External assessment 2022

Question and response book

Biology

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 (45 marks)

- 11 short response questions

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Queensland Government | QCAA Queensland Curriculum & Assessment Authority

LUI

School code

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Book of books used

Attach your barcode ID label here

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.

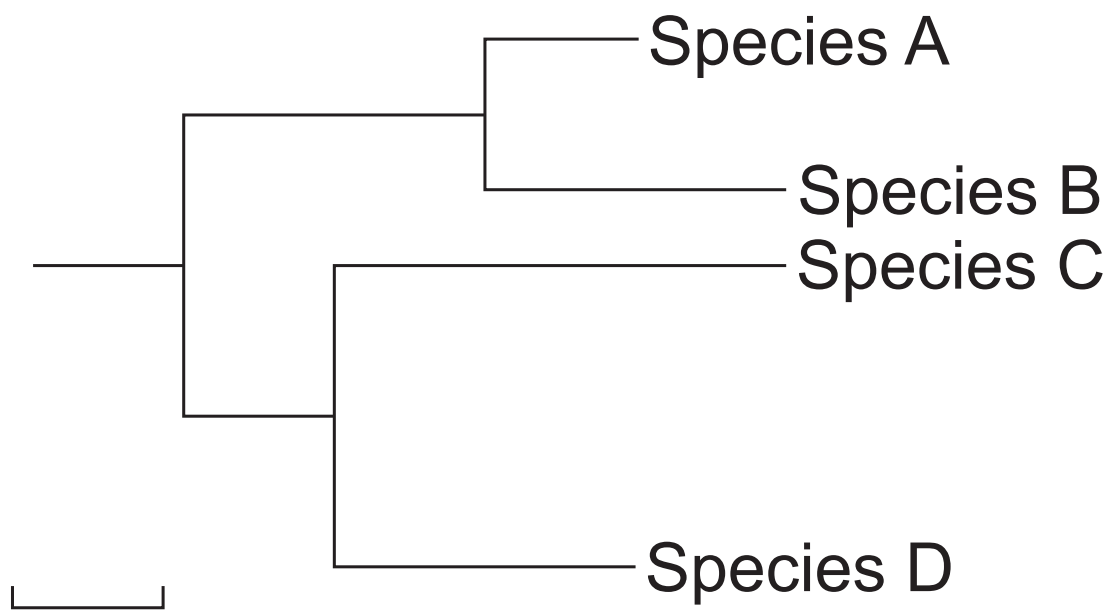
Do not write on this page

This page will not be marked

Do not write outside this box.

Question 1 (3 marks)

This phylogenetic tree uses horizontal distance to represent genetic difference.



Scale 1 unit = nucleotide difference

a) Infer which species is most closely related to species B. Explain your reasoning. [2 marks]

b) Determine the genetic difference between species A and D. [1 mark]

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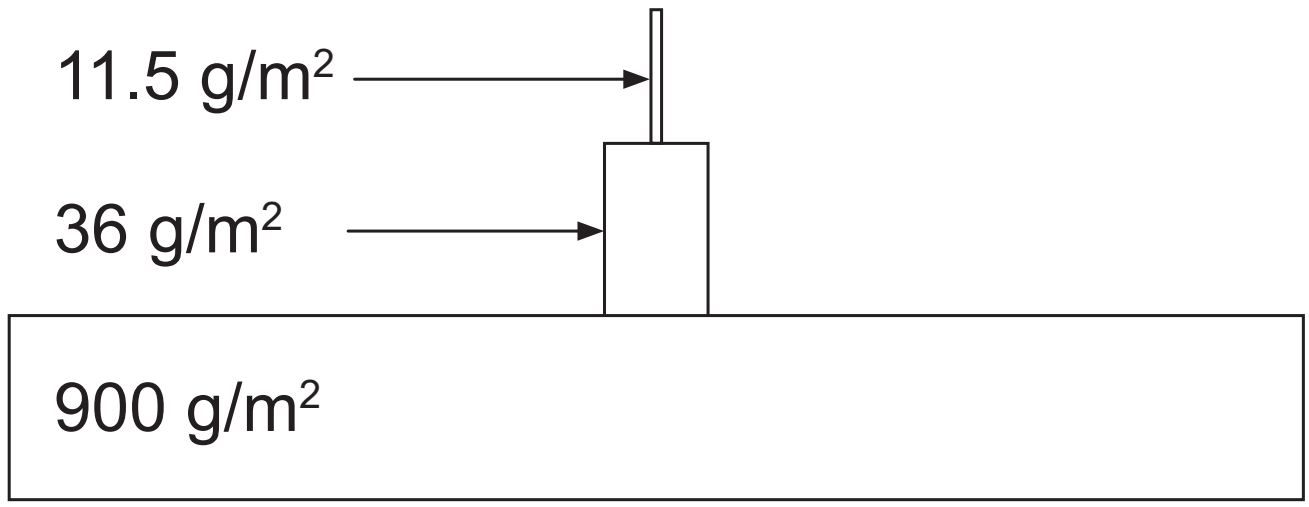
Question 2 (4 marks)

This is a biomass pyramid for a grassland community.



