Marine Science marking guide and response

External assessment 2024

Combination response (92 marks)

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. describe and explain the reef and beyond, changes on the reef, oceans of the future and managing fisheries
2. apply understanding of the reef and beyond, changes on the reef, oceans of the future and managing fisheries
3. analyse evidence about the reef and beyond, changes on the reef, oceans of the future and managing fisheries to identify trends, patterns, relationships, limitations or uncertainty
4. interpret evidence about the reef and beyond, changes on the reef, oceans of the future and managing fisheries to draw conclusions based on analysis.

Note: Objectives 5, 6 and 7 are not assessed in this instrument.

Purpose

This document consists of a marking guide and a sample response.

The marking guide:

- provides a tool for calibrating external assessment markers to ensure reliability of results
- indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- informs schools and students about how marks are matched to qualities in student responses.

The sample response:

- demonstrates the qualities of a high-level response
- has been annotated using the marking guide.

Mark allocation

Where a response does not meet any of the descriptors for a question or a criterion, a mark of '0' will be recorded.

Where no response to a question has been made, a mark of 'N' will be recorded.

Allow FT mark/s — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can still be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

Marking guide

Multiple choice

Question	Response
1	A
2	B
3	D
4	A
5	D
6	A
7	C
8	A
9	D
10	D
11	B
12	C
13	C
14	D
15	C
16	B
17	C
18	A
19	B
20	C

Paper 1: Short response

Q	Sample response	The response:
21	Reef zone X: lagoon Reef zone Y: crest	• identifies X **[1 mark]** • identifies Y **[1 mark]**
22a)	Crown-of-thorns starfish outbreak (COTS) The number of other disturbance events for the two reefs is the same.	• identifies COTS outbreak **[1 mark]** • provides valid reasoning **[1 mark]**
22b)	Reef B would be least affected by surface runoff. Reef B is located further from the coast (100 km) than reef A (20 km). Reef B had no crown-of-thorns starfish outbreaks during the 15-year study, but reef A had 4. Crown-of-thorns starfish outbreaks are linked to low water quality, which can be caused by surface runoff.	• infers reef B **[1 mark]** • provides a piece of evidence **[1 mark]** • provides a second piece of evidence **[1 mark]**
22c)	Reef A has connectivity to surrounding habitats, as COTs are carried with ocean currents onto reef A, but this does not extend to reef B. Connectivity allows water transfer between habitats, but as reef B shows an increase in coral cover and no COTs outbreaks, it is unlikely that there is connectivity between reef B and reef A.	• concludes that there is low/no connectivity between reef A and reef B **[1 mark]** • provides a piece of evidence **[1 mark]**
23a)	The carbonate compensation depth is the depth in oceans where the rate of supply of calcium carbonate (marine snow) to the sea floor is balanced by the rate of dissolution. Upwelling reduces the depth of the carbonate compensation depth.	• describes carbonate compensation depth **[1 mark]** • describes that upwelling reduces the depth of carbonate compensation depth **[1 mark]**
23b)	Upwelling brings cold, nutrient-dense water from the deep ocean to the ocean surface. These nutrients then support growth of phytoplankton, zooplankton and other small organisms. These organisms provide a food source for fish, resulting in the increased presence of fish populations where upwelling occurs.	• identifies that upwelling brings nutrients to the surface **[1 mark]** • identifies that nutrients support plankton growth **[1 mark]** • explains how the presence of food is related to the distribution of fish **[1 mark]**

Q	Sample response	The response:
24	The graph shows the number of extended coral polyps at night (as high as 4400) is much higher than the number extended during daylight hours (as low as 600). Corals need to extend polyps to catch food. Therefore most coral polyps are feeding during the night not during the day.	• identifies that polyps feed during the night **[1 mark]** • explains that polyps need to be extended to catch food **[1 mark]** • provides evidence **[1 mark]**
25a)	The calcification rate of *Acropora* decreased as CO_2 concentration increased in both the field and laboratory therefore ocean acidification reduces *Acropora* growth.	• identifies that *Acropora* growth is reduced **[1 mark]**
25b)	As CO_2 concentration increased, *Porites* in the laboratory setting showed increased calcification rates, whereas *Porites* in the field setting showed decreased calcification rates. The calcification rates of *Porites* are lower in the field setting than in the laboratory setting at both low and high concentrations of CO_2.	• identifies a difference **[1 mark]** • identifies a second difference **[1 mark]**
25c)	Laboratory experiments cannot mimic all variables that will be experienced in the field, which may limit validity of laboratory results.	• describes a limitation **[1 mark]**
26a)	Criterion 1: includes critical habitats in the MPA Criterion 2: size	• identifies one criterion **[1 mark]** • identifies a second criterion **[1 mark]**

