11.1 – POPULATIONS

C4.1.1	Populations as interacting groups of organisms of the same species living in an area
C4.1.2	Estimation of population size by random sampling
C4.1.3	Random quadrat sampling to estimate population size for sessile organisms
C4.1.4	Capture-mark-release-recapture and the Lincoln index to estimate population size for motile organisms
C4.1.5	Carrying capacity and competition for limited resources
C4.1.6	Negative feedback control of population size by density-dependent factors
C4.1.7	Population growth curves
C4.1.8	Modelling of the sigmoid population growth curve
C4.1.9	Competition versus cooperation in intraspecific relationships
C4.1.16	Predator-prey relationships as an example of density-dependent control of animal populations

ECOLOGICAL TERMS

Define the following ecological terms

Species: ____

____

Population: ____

____

Community: ____

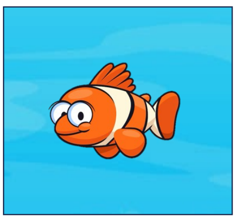
____

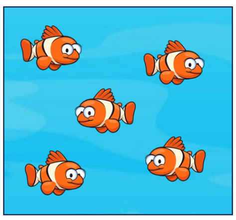
Habitat: ____

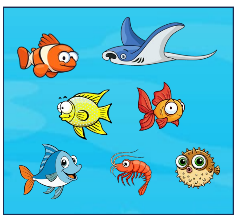
____

Ecosystem: ____

____


Species


Population


Community


Habitat


Ecosystem

POPULATION SAMPLING

Differentiate between random sampling and systematic sampling

Random: ____

Systematic: ____

Define sampling error and suggest a way of reducing it

____

____

Outline the use of quadrat sampling for sessile organisms

____

____

____

____

Outline the use of the capture-mark-release-recapture method and Lincoln index for motile organisms

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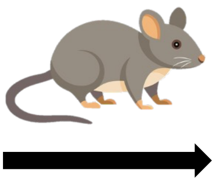
Estimate the population size based on the following information

Sampling Data:

10 mice captured and marked

10 mice recaptured (4 marked)



Solution:

Outline the assumptions made when using the Lincoln index to estimate population size

____

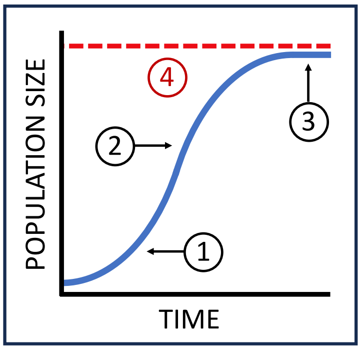
____

____

____

POPULATION GROWTH

Identify the different components of a standard population growth curve



1. ____

2. ____

3. ____

4. ____

Explain the reason for the expected shape of a population growth curve

____

____

____

Identify two organisms that can be used for modelling population growth and the reason for their use

____

____

DENSITY-DEPENDENT FACTORS

List three examples of density-dependent factors that push populations towards the carrying capacity

____

Explain how density-dependent factors influence population size, referencing a predator-prey relationship

____

____

____

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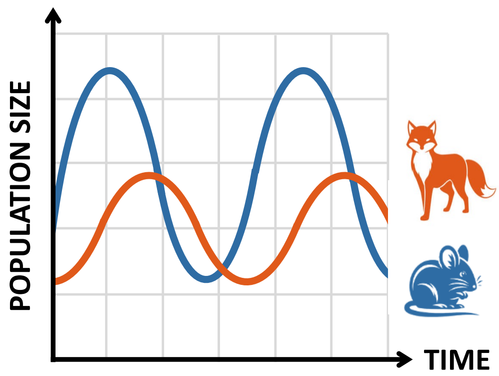
____



INTRASPECIFIC RELATIONSHIPS

Provide a specific example of competition and cooperation in intraspecific relationships

Competition: ____

Cooperation: ____

11.2 – COMMUNITIES

C4.1.10	A community as all of the interacting organisms in an ecosystem
C4.1.11	Herbivory, predation, interspecific competition, mutualism, parasitism and pathogenicity as categories of interspecific relationships within communities
C4.1.12	Mutualism as an interspecific relationship that benefits both species
C4.1.13	Resource competition between endemic and invasive species
C4.1.14	Tests for interspecific competition
C4.1.15	Use of the chi-squared test for association between two species
C4.1.17	Top-down or bottom-up control of populations in communities
C4.1.18	Allelopathy and secretion of antibiotics

