LUI | | | | | | | | | | | School code | | | | |

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment 2021

Question and response book

Marine Science

Paper 2

Time allowed

- Perusal time — 10 minutes
- Working time — 90 minutes

General instructions

- Answer all questions in this question and response book.
- Write using black or blue pen.
- QCAA-approved calculator permitted.
- Planning paper will not be marked.

Section 1 (48 marks)

- 7 short response questions

Clear zone — margin trimmed off after completion of assessment

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

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Section 1

Instructions

- If you need more space for a response, use the additional pages at the back of this book.
  - On the additional pages, write the question number you are responding to.
  - Cancel any incorrect response by ruling a single diagonal line through your work.
  - Write the page number of your alternative/additional response, i.e. See page …
  - If you do not do this, your original response will be marked.
- This section has seven questions and is worth 48 marks.

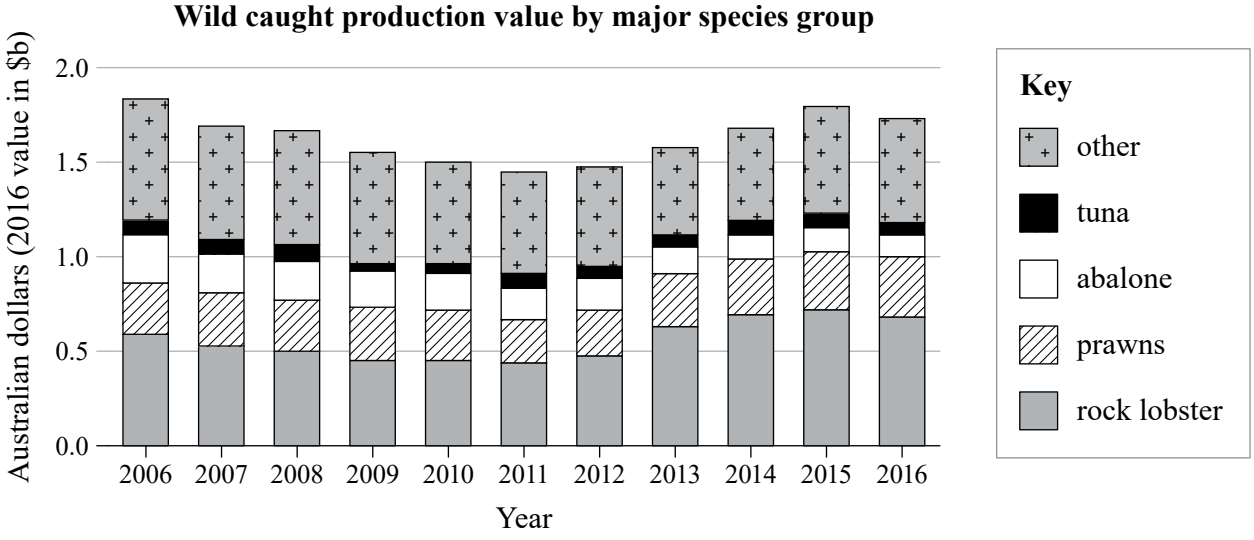
QUESTION 1 (4 marks)