Not to scale

a) Calculate the percentage energy transfer between the first two trophic levels. Show your working. [2 marks]

b) Explain the loss of biomass between trophic levels. [2 marks]

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Question 3 (4 marks)

A glacier has retreated, leaving a large amount of gravel, small rocks, sand and mud.

a) Explain the steps of succession that would occur if the glacier continues to retreat. [3 marks]

b) Identify the type of ecological succession. [1 mark]

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Question 4 (1 mark)

Define *keystone species*.

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Question 5 (5 marks)

a) Describe the roles of messenger RNA and transfer RNA in protein synthesis. [2 marks]

b) Explain how transcription factors control cell differentiation, using an example. [3 marks]

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Question 6 (5 marks)

An environmental report identified overexploitation, habitat destruction and pollution as human activities affecting biodiversity in Australia. The tables on pages 8 and 9 show the estimated impact of each activity in 2011 and 2016.

2011

Human activities	Assessment grade				Confidence	
	Very high impact	High impact	Low impact	Very low impact	In grade	In trend
Over-exploitation	↙				●	●
Habitat destruction	↗				●	◒
Pollution	↙				◒	●

2016

Human activities	Assessment grade				Confidence	
	Very high impact	High impact	Low impact	Very low impact	In grade	In trend
Over-exploitation			—		◔	◔
Habitat destruction	↙				●	●
Pollution		↙			◔	●

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Recent trends		
↗ Improving	↙ Getting worse	— Stable

Grade	
	Very low impact: Few, if any, species and/or ecosystems are suffering substantial adverse effects from this pressure
	Low impact: A small proportion of species and/or ecosystems are suffering substantial adverse effects from this pressure
	High impact: A significant proportion of species and/or ecosystems are suffering substantial adverse effects from this pressure
	Very high impact: A large proportion of species and/or ecosystems are suffering substantial adverse effects from this pressure

Confidence	
●	**Adequate:** Adequate high-quality evidence **and** high level of consensus
◔	**Somewhat adequate:** Adequate high-quality evidence **or** high level of consensus
◒	**Limited:** Limited evidence **or** limited consensus
◔	**Very limited:** Limited evidence **and** limited consensus

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a) Explain how one human activity identified in the tables could reduce biodiversity. [1 mark]

b) Predict which human activities will have the highest and lowest impact on biodiversity in 2023. Explain your reasoning using evidence from the tables. [4 marks]

Highest impact: _____

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Lowest impact:

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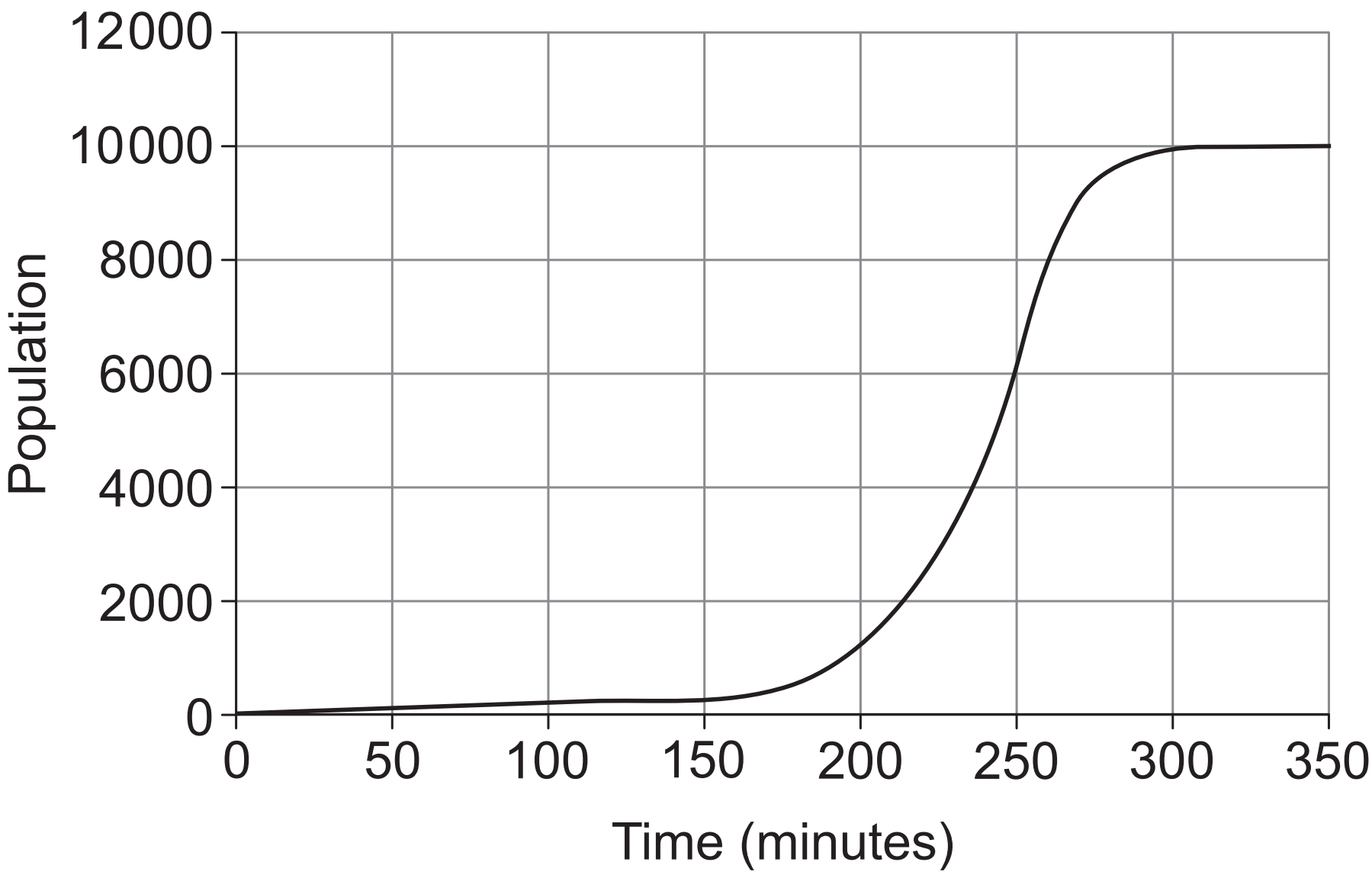
Question 7 (6 marks)

The graph shows the population of bacteria in a Petri dish over time.



a) Identify the mode of population growth. [1 mark]

b) Determine the carrying capacity under these conditions. [1 mark]

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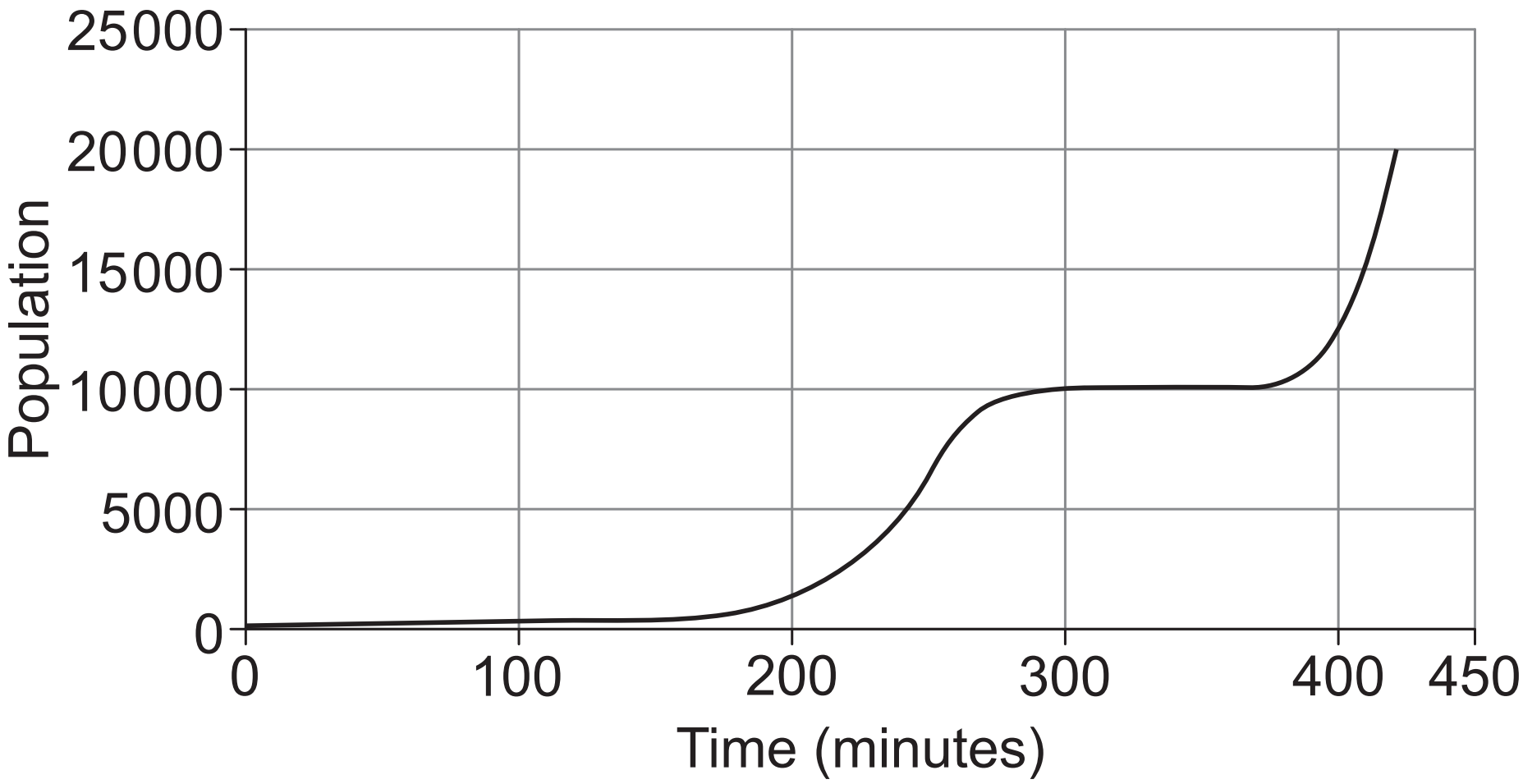
Conditions were modified at 380 minutes and the population continued to be monitored. Results are shown.