INTERSPECIFIC RELATIONSHIPS

Identify different categories of interspecific relationships within communities (including specific examples)

	Description	Example
Herbivory		
Predation		
Competition		
Parasitism		
Pathogenicity		

Define mutualism and reference three specific examples (root nodules, mycorrhizae, zooxanthellae)

Definition: ______________________________

1. ______________________________

2. ______________________________

3. ______________________________

INVASIVE SPECIES

Define invasive species with reference to a specific example

Outline the reasons why an introduced species may become invasive

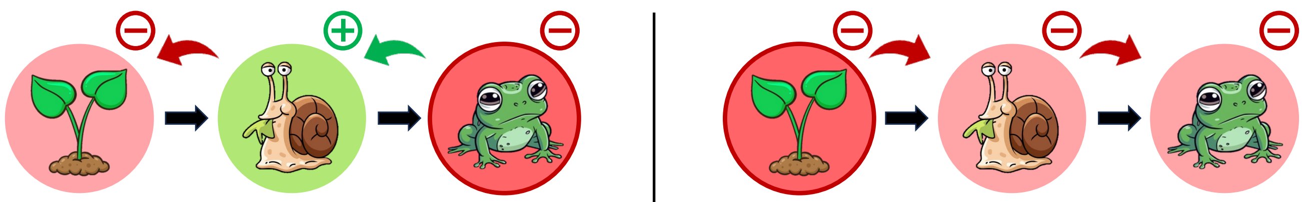
ALLELOPATHY

Describe allelopathy

Differentiate between allelopathy and antibiosis

POPULATION CONTROL

Distinguish between top-down and bottom-up control of populations in communities



Top-down control (frog removed)

Bottom-down control (plant removed)

ASSOCIATION TESTS

Complete the chi-squared test to determine if two species share a negative association (competition)

The presence or absence of two plant species was recorded in 150 quadrats within a woodland area

25 = both present   30 = ivy only   45 = oak only   50 = neither present

1. Identify Hypotheses

Null Hypothesis: ____

Alternative Hypothesis: ____

2. Calculate Frequencies

Observed Frequencies:

		Ground Ivy		
		Present	Absent	Total
Wood Oak	Present	25	45	70
	Absent	30	50	80
	Total	55	95	150

Expected: (Row total × Column total) ÷ Total

	Observed	Expected
Ivy only		
Oak only		
Both species		
No species		

3. Calculate Chi-Squared Value

	Ivy only	Oak only	Both species	No species
$\frac{(O-E)^2}{E}$				

4. Determine Statistical Significance

Degree of Freedom	Probability of Exceeding Critical Value						
	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.584	1.212	2.366	4.11	6.25	7.81	11.34

Conclusion: ____

____

11.3 – HABITATS

B4.1.1	Habitat as the place in which a community, species, population or organism lives
B4.1.2	Adaptations of organisms to the abiotic environment of their habitat
B4.1.3	Abiotic variables affecting species distribution
B4.1.4	Range of tolerance of a limiting factor
B4.1.5	Conditions required for coral reef formation
B4.1.6	Abiotic factors as the determinants of terrestrial biome distribution
B4.1.7	Biomes as groups of ecosystems with similar communities due to similar abiotic conditions and convergent evolution
B4.1.8	Adaptations to life in hot deserts and tropical rainforests

ABIOTIC FACTORS

List three abiotic variables that may affect the distribution of plant or animal species

Plant:

1. ______________________________________
2. ______________________________________
3. ______________________________________

Animal:

1. ______________________________________
2. ______________________________________
3. ______________________________________

Describe the range of tolerance of a limiting factor

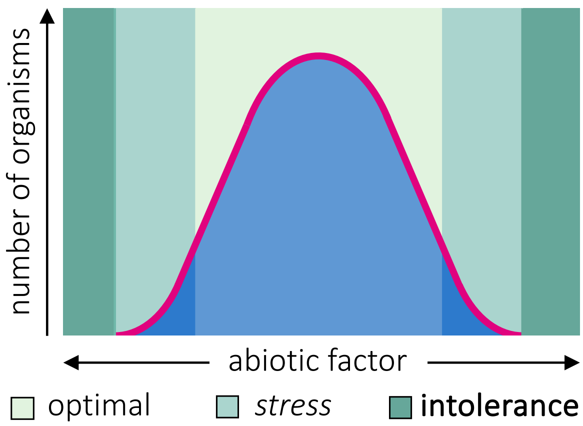
____

____

____

____

____



Outline how transects and kite graphs can be used to show distribution along a changing abiotic variable