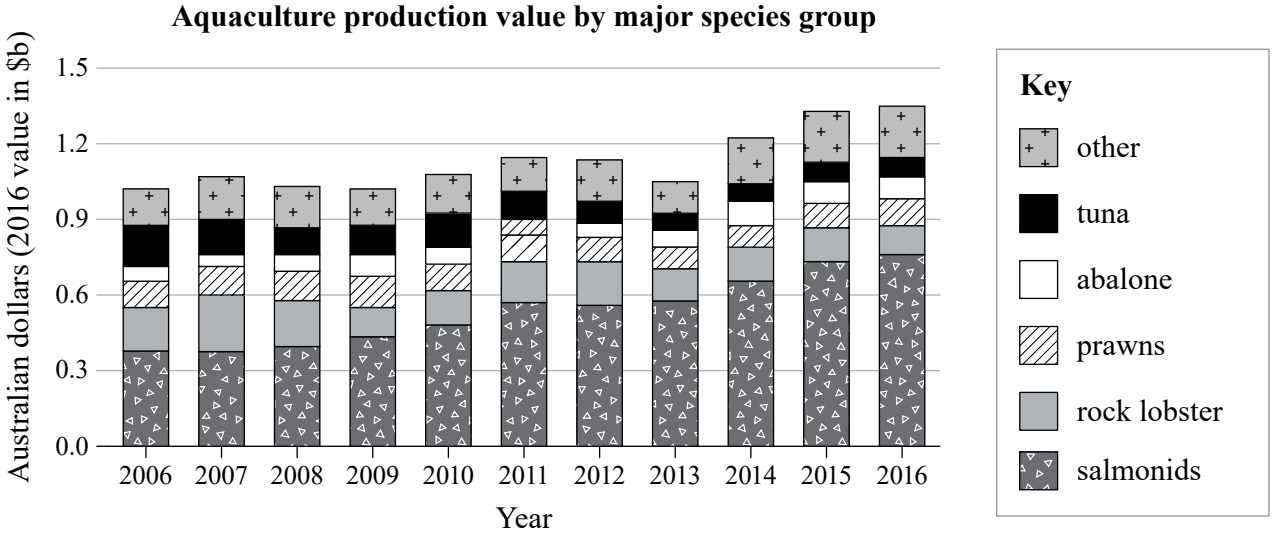
Explain the concept of coral bleaching in terms of Shelford's law of tolerance.

Do not write outside this box.

QUESTION 2 (6 marks)

The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) reports for Australian fisheries from 2006 to 2016 are shown in the graphs.





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a) Identify the most economically valuable species for Australian fisheries in 2016. *[1 mark]*

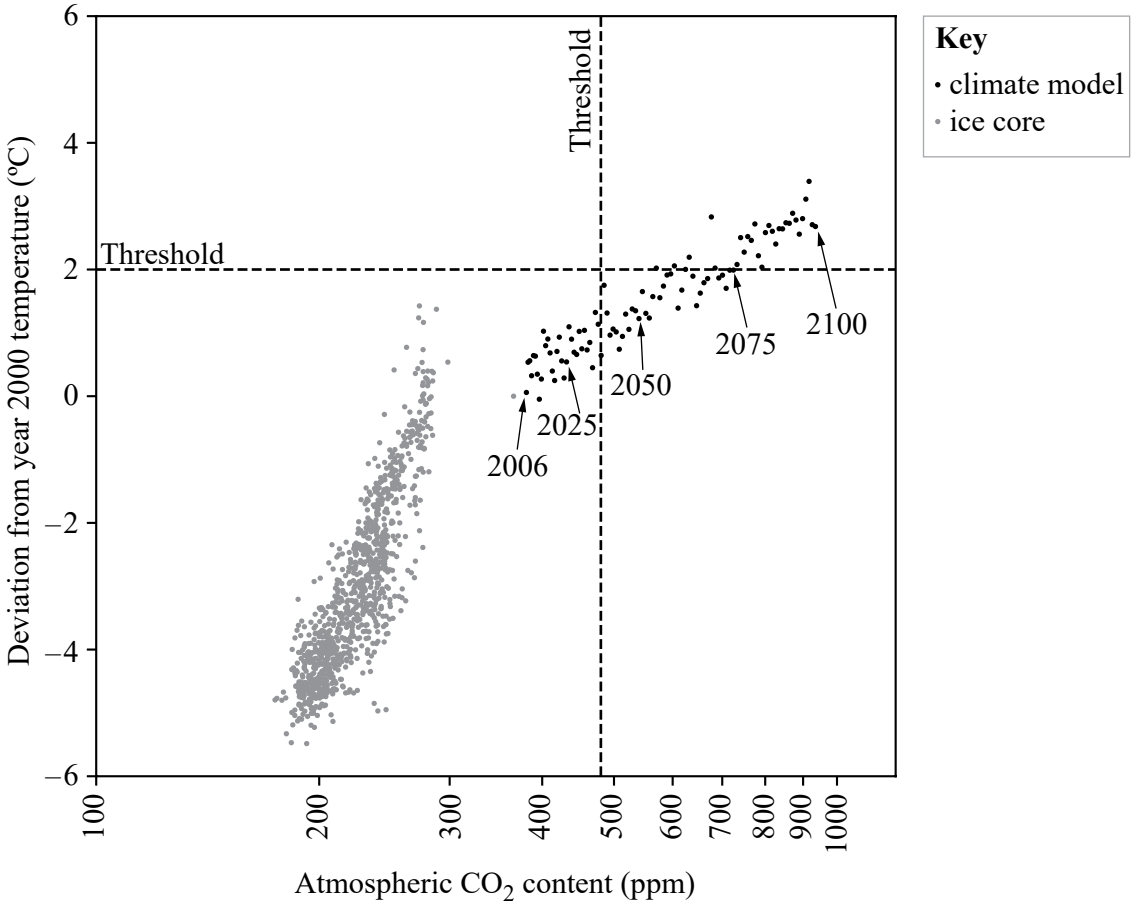
b) Determine how changes in fisheries' practices for wild caught and aquaculture have impacted the combined value of Australia's production from 2006 to 2016. *[3 marks]*

