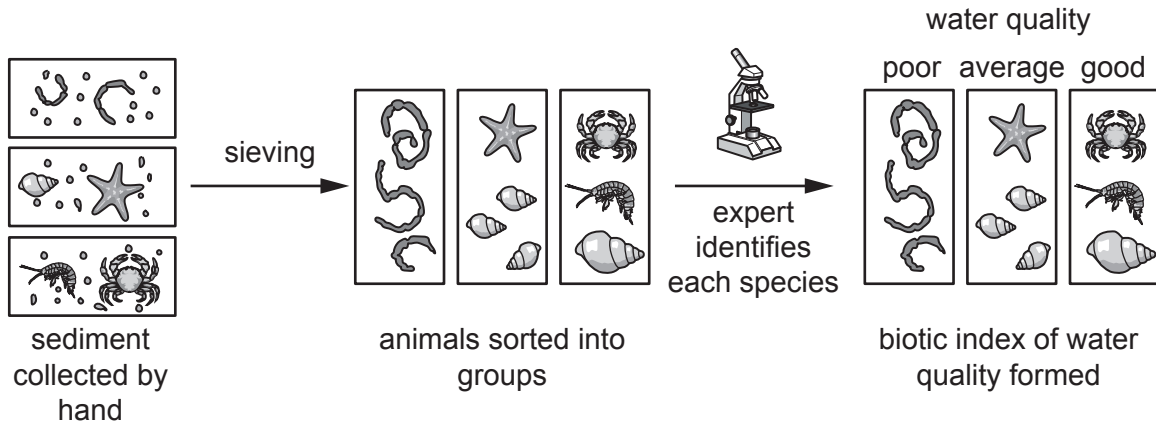


Fig. 5.2

Recently scientists have used the latest digital technology for benthic monitoring.

- Sediment samples are collected remotely from the seabed under the cages. The sediment contains fragments of genes called eDNA, from each species living below the cage.
- Computers identify the species each piece of eDNA came from and predict the numbers of each species present.
- This is compared to a biotic index to classify water quality.

- (i) Suggest **two** advantages of using this technology instead of using the traditional method for benthic monitoring.

1

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2

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[2]

- (ii) Suggest **one** reason why using this new technology might not be accurate.

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..... [1]

[Total: 12]

6 (a) Read the information about oysters in Chesapeake Bay, United States of America.

Oyster numbers reduced to just 0.3% of the population in the 1800s. Disease, habitat loss, overharvesting and poor water quality were the main factors for this reduction.

In recent years the oyster population has recovered due to water quality improvement of the ten tributaries which flow into the bay, increasing disease resistance, growth of aquaculture and better management of the wild harvest.

Oysters are filter feeders and are used to improve water quality and provide a habitat for many species, especially crabs and shrimp, which in turn provide food for fish.

Better management techniques include creating sanctuary areas for oysters where no harvesting is allowed.

(i) Suggest the benefits of creating oyster sanctuary areas.

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..... [3]

(ii) Suggest how aquaculture can be used to increase oyster numbers in the bay.

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..... [2]

- (iii) The Chesapeake Oyster Alliance has been set up to help restore oyster numbers in the bay.

Suggest why it is important to involve the local population in this alliance.

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..... [2]

- (b) (i) Scientists are working on improving disease resistance in oysters. The traditional method involved the use of selective breeding based on phenotype.

Describe what is meant by selective breeding based on phenotype.

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..... [3]

Recently, a technique involving genomics has been used to help with selective breeding to improve disease resistance in oysters. The genes that confer resistance are located and identified, and only oysters that contain these genes are allowed to breed.

- (ii) Describe what is meant by the term gene.

.....
..... [1]

- (iii) Explain why this breeding process is **not** an example of genetic engineering.

.....
..... [1]

- (iv) Suggest the benefits of selecting the individuals allowed to breed according to their genes, rather than selecting them according to their phenotype.

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..... [2]

[Total: 14]

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