A-level Biology required practical No. 12
Student Sheet

Investigation into the effect of a named environmental factor on the distribution of a given species

Learning Objectives:

i. To develop practical skills **a, b, k and l,** and begin to demonstrate **competencies 2c and 4a**
ii. To investigate the effect of soil temperature/wind speed/distance from sea shore on the distribution of sand dune species.
iii. To use a statistical test to discover if there is a correlation between position in the transect and number of species.
iv. To compare the species diversity in the middle marsh and the lower marsh terrain.

How are the species distributed along your transect?

Method

'ou are provided with the following:

- A quadrat frame
- Ranging poles
- Tape measure
- Key of plants common on sand dunes
- Temperature probe
- Anemometer
- A sand dunes transect survey record sheet

You should read these instructions carefully before you start work.

1. You will be taken to the starting point on the seashore of East Head. We will be running transects from the shore into the dunes and sampling the species at regular intervals.
2. Place the first quadrat on the ground and record the species that are present on the record sheet. Use the key to sand dune species to identify those present. Bear in mind not all species will necessarily be in flower, so you may have to rely on other features.
3. Use the temperature probe to record the soil temperature and the air temperature. Use an anemometer (if available) to measure wind speed.
4. Us the tape measure to determine the site of your next quadrat. You need to make sure that you are moving regular distances along a straight line (a compass bearing can help ensure that you do this).
5. Place the next quadrat and record the species present, and record the abiotic factors as before.
6. Identify the species present, and note them on the record sheet.
7. Repeat at regular intervals along the transect. You will need a minimum of 5 data points.

How does position in the salt marsh affect the species diversity?

Method

You are provided with the following:

- A quadrat frame
- Tape measure
- Random number table
- Key of plants common on sand dunes/salt marsh
- A sand dunes quadrat survey record sheet

You should read these instructions carefully before you start work.

1. You will be taken to a region of East Head where there is a salt marsh. You will compare the middle marsh with the lower marsh to look at any differences in species distribution
2. Run a tape measure along the side of the path, and then another at right angles into the marsh. This will be used to select random positions to place your quadrat.
3. Use the random number table to generate a random number. This will correspond to a position along the tape measure. If (for example) the random number is 34, then your first quadrat will be placed at the 3m mark along one tape, and at the 4m mark on the other
4. Use the key to sand dune plant species to identify which species are present and record these on the quadrat record sheet in the "middle marsh" section.
5. Once all species are identified you can add up the total number of species present.
6. Repeat at another randomly placed quadrat.
7. Once you have sampled several quadrats in the middle marsh region, move to the lower marsh region.
8. Repeat points 1-6 in the new region, recording in the "lower marsh" section of the record sheet.

Risk assessment

Hazard	Associated Risk	Method to reduce risk
Ranging poles	Risk of injury if fallen on, potential to hit others if not carried correctly	Carry carefully and upright if possible.
Hazardous debris e.g. broken glass	Risk of cuts to feet/hands	Warning before practical work. First aid kit available at all times. If debris is found, create an area "out of bounds" for sampling.
Sea spurge and plants in General	Risk of irritation/rash when handling plants	Warned not to pick vegetation unless specifically advised
Tripping hazards, uneven Ground	Uneven sand-dunes when walking transect, risk of tripping	Warning before survey work
Hypothermia / heatstroke/sunburn	No shade in survey region. Coastal region exposed to the elements.	Bring hats/glasses, suncream and warm layers if necessary
Dangerous currents/tidal Flows	Chichester Harbour nearby, rip currents make area dangerous for bathing	Do not enter the water unless specifically advised

Competencies demonstrated	
2. Applies investigative approaches and	c. Identifies and controls significant quantitative variables where applicable, and plans approaches to take account of variables that cannot readily be controlled.
4. Makes and records observations	a. Makes accurate observations relevant to the experimental or investigative procedure.