c) Identify two modifications that could cause this change. Explain your reasoning. [4 marks]

Question 8 (3 marks)

Over time, the South African cheetah population has suffered drastic reduction due to periodic droughts, disease and hunting. Currently, only small, isolated populations of cheetahs exist in the wild. Explain, in terms of genetic diversity, why cheetah populations are now on the verge of extinction.

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Question 9 (3 marks)

The biological species concept defines *species* as a group of organisms that can interbreed to produce fertile offspring.

a) Identify another method for defining a *species*. [1 mark]

b) Describe one limitation of the biological species concept and one limitation of the method identified in Question 9a). [2 marks]

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Question 10 (3 marks)

In fruit flies, eye colour is a sex-linked trait inherited on the X chromosome. The red-eye allele (R) is dominant over the white-eye allele (r). A red-eyed male and white-eyed female have 50 offspring.

Use a Punnett square to predict the number of male and female offspring and their eye colour.

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Question 11 (8 marks)

Allele frequencies were monitored in two large populations of field mice from neighbouring forests over a 10-year period. Results are shown.

Forest X

Year	Genotype			Allele frequency	
	AA	Aa	aa	A	a
2013	52	146	102	0.42	0.58
2014	48	144	108	0.40	0.60
2015	55	147	98	0.43	0.57
2016	60	150	90	0.45	0.55
2017	58	142	100	0.43	0.57
2018	58	148	94	0.44	0.56
2019	59	152	89	0.45	0.55
2020	60	148	92	0.45	0.55
2021	65	149	86	0.46	0.54
2022	66	149	85	0.47	0.53

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Forest Y

Year	Genotype			Allele frequency	
	AA	Aa	aa	A	a
2013	0	0	300	0.00	1.00
2014	0	0	300	0.00	1.00
2015	0	0	300	0.00	1.00
2016	0	15	285	0.03	0.98
2017	3	46	251	0.09	0.91
2018	14	60	226		
2019	31	91	178	0.26	0.75
2020	48	104	148	0.33	0.67
2021	60	122	118	0.40	0.60
2022	66	137	97	0.45	0.55

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a) Calculate the allele frequencies for forest Y in 2018. Show your working. [2 marks]

b) Identify temporal trends in allele frequency for forests X and Y and infer reasons for the observed differences. [6 marks]

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Additional page for student responses

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References

Question 6

Adapted from

Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2011, *Australia: State of the environment 2011*, p. 640, Canberra, https://soe.dcceew.gov.au/sites/default/files/2022-05/soe2011-report-biodiversity.pdf. Used under Creative Commons Attribution 4.0 licence (CC BY 4.0).

Australian Government Department of the Environment and Energy 2017, *Australia: State of the environment 2016*, pp. 39–41, Canberra, https://soe.dcceew.gov.au/sites/default/files/2022-05/soe2016-biodiversity-launch-version2-24feb17.pdf. Used under Creative Commons Attribution 4.0 licence (CC BY 4.0).

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