Q	Sample response	The response:
26b)	Criterion 1: Critical habitats are included in the MPA. Site 1 only includes reef environments but site 2 incorporates seagrass, mangroves and reef ecosystems. This site protects the range of habitats used by species during their different life stages and is more representative of the habitats seen in the area. Criterion 2: Size Site 2 covers a larger area (24 ha) than site 1 (2 ha). This protects a larger portion of the region and enhances population persistence by increasing the protection of larger populations of more species.	• provides a reason for criterion 1 **[1 mark]** • justifies the reason using evidence 1 **[1 mark]** • provides a reason for criterion 2 **[1 mark]** • justifies the reason using evidence **[1 mark]**

Paper 2: Short response

Q	Sample response	The response:
1	Hermatypic *Scleractinia* corals are reef-building, whereas ahermatypic *Scleractinia* corals are not reef-building.	• identifies a difference **[1 mark]**
2	1. commercial 2. artisanal	• identifies a main type of fishery **[1 mark]** • identifies a second main type of fishery **[1 mark]**
3	Similarity: Both reefs showed a relatively consistent (~40%) coral cover prior to the first bleaching event in 1997. Difference: Between 1998 and 2016, the coral cover on reef A increased and stabilised at pre-bleaching levels (~42%), whereas the coral cover on reef B remained low (<10%). Significance: This indicates that reef A is more resilient than reef B to single bleaching events, but not to close, multiple events.	• identifies a similarity **[1 mark]** • identifies a difference **[1 mark]** • identifies the significance **[1 mark]**
4a)	$N = \frac{M \times n}{m}$ $N = \frac{95000 \times 87000}{19000}$ $N = 435000$	• provides correct substitution **[1 mark]** • determines N = 435 000 **[1 mark]**
4b)	1. feeding pattern 2. migration	• identifies a factor **[1 mark]** • identifies a second factor **[1 mark]**
4c)	Capture–recapture does not appear to be a reliable method of estimating population size. There is a large variation in the estimated population between seasons, with the estimated population size in July less than half of the estimated population in January.	• infers capture–recapture method is not reliable **[1 mark]** • provides evidence from the graph **[1 mark]**

Q	Sample response	The response:
5a)	The ecological tipping point occurred in 2022. Coral cover underwent a rapid decline in 2022 and then stabilised in an alternate state, showing the tipping point was reached.	• identifies 2022 **[1 mark]** • identifies that large decline in coral cover is associated with ecological tipping point **[1 mark]**
5b)	Poor and very poor water quality in 2018–2020 led to increased crown-of-thorns starfish outbreaks. These outbreaks caused small declines in coral cover in 2019, 2020 and 2021 and although the reef was able to recover, its resilience was reduced. In 2022, a crown-of-thorns starfish outbreak and cyclone event greatly reduced coral cover. This combined with low reef resilience meant the reef reached its ecological tipping point and was unable to recover, causing the reef to enter an alternate stable state.	• infers poor water quality led to crown-of-thorns starfish outbreaks **[1 mark]** • identifies the effect of crown-of-thorns starfish outbreaks on coral cover **[1 mark]** • infers reef resilience was reduced **[1 mark]** • identifies the effect of the cyclone event on coral cover **[1 mark]** • identifies that the combined effects of all the factors caused the reef to reach its ecological tipping point **[1 mark]**
6	Corals and zooxanthellae have a mutualistic, symbiotic relationship. Zooxanthellae photosynthesise, producing carbohydrates and oxygen, which can be used by corals for respiration. The carbon dioxide and water produced by corals during respiration can be used by zooxanthellae for photosynthesis.	• identifies relationship is symbiotic **[1 mark]** • describes a benefit to corals **[1 mark]** • describes a benefit to zooxanthellae **[1 mark]**
7a)	The carrying capacity is 7000 organisms/m^3. This is the point where production rate is highest while still maintaining a high survival rate.	• predicts carrying capacity of 7000 organisms/m^3 **[1 mark]** • justifies the prediction using evidence **[1 mark]**
7b)	The high levels of nitrogen/ammonia in the system and disease could reduce the carrying capacity of an intensive aquaculture system.	• identifies a factor that reduces carrying capacity **[1 mark]** • identifies a second factor that reduces carrying capacity **[1 mark]**