	Apparatus and techniques
AT a	use appropriate apparatus to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH)
AT b	use appropriate instrumentation to record quantitative measurements, such as a colorimeter or potometer
AT k	use sampling techniques in fieldwork
AT l	use ICT such as computer modelling, or data logger to collect data, or use software to process data

Report on Fieldwork

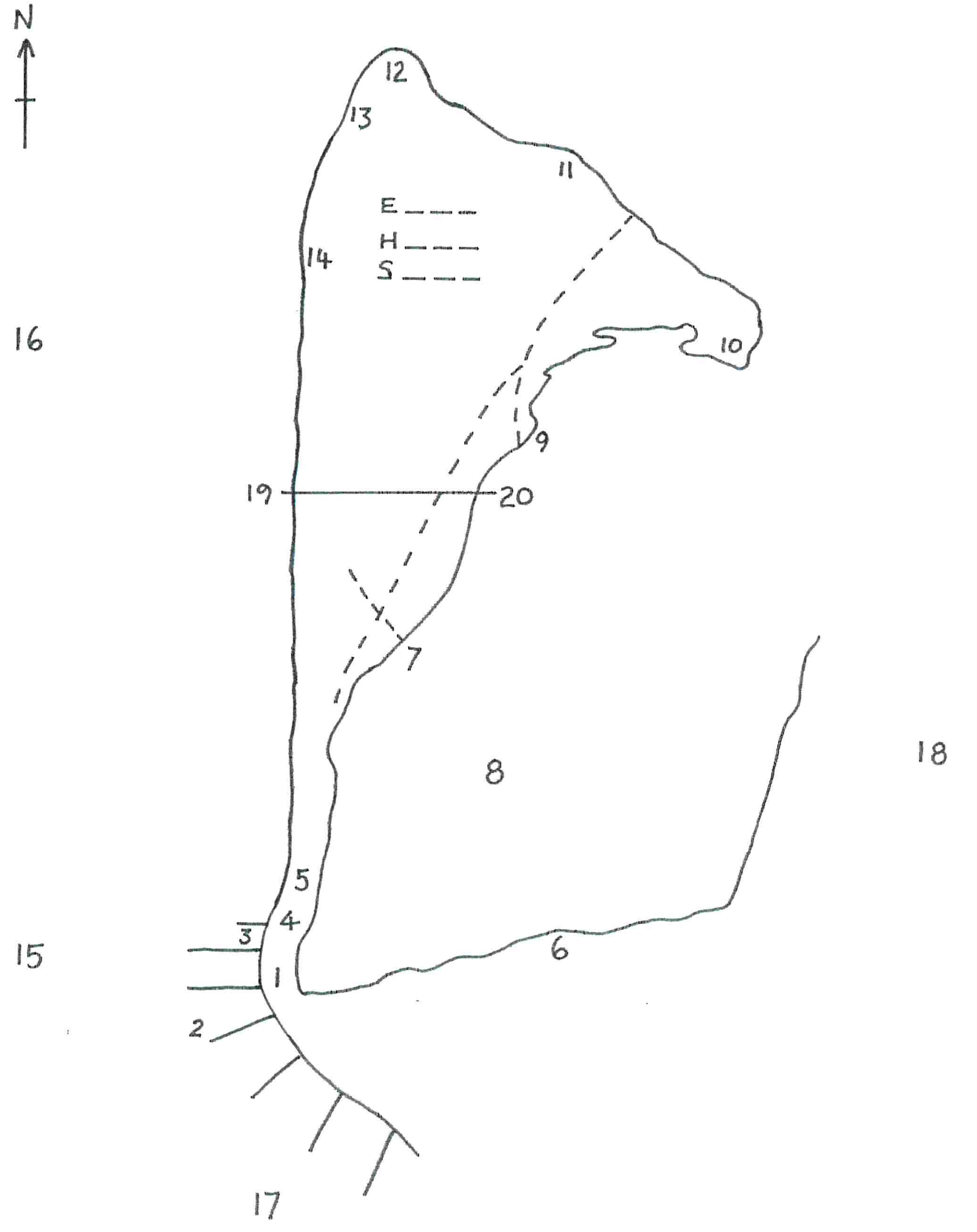
Once you have completed both tasks you will have collected enough data to produce a report on your fieldwork. This will be a substantial piece of work, and will be finished in the days following the trip (including home study).
You should aim to include the following:

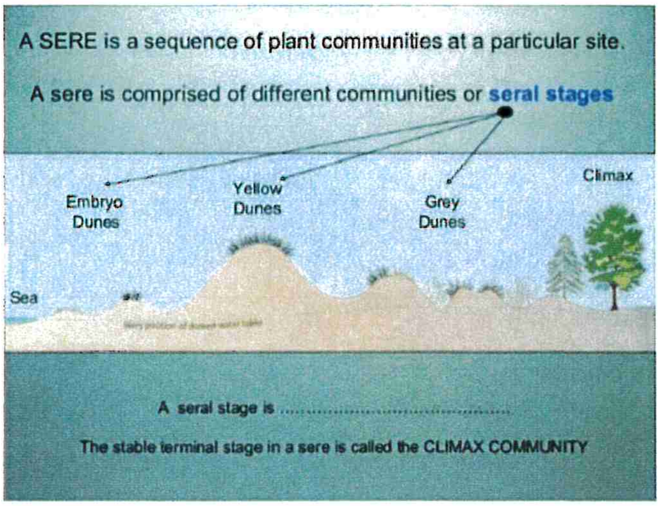
- Details of any hypotheses you were testing
- Your data
- Graphs
- Any statistical tests you conducted
- Any conclusions that you can draw and a suggested biological explanation for them

East Head – Management and Sea Defences

Date: ____________________ **Wind Direction:** ______________________ **State of tide:** _______________

Add the following to your map: *hinge, neck, tip, hook, rock berm, sea wall, rock armour (rip rap), groynes, gabions, beach nourishment, marram grass planting, sand dunes, sand, shingle, salt marsh, dog bins, notices, protected areas (rope fences), board walks, entrance to Chichester Harbour, 'The Winner' sand bar, West Wittering beach, W-E transect line, West Wittering village, Snow Hill Creek.*





Sand dune formation

Needs 4 essential ingredients:

1.

2.

3.

4.

Succession

Embryo dunes: Sand couch grass (and lyme grass) are pioneer species.

Yellow dunes: Higher so above high water so marram grass (which is less tolerant of sea water) can grow here.

Behind high yellow dunes wind speed

Biodiversity

Dune Slack

Grey dunes Grey because of grey lichens covering them and

Climax Vegetation at East Head ?

Sand Dunes Transect Survey Sheet

Area of Transect: East Head **Name** **Date**

		Stations (Write % cover of each species in quadrat.)													
Quadrat Number:		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Distance from last station (m)		0													
Distance from station 1 (m)		0													
Angle of slope to next station															
Air Temperature (°C)															
Soil Temperature (°C)															
Wind Speed (m/s)															
% ground cover: organic (plants)															
% ground cover: inorganic (sand, mud)															
Plant Species															
English Name	**Scientific name**														
Marram Grass	*Ammonphila arenaria*														
Lyme Grass	*Leymus arenarius*														
Sand Couch	*Elytrigia juncea*														
Seas Spurge	*Euphorbia paralias*														
Common Catsear	*Hypochaeris radicata*														
Red Fescue	*Festuca rubra*														
Ragwort	*Senecio jacobaea*														
Sand Sedge	*Carex arenaria*														
Bramble	*Rubus fruticosus*														
Groundsel	*Senecio vulgaris*														
Centaury	*Centaurium erythraea*														
Lesser Hawkbit	*Leontodon hispidus*														
Silverweed	*Potentilla recta*														
Buckshorn Plantain	*Plantago coronopus*														
Pearlwort	*Sagina spp.*														
White Clover	*Trifolium repens*														
Hairsfoot Clover	*Trifolium arvense*														
Birdsfoot Trefoil	*Lotus corniculatus*														
Chickweed	*Stellaria media*														
Grass species															
Marsh Bedstraw	*Galium palustre*														
Marsh willowherb															
Moss species															
Lichen species															
Common cudweed	*Filago vulgaris*														
Common polyplody	*Polypodium vulgare*														
Rush	*Juncus spp.*														
Total Number of Species in Quadrat															

Saltmarsh Notes

Name ______________________

What is a saltmarsh? A saltmarsh is a muddy shore where plants grow between high and low water.

Why is a saltmarsh important?