c) Explain one attribute of a major Australian aquaculture species that makes it desirable to farm. *[2 marks]*

Do not write outside this box.

QUESTION 3 (9 marks)

The figure shows temperature and atmospheric carbon dioxide data for the past 800 000 years, derived from Antarctic ice cores and climate model predictions for the Caribbean Sea. The climate model encompasses the years 2006 to 2100 under the RCP8.5 emissions scenario.



a) Identify the ecological tipping point associated with changes in carbonate chemistry and explain how this applies to coral reefs. *[3 marks]*

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b) Contrast the ice core data with the climate model predictions. *[2 marks]*

c) Predict how the community composition of a Caribbean coral reef will change between now and 2100 under the RCP8.5 emissions scenario. *[4 marks]*

Do not write outside this box.

QUESTION 4 (8 marks)

Fish species diversity and coral cover were surveyed at a coral reef before and after a cyclone. The results of the fish transect data were collected and their trophic groups are shown.

Before cyclone

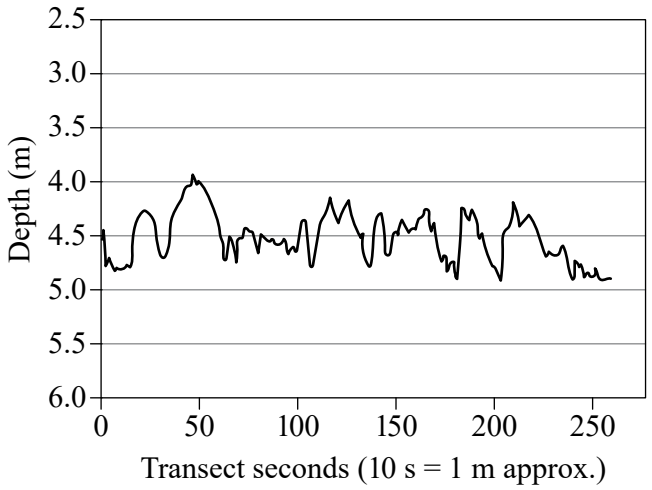
	Species							
Family	**h**	**d**	**co**	**ca**	**i**	**o**	**p**	**Total**
Acanthuridae	1	1						**2**
Chaetodontidae			2					**2**
Labridae			1	3	7		2	**13**
Pomacentridae						8	7	**15**
Scaridae								**0**