Transects:

____

____

Kite Graphs:

____

____

CORAL REEF FORMATION

List the conditions required for coral reef formation

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

BIOMES

Define biome

____

____

Compare the climate conditions of different types of biomes

	Temperature	Rainfall	Productivity	Biodiversity
Tropical Rainforest				
Temperate Forest				
Boreal Forest (Taiga)				
Grassland				
Tundra				
Hot Desert				

CLIMOGRAPH

Identify the biomes based on temperature and rainfall

1. ____

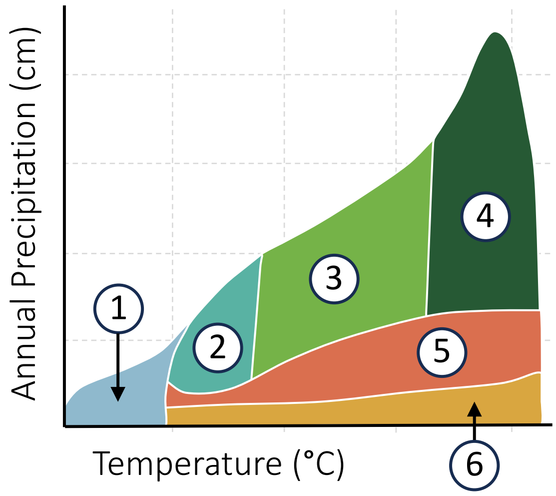
2. ____

3. ____

4. ____

5. ____

6. ____



ADAPTATIONS

Identify adaptations possessed by organisms to suit the abiotic conditions of the following habitats

Sand Dunes:

____

____

____

Mangroves:

____

____

____

Hot Desert:

____

____

____

Tropical Rainforest:

____

____

____

11.4 – ECOSYSTEMS

D4.2.1	Stability as a property of natural ecosystems
D4.2.2	Requirements for stability in ecosystems
D4.2.3	Deforestation of Amazon rainforest as an example of a tipping point in ecosystem stability
D4.2.4	Use of a model to investigate the effect of variables on ecosystem stability
D4.2.5	Role of keystone species in the stability of ecosystems
D4.2.6	Assessing sustainability of resource harvesting from natural ecosystems
D4.2.7	Factors affecting the sustainability of agriculture
D4.2.11	Restoration of natural processes in ecosystems by rewilding

STABILITY

Define ecosystem stability

___

___

Identify four key requirements for stability in ecosystems

- R ___
- A ___
- G ___
- E ___

HINT: RAGE

MESOCOSMS

Describe the use of a mesocosm to investigate the effect of a variable on ecosystem stability

___

___

___

___

Suggest why aquatic mesocosms (aquariums) are typically more stable than terrestrial mesocosms

___

___

KEYSTONE SPECIES

Define keystone species

____

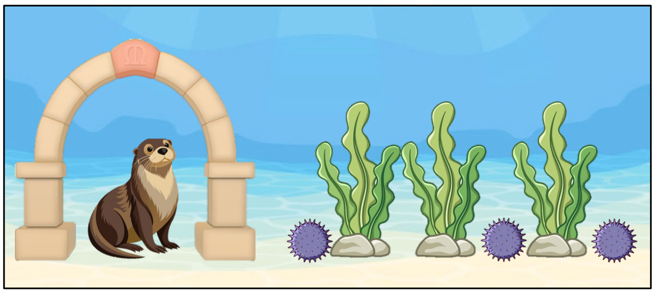
____

Outline three different examples of how keystone species may influence ecosystem stability

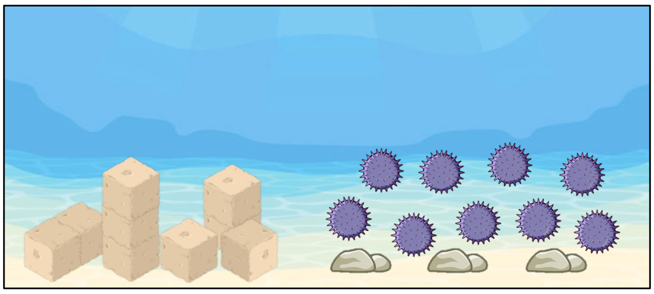
1. ____

2. ____

3. ____



Kelp → Urchin → Otter



No Otter → Urchin Overpopulation

TIPPING POINTS

Explain how deforestation of the Amazon rainforest could lead to a tipping point in ecosystem stability