Q	Sample response	The response:
7c)	The intensive aquaculture system has a higher production (1.75 kg/m^3) than the extensive aquaculture system (0.7 kg/m^3). This is because intensive systems tightly control conditions within optimum conditions, maximising the size of fish, however, the environment is not tightly controlled in extensive systems and so organisms may not grow to their optimum size. The total costs are higher in an intensive aquaculture system ($11.75/$m^3$) than in an extensive aquaculture system ($6.02/$m^3$) because an intensive system involves intervention in the growing process that adds to costs, such as with supplemental feeding and water aeration, but this does not occur in extensive systems. Survival of organisms is higher in extensive systems (95%) than intensive systems (75%), as the stocking density is lower in extensive systems and so there is not as much competition for food and resources in extensive systems.	• explains a difference **[1 mark]** • explains a second difference **[1 mark]** • explains a third difference **[1 mark]**

Q	Sample response	The response:
8a)	Similarity: The first year of land clearing (2016) had very little effect on shallow and deep-water aragonite saturation. Difference: From 2017, the aragonite saturation state in shallow water had increasingly larger changes, whereas the deep-water aragonite saturation state continued to have small changes. Significance: Land clearing led to river discharge that affected the aragonite saturation state in shallow water much more than in deep water.	• identifies a similarity **[1 mark]** • identifies a difference **[1 mark]** • identifies the significance **[1 mark]**
8b)	Corals inhabiting shallow water will have reduced calcification rates when aragonite in water is undersaturated. This will result in decreased resilience of corals in the fringing reef ecosystem.	• predicts an effect on coral species **[1 mark]** • predicts an effect on the fringing reef ecosystem **[1 mark]**
9a)	an increase in atmospheric temperature	• identifies an increase in atmospheric temperature **[1 mark]**
9b)	Increased atmospheric CO_2 increases ocean CO_2 and reduces ocean pH (ocean acidification). In the short term, resilience will prevent a reduction in coral growth limiting changes to coral reef species. However, if these conditions continue, in the long term, coral growth will decline, decreasing biodiversity on the reef. This is because coral provides habitat for reef species.	• predicts a short-term effect on coral reef species **[1 mark]** • explains the short-term effect on coral reef species **[1 mark]** • predicts a long-term effect on coral reef species **[1 mark]** • explains the long-term effect on coral reef species **[1 mark]**
10	Corals act as ecosystem engineers and increase habitat complexity. As a result of increasing complexity, species diversity increases as corals provide niches and habitat for many other organisms to seek shelter, live, hide and feed.	• identifies that corals increase habitat complexity **[1 mark]** • identifies that increased habitat complexity results in high species diversity **[1 mark]** • identifies that corals provide niches or habitat for other organisms **[1 mark]**

Q	Sample response	The response:
11	Increasing ocean temperature reduces the ability of the ocean to sequester CO_2. This means that there is a decrease in primary productivity by phytoplankton, which reduces the production of particulate organic carbon (POC). As there is less POC, less of it can be processed into dissolved inorganic carbon and drawn down into the deep ocean. Therefore, the ocean has a reduced capacity to draw down CO_2 and store it in deep, cold water.	• identifies that increased ocean temperature reduces the ocean's ability to sequester CO_2 **[1 mark]** • identifies that less CO_2 reduces primary productivity **[1 mark]** • explains the reduction in the ocean's ability to store organic carbon **[1 mark]**