1. Habitat ____

2. Food resource ____

3. Shelter ____

4. Sea defence ____

How is a saltmarsh formed? It is formed by **succession.** It is a **halosere**

Stages of succession:

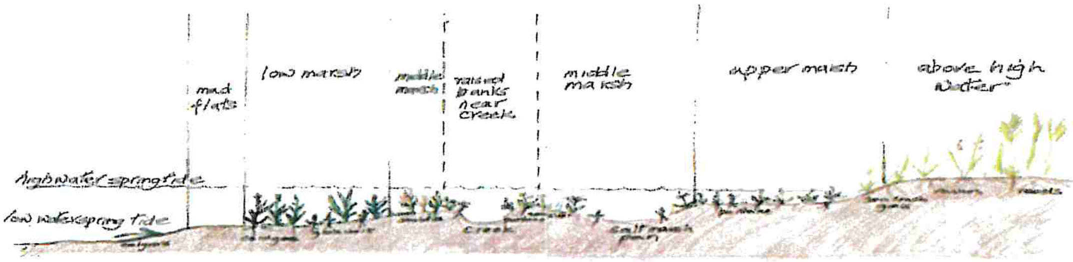
1. Silt deposited ____

2. Colonisation ____

3. Establishment ____

4. Stabilisation and Climax ____

Profile of a Saltmarsh



What factors are important in a saltmarsh?

1. Salinity ____

2. Water logging ____

3. Drag and scour ____

4. Submergence ____

Adaptations of plants

1. Cell sap has high osmotic pressure ______________________________

2. Leaves and stems store water ______________________________

3. Air tissue in roots ______________________________

4. Long roots ______________________________

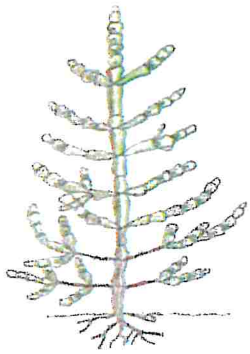
5. Smooth, flexible plants ______________________________

6. Plants store salt and then drop leaves ______________________________

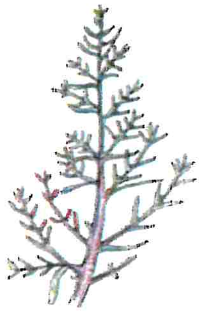
7. Salt glands ______________________________