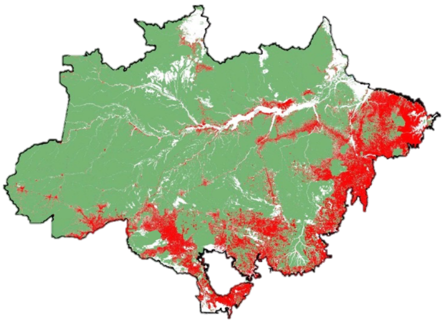
____

____

____

____

____



Deforestation shown in **red**

Determine the extent of deforestation (percentage change) based on the data provided below

Year	2000	2020	2025
Land Cover	8.50 million km^2	7.96 million km^2	7.72 million km^2

From 2000 – 2020: ____

From 2000 – 2025: ____

Note: There is uncertainty regarding the minimum area of rainforest that is sufficient to maintain stability

SUSTAINABILITY

Define sustainable harvesting

___

___

Describe how the sustainability of harvesting is managed and assessed for a plant and marine species

Fishing (Bluefin tuna):

___

___

___

Timber (Hoop pine):

___

___

___

Identify factors affecting the sustainability of agriculture

- S ___
- C ___
- A ___
- L ___
- E ___

HINT: SCALE

REWILDING

Outline the three key steps involved in the restoration of natural processes in ecosystems by rewilding

1. ___
2. ___
3. ___

Identify a specific example of a successful rewilding programme

___

11.5 – SUCCESSION (AHL)

D4.2.12 Ecological succession and its causes

D4.2.13 Changes occurring during primary succession

D4.2.14 Cyclical succession in ecosystems

D4.2.15 Climax communities and arrested succession

ECOLOGICAL SUCCESSION

Define ecological succession

____

____

Identify one abiotic change and one biotic change that could cause ecological succession

Abiotic: ____

Biotic: ____

PRIMARY SUCCESSION

Outline the process of primary succession

____

____

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Identify the key changes that occur during primary succession

____

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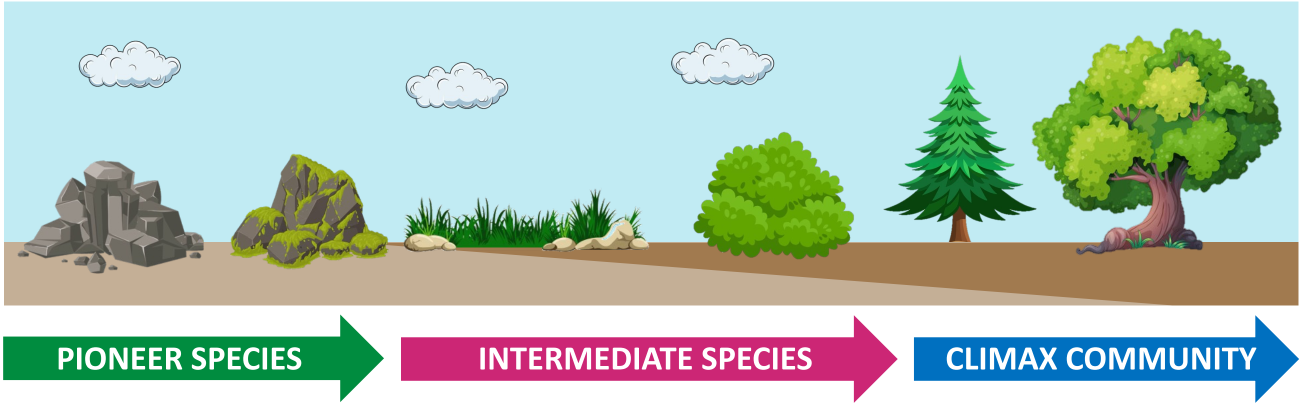


CYCLICAL SUCCESSION

Outline cyclical succession between two desert plants

1.

2.