After cyclone

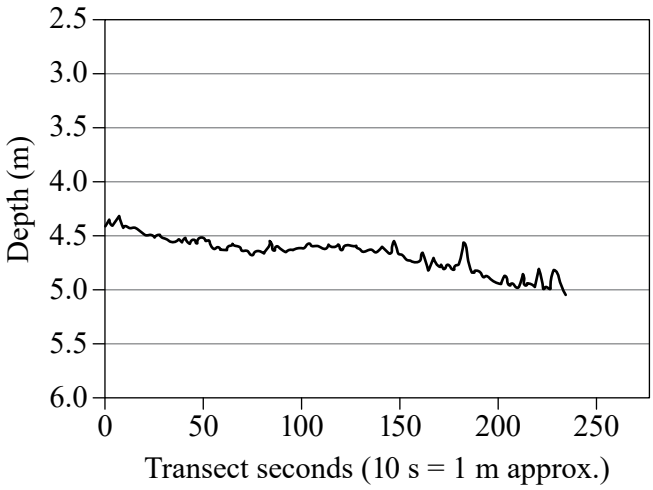
	Species							
Family	**h**	**d**	**co**	**ca**	**i**	**o**	**p**	**Total**
Acanthuridae	1	1						**2**
Chaetodontidae								**0**
Labridae								**0**
Pomacentridae						4	3	**7**
Scaridae	3							**3**

Key **h** = herbivore **d** = detrivore **co** = corallivore **ca** = carnivore
i = benthic invertivore **o** = omnivore **p** = planktivore

Rugosity transect data before cyclone



Rugosity transect data after cyclone



a) Determine the family most affected by the cyclone. Explain your reasoning. *[2 marks]*

Do not write outside this box.

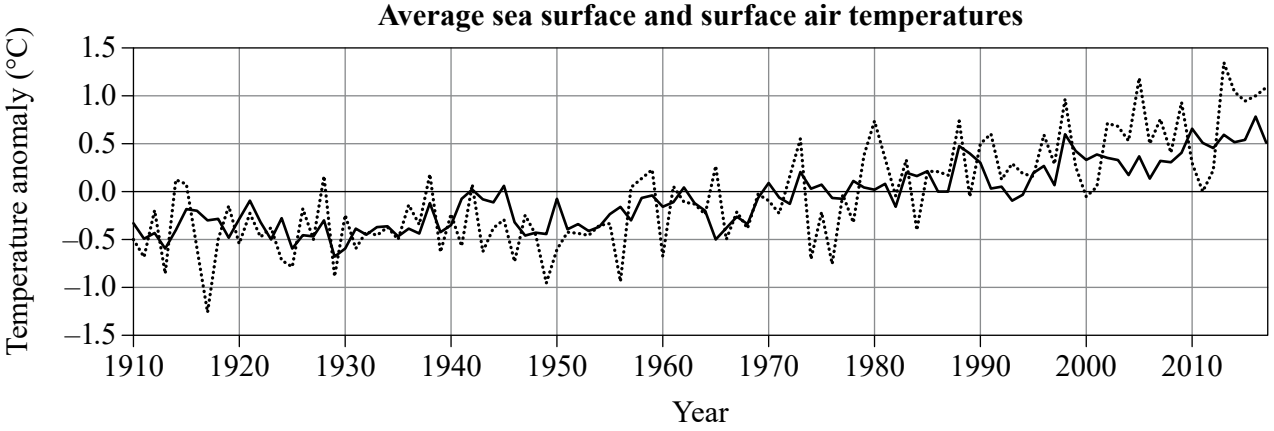
b) Draw conclusions about how changes in habitat complexity influenced the diversity of fish species found at the reef. *[6 marks]*

Do not write outside this box.