Saltmarsh plants

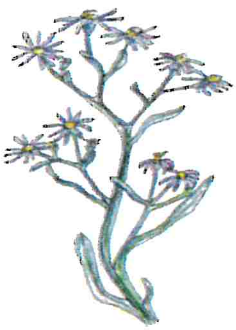
Cord Grass



Glasswort



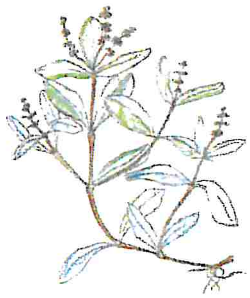
Annual Sea Blite



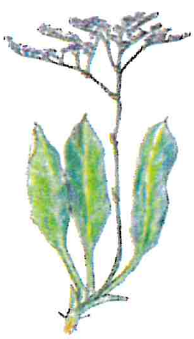
Sea Aster

______________ ______________ ______________ ______________

______________ ______________ ______________ ______________



Sea Purslane

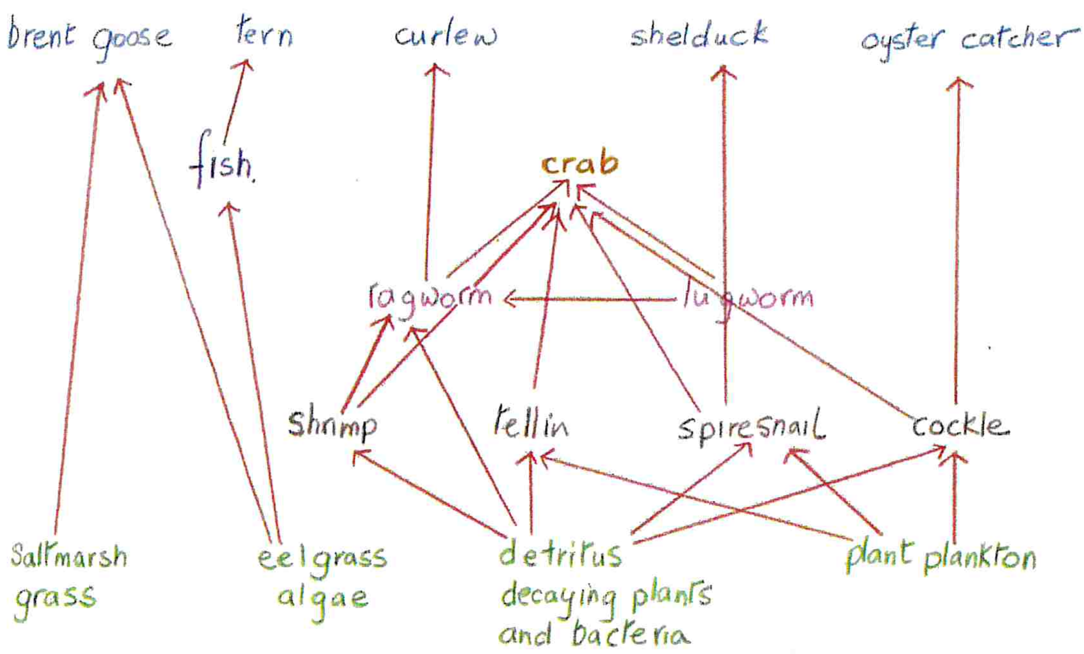


Sea Lavender

______________ ______________

______________ ______________

A Food Web of the Salt Marsh



Saltmarsh Plant Species Survey sheet

Area of Survey ____________________ **Name** ________________________ **Date** ____________________

Quadrats

Tick if species present OR **Write percentage cover** OR **Write number of plants**

(Circle the one you are doing)

Zones: Mudflat, Lower marsh, Middle Marsh, Upper Marsh, Above High Water		**First zone** ____________						**Second Zone** ____________				
Plant Species												
English name	**Scientific name**											
Seaweed spp.												
Cord grass	*Spartina townsendii*											
Glasswort	*Salicornia spp.*											
Annual Sea Blite	*Suaeda maritima*											
Sea Aster	*Aster tripolium*											
Saltmarsh Grass	*Puccinellia maritima*											
Sea Purslane	*Halimone portulacoides*											
Sea Lavender	*Limonium vulgare*											
Common Reed	*Phragmites australis*											
Sea Couch Grass	*Elymus pycnanthus*											

Biology – A-Level Practical Endorsement

Student Name ______________________________

Date completed

Experiment 12 – Investigation into the effect of a named environmental factor on the distribution of a given species

Competences Demonstrated		
	Student Reflection	Teacher Certification
2c		
4a		

Apparatus and Techniques Used		
	Student Reflection	Teacher Certification
a		
b		
k		
l		

Q1.

(a) A student investigated the diversity of plants at several sites on a golf course. At each site she took a large number of random samples.

(i) Explain the importance of taking a large number of samples at each site.

___

___

___

(1)

(ii) Explain the importance of taking samples at random.

___

___

___

(1)

The student collected data from one part of the golf course and calculated an index of diversity.

The table shows her data.

Species	**Number of plants per m²**
Sheep's fescue	11
Creeping buttercup	6
Clover	5
Dandelion	2
Sheep's sorrel	1
Lady's bedstraw	7
Stemless thistle	4

The index of diversity can be calculated from the formula

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

where

d = index of diversity
N = total number of organisms of all species
n = total number of organisms of each species

(b) Use the formula to calculate the index of diversity for the plants on this part of the golf course. Show your working.

Answer ____________________

(2)

(c) The golf course was surrounded by undeveloped grassland from which it had been produced.
The golf course had

- some areas of very short grass which was cut frequently
- some areas of longer grass which was cut less frequently
- some areas of long grass and shrubs which were never cut.

The index of diversity for the insects on the golf course was higher than that for the surrounding undeveloped grassland.

Explain the effect of developing this golf course on the index of diversity of insects.