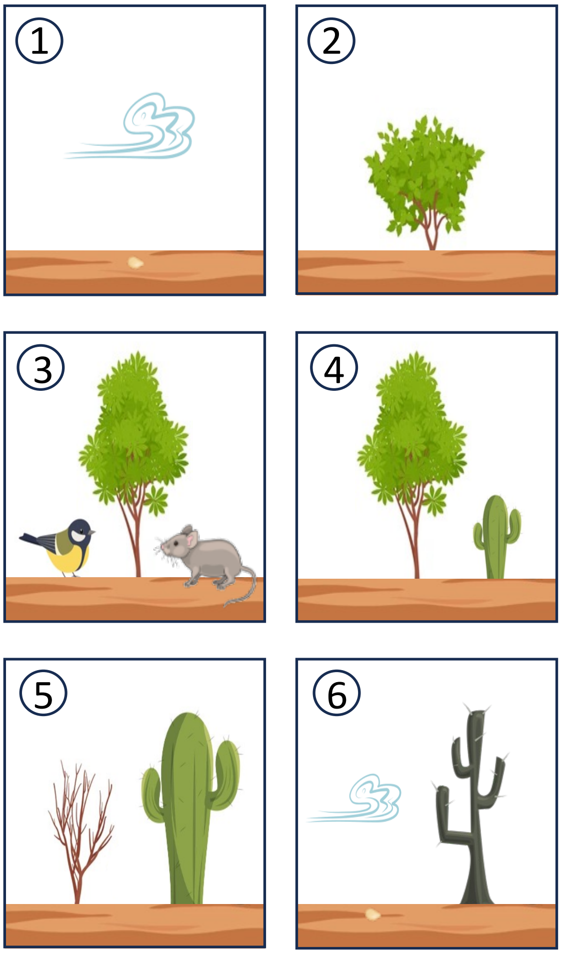
3.

4.

5.

6.

7.



CLIMAX COMMUNITY

Explain what is represented by a climax community

Describe two examples where humans interfere with natural succession processes (arrested succession)

Livestock Grazing:

Drainage of Bogs:

11.6 – SEASONAL CHANGES (AHL)

D4.3.9	Phenology as research into the timing of biological events
D4.3.10	Disruption to the synchrony of phenological events by climate change
D4.3.11	Increases to the number of insect life cycles within a year due to climate change
D4.3.12	Evolution as a consequence of climate change

PHENOLOGY

Define phenology

____

____

Identify six different examples of phenological events

1. ________________________________
2. ________________________________
3. ________________________________
4. ________________________________
5. ________________________________
6. ________________________________

Identify two abiotic variables that influence the timing of phenological events

____

____

INSECT LIFE CYCLES

Explain how climate change is increasing the number of insect life cycles and its impact on spruce trees

____

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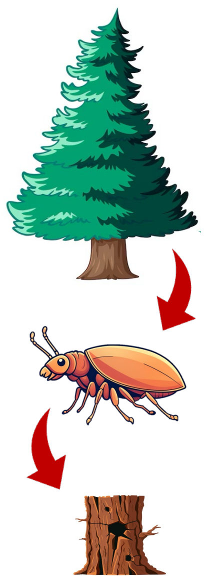
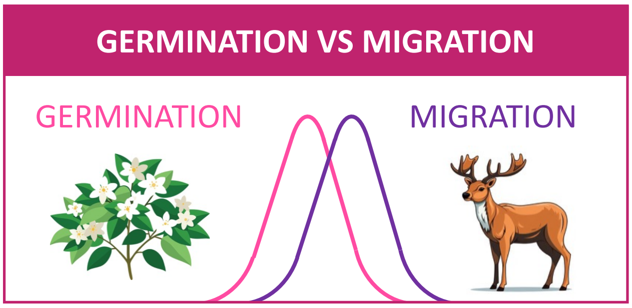


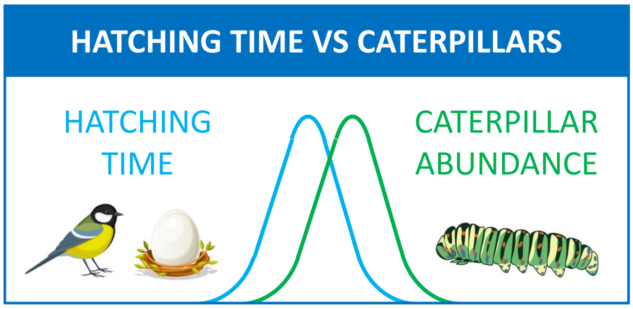
CLIMATE DISRUPTIONS

Describe the disruption to the synchrony of phenological events by climate change

Reindeer Migration:

Nesting Patterns:





INDUCED EVOLUTION

Outline how climate change has induced changes in the fitness of the tawny owl

Grey Tawny Owl

Brown Tawny Owl