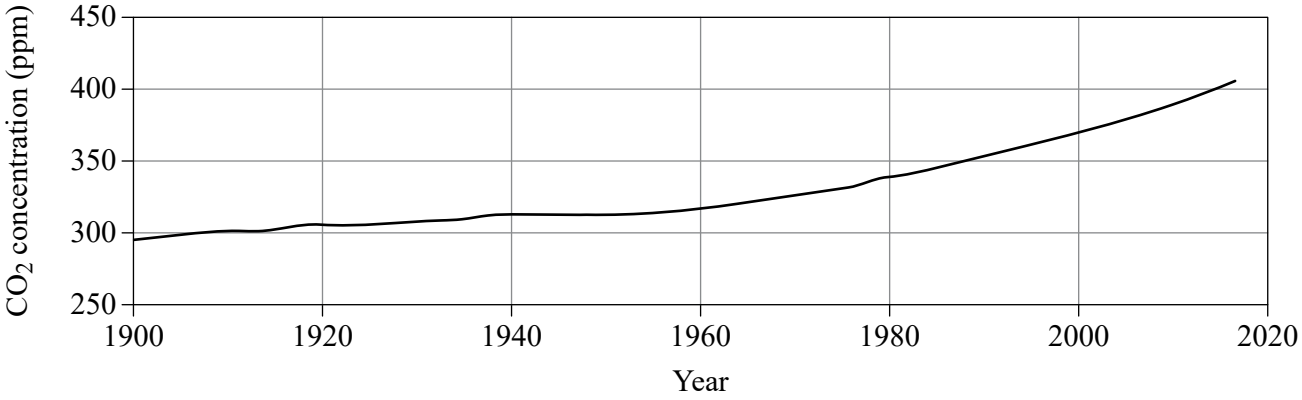
QUESTION 5 (7 marks)

Changes in average Australian sea surface and surface air temperatures, atmospheric carbon dioxide (CO_2) concentration and average sea surface pH in Australian waters are shown on the graphs.

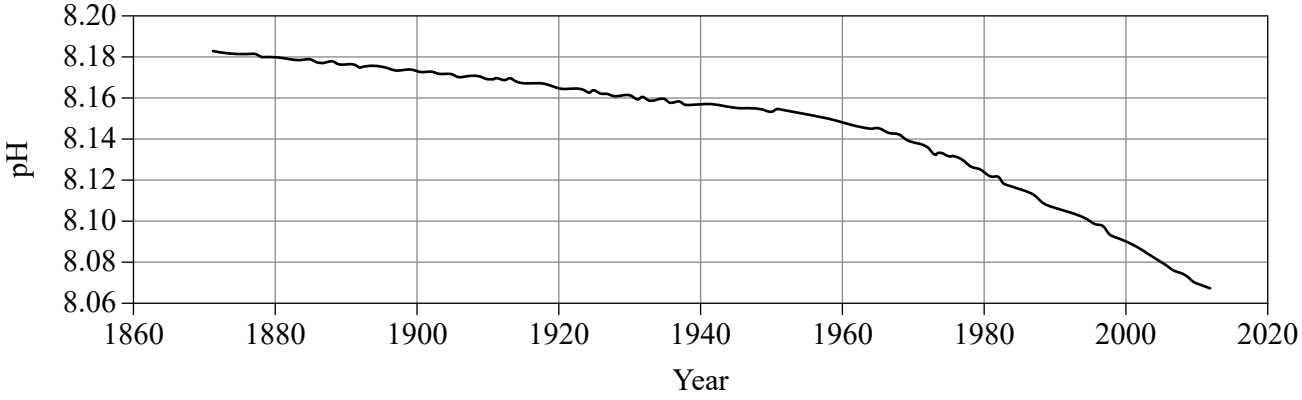
Average sea surface and surface air temperatures



Atmospheric carbon dioxide (CO_2) concentration



Average sea surface pH



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a) Identify the relationship between global temperature, the concentration of atmospheric CO_2, and the pH of Australian waters. *[3 marks]*