____

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____

____

*(Extra space)*_______________________________

____

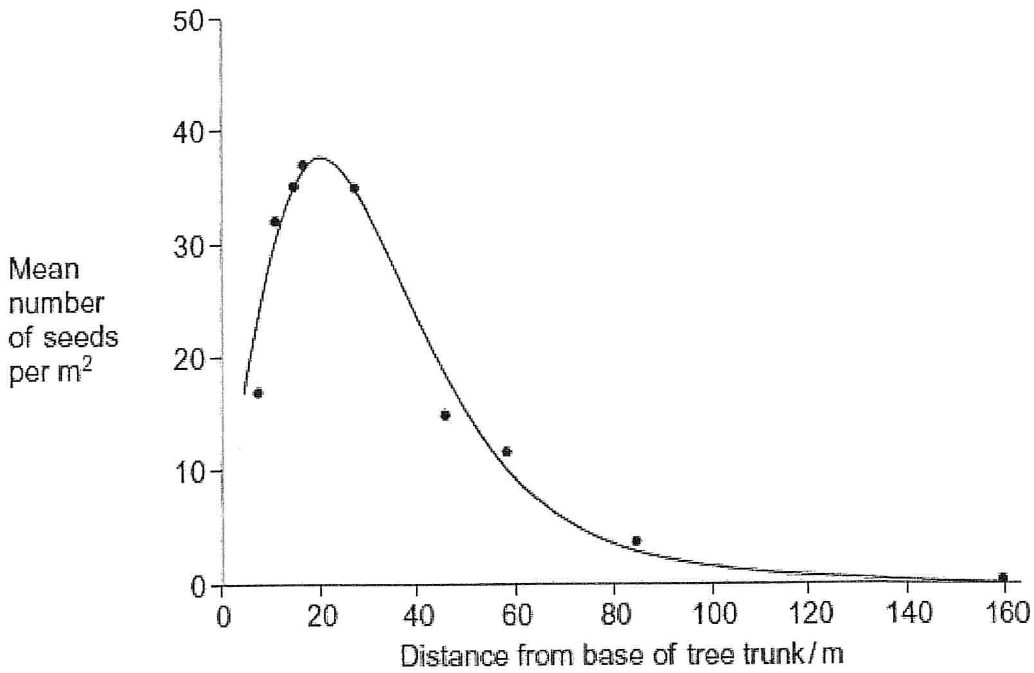
____

(3)

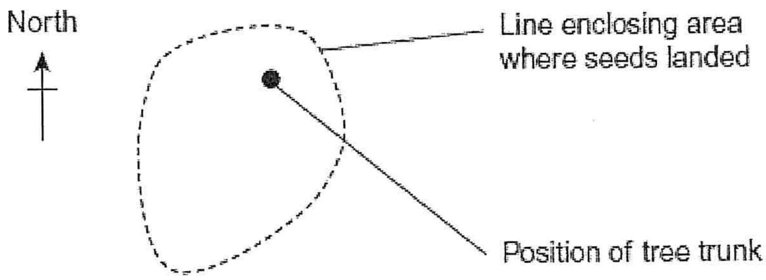
(Total 7 marks)

Q2.

A 75 m tall tree released very large numbers of small seeds. Ecologists used quadrats along a transect to measure the number of these seeds at different distances from the tree. Their results are shown on the graph.



The seeds of this tree are dispersed by wind. The diagram shows the pattern of seed dispersal from this tree.



(a) Describe how the ecologists could have used quadrats and a transect to obtain the data from which the graph was drawn.

____

____

____

____

____

(2)

(b) Look at the diagram showing the pattern of seed dispersal from this tree.

(i) Suggest an explanation for the shape of the line enclosing the area where the seeds landed.

____

____

____

____

(2)

(ii) The line enclosing the area where the seeds landed would be different for trees of this species that were of a different height. Suggest why.

____

____

____

____

(2)

(c) In an ecological succession, trees that are pioneer species often have smaller seeds than those that are part of a climax community.

(i) The species of tree in this investigation is adapted to colonising areas that have been cleared of vegetation. Use information given above to explain how.

____

____

____

____

(2)

(ii) The seeds produced by this species of tree did **not** grow successfully in a climax community. Suggest why.

____

____

____

____

____

(2)

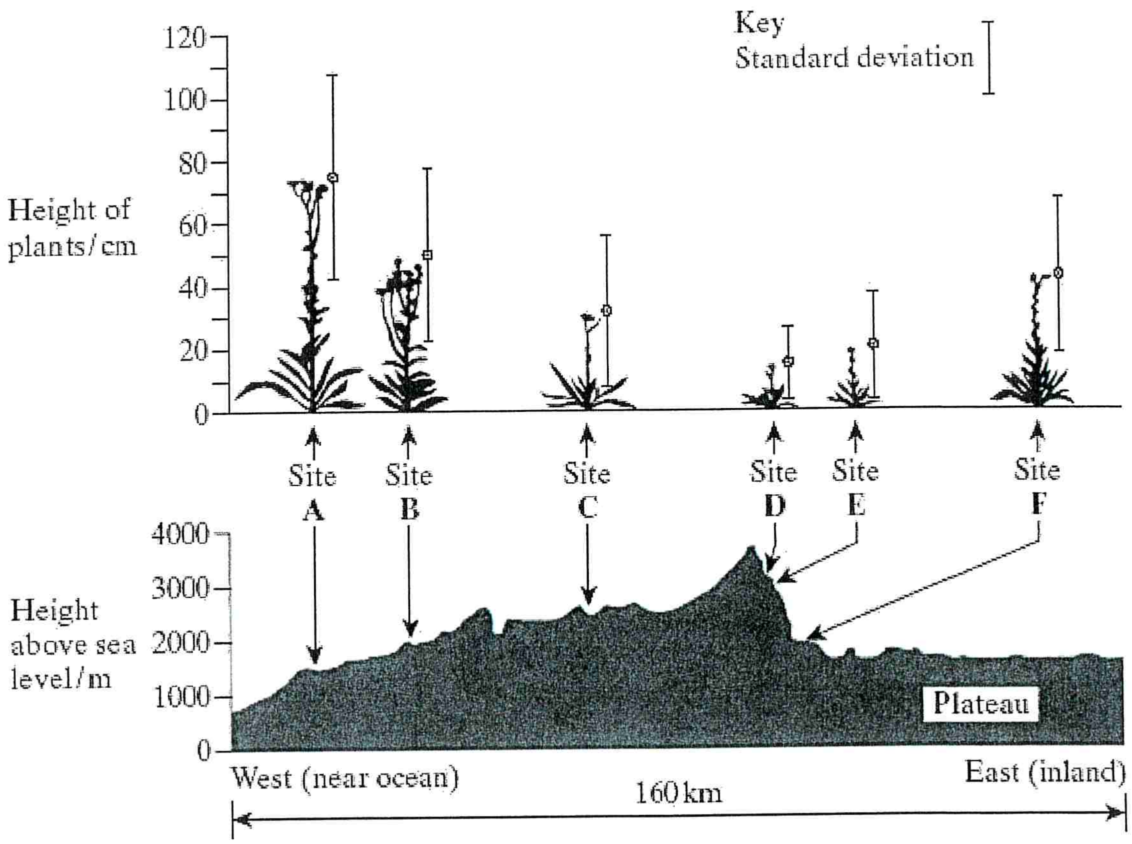
(Total 10 marks)

Q3.

Climatic factors, such as temperature and rainfall, vary greatly over short distances across mountain ranges. In an investigation, populations of the plant, *Achillea lanulosa*, were sampled from several sites on a transect across a mountain range. At each sampling site, seeds were collected at random. Each batch of seeds was germinated and grown to maturity under the same experimental conditions.

The diagram shows

- a profile indicating the position and altitude of the sampling sites
- the mean height of mature plants grown from each sample of seeds
- the standard deviation of heights of the mature plants grown from each sample of seeds.



(a) (i) Give **one** limitation of using a line transect to collect these data.

____

____

(1)

(ii) Suggest how plants should be chosen at each sampling site to avoid bias and to be representative.

____

____

____

____

(2)

(b) (i) What information does the bar representing standard deviation give about the plants in a sample?

____

____

(1)

(ii) Describe what the results show about the variation of the height of the plants in relation to altitude.

____

____

(2)

S (iii) There was a significant difference between the mean heights of the plants grown from seeds taken from sites **A** and **D**. Describe the evidence from the information given which shows that this is likely to be due to genetic differences between the two populations.

(1)

(Total 7 marks)

Spearman's Rank Correlation Coefficient

Null hypothesis:

Alternative hypothesis:

Spearman's Rank Correlation coefficient is calculated by the following equation:

$$r_s = 1 - \frac{6\Sigma d^2}{n^3 - n}$$

D= the difference between the ranks

Σ= the sum of (the total)

Write your independent variable data in the value x column, and the dependant variable data in the value y coloumn. Then rank the two sets separately; the lowest value gets the lowest rank. Equal values get the same rank (calculate an average rank)

x	R	y	Obs (n)	Value (x)	Rank (R_x)	Value (y)	Rank (R_y)	D (R_x-R_y)	D^2
	1		1						
	2		2						
	3		3						
	4		4						
	5		5						
	6		6						
	7		7						
	8		8						
	9		9						
	10		10						
	11		11						
	12		12						
	13		13						
	14		14						
	15		15						
	16		16						
	17		17						
	18		18						
	19		19						
	20		20						
	21		21						
	22		22						
							Σ		