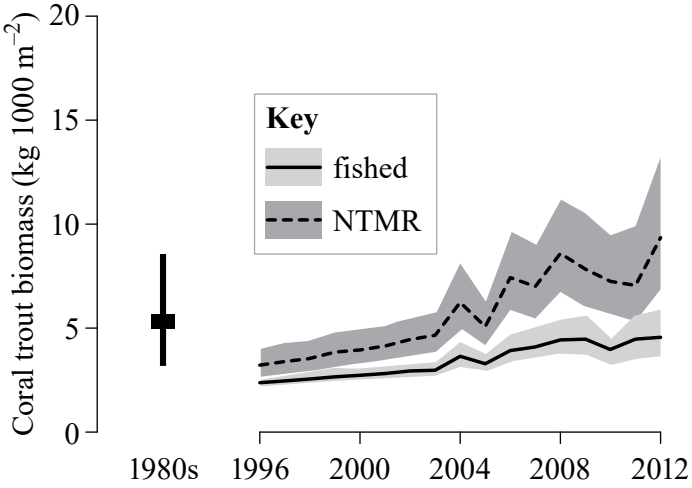
b) Explain the relationship between atmospheric CO_2, the pH of Australian waters and calcification rates in terms of hydrogen ion and carbonate ion concentrations. *[4 marks]*

Do not write outside this box.

QUESTION 6 (10 marks)

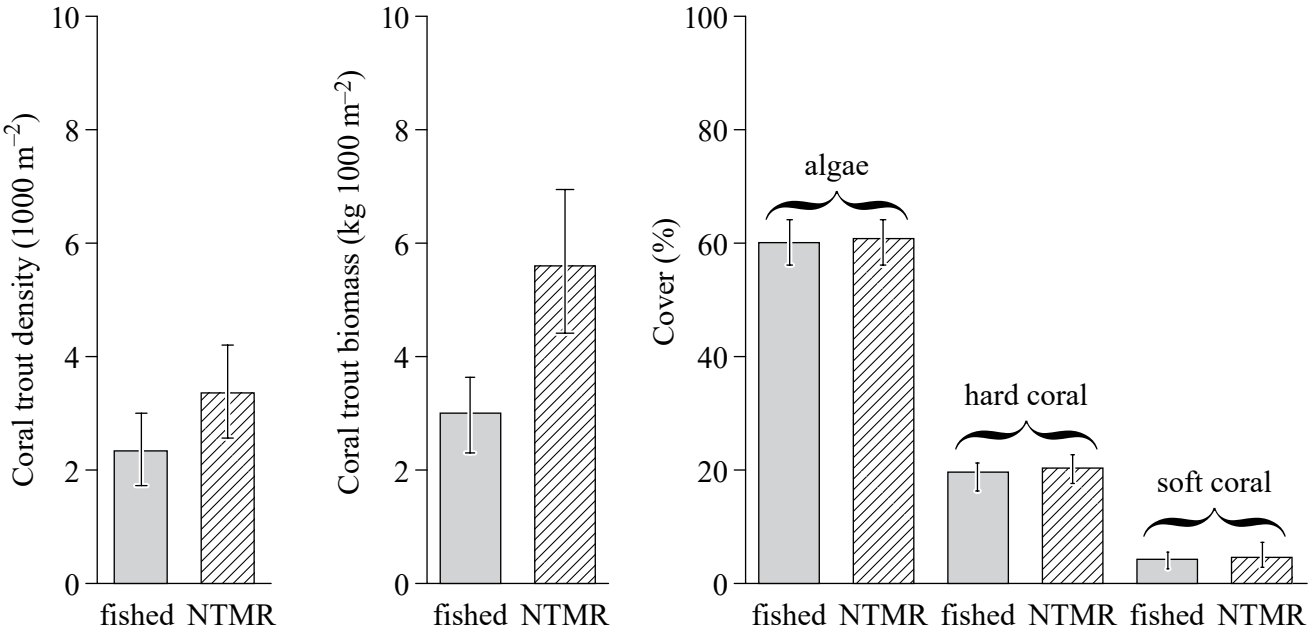
No-take marine reserves (NTMRs) or green zones that are closed to commercial and recreational fishing are widely advocated as conserving exploited fish stocks and biodiversity. The effect of zoning on coral trout (*Plectropomus leopardus*) in the Great Barrier Reef Marine Park (GBRMP) is shown.

Coral trout biomass GBRMP



Year	Zoning plan	GBRMP protected (%)
1983–1988	Regional	1.0
1989–2003	Multiuse	4.5
2004–present	NTMRs	33.0

Coral trout data averaged for 2004 to 2012



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a) Identify a management strategy, other than zoning, used to support marine ecosystem health within the GBRMP. *[1 mark]*

b) Draw a conclusion about the effectiveness of zoning in the GBRMP as a management strategy to support marine ecosystem health. Justify your conclusion. *[6 marks]*

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c) Compare the roles of government and non-government organisations in the implementation of NTMRs. *[3 marks]*

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QUESTION 7 (4 marks)

The average sea surface temperature (SST), the maximum monthly mean (MMM) and the bleaching threshold temperature for coral in two regions of the Great Barrier Reef were recorded.

Great Barrier Reef region	SST (°C)	MMM (°C)	Bleaching threshold temperature (°C)
Far Northern	27.5	29.0	30.0
Southern	26.5	28.0	29.0

Compare the potential changes in coral cover and resilience in the Far Northern and Southern regions if the MMM increased to 29.2 ºC.

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References

Question 2

Graphs adapted from figures 3 and 4, Mobsby, D 2018, *Australian fisheries and aquaculture statistics 2017*, Fisheries Research and Development Corporation project 2018-134, ABARES, Canberra, December. https://doi.org/10.25814/5c07b19d3fec4, CC BY 4.0

Question 3

Data sources:

Bereiter, B et al. 2015, 'Revision of the EPICA Dome C CO2 record from 800 to 600 kyr before present', *Geophysical Research Letters*, vol. 42, issue 2, pp. 542– 549, https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014GL061957.

Parrenin, F et al. 2013, 'Synchronous change of atmospheric CO2 and Antarctic temperature during the last deglacial warming', *Science*, vol. 339, issue 6123, pp. 1060–1063, https://doi.org/10.1126/science.1226368

Dunne, J. P., and Coauthors, 2012: GFDL's ESM2 Global Coupled Climate–Carbon Earth System Models. Part I: Physical Formulation and Baseline Simulation Characteristics. *J. Climate*, 25, 6646–6665, https://doi.org/10.1175/JCLI-D-11-00560.1.

"The Earth System Grid Federation: An open infrastructure for access to distributed geospatial data". Future Generation Computer Systems, 36, 400-417, doi:10.1016/j.future.2013.07.002, 2014 https://esgf.nci.org.au/search/esgf-nci/

RCP8.5 Riahi, K., and Nakicenovic, N. (eds): 2007, Greenhouse Gases - Integrated Assessment, Technological Forecasting and Social Change, Special Issue, 74(7), September 2007, 234 pp. (ISSN 0040-1625)

Question 4

Graphs adapted from: Dustan, P, Doherty, O & Pardede, S 2013, figure 3 in 'Digital Reef Rugosity Estimates Coral Reef Habitat Complexity', in SCA Ferse (ed.), *PLoS ONE*, vol. 8, no. 2, p. e57386 https://doi.org/10.1371/journal.pone.0057386, Licensed under Creative Commons Attribution (CC BY 4.0)

Question 5

Graphs adapted from 'State of the Climate 2020', Bureau of Meteorology & CSIRO, http://www.bom.gov.au/state-of-the-climate/documents/State-of-the-Climate-2020.pdf

Question 6

Adapted from AIMS figures 2, 3 and 5. Obtained from '*Twice the coral trout in Great Barrier Reef protected zones*' eAtlas 2015, Eatlas.org.au, https://eatlas.org.au/nerp-te/gbr-aims-effects-of-zoning, Licensed under CC BY 4.0.