Check that your rankings are correct; ΣD should equal zero

Spearman's Rank Correlation coefficient is calculated by the following equation:

$$r_s = 1 - \frac{6\Sigma d^2}{n^3 - n}$$

$\Sigma D^2 =$ ☐ $6\Sigma D^2 =$ ☐

$n =$ ☐ $n^3 =$ ☐ $n^3 - n =$ ☐

$$r_s = 1 - \frac{6\Sigma d^2}{n^3 - n}$$

$r_s = 1 - \frac{\square}{\square}$ $r_s = 1 -$ ☐

$r_s =$ ☐

To see if your result is significant you will need to compare your test value (r_s) with a table of critical values. We usually work to a 95% confidence value. This means that we are 95% confident we have a significant correlation. If you test value is equal to or greater that the critical value you can reject your null hypothesis.

Number of pairs (n)	Confidence level		
	90%	95%	98%
5	0.900	1.000	1.000
6	0.829	0.886	0.943
7	0.714	0.786	0.893
8	0.643	0.738	0.833
9	0.600	0.683	0.783
10	0.564	0.648	0.746
12	0.506	0.591	0.712
14	0.456	0.544	0.645
16	0.425	0.506	0.601
18	0.399	0.475	0.564
20	0.377	0.450	0.534
22	0.359	0.428	0.508
24	0.343	0.409	0.485
26	0.329	0.392	0.465
28	0.317	0.377	0.448
30	0.306	0.364	0.432

$r_s =$ ☐

$n =$ ☐

Confidence level= ☐

Critical value= ☐

Therefore we can **accept/ reject** the null hypothesis

Using Students t-test

Difference between two populations can be tested for significance using Students t test

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\frac{(S_1)^2}{n_1} + \frac{(S_2)^2}{n_2}}}$$

Where;

$\bar{X}$ = mean

S= standard deviation

n = number of values

Calculate you summary statistics for your two data sets:

n_1=

$\bar{X}_1$=

$_1$= S_1^2=

n_2=

$\bar{X}_2$=

S_2= S_2^2=

State your null hypothesis:

Calculate t

t =

t =

Calculate the degrees of freedom:

d.f = $(n_1+n_2)-2$

Use the table below for the critical value

Degrees of freedom	p = 0.1	p = 0.05	p = 0.02	p = 0.01	p = 0.002	p = 0.001
1	6.314	12.706	31.821	63.657	318.310	636.620
2	2.920	4.303	6.965	9.925	22.327	31.598
3	2.353	3.182	4.541	5.841	10.214	12.924
4	2.132	2.776	3.747	4.604	7.173	8.610
5	2.015	2.571	3.365	4.032	5.893	6.869
6	1.943	2.447	3.143	3.707	5.208	5.959
7	1.895	2.365	2.998	3.499	4.785	5.408
8	1.860	2.306	2.896	3.355	4.501	5.041
9	1.833	2.262	2.821	3.250	4.297	4.781
10	1.812	2.228	2.764	3.169	4.144	4.587
11	1.796	2.201	2.718	3.106	4.025	4.437
12	1.782	2.179	2.681	3.055	3.930	4.318
13	1.771	2.160	2.650	3.012	3.852	4.221
14	1.761	2.145	2.624	2.977	3.787	4.140
15	1.753	2.131	2.602	2.947	3.733	4.073
16	1.746	2.120	2.583	2.921	3.686	4.015
17	1.740	2.110	2.567	2.898	3.646	3.965
18	1.734	2.101	2.552	2.878	3.610	3.922
19	1.729	2.093	2.539	2.861	3.579	3.883
20	1.725	2.086	2.528	2.845	3.552	3.850
21	1.721	2.080	2.518	2.831	3.527	3.819
22	1.717	2.074	2.508	2.819	3.505	3.792
23	1.714	2.069	2.500	2.807	3.485	3.767
24	1.711	2.064	2.492	2.797	3.467	3.745
25	1.708	2.060	2.485	2.787	3.450	3.725
26	1.706	2.056	2.479	2.779	3.435	3.707
27	1.703	2.052	2.473	2.771	3.421	3.690
28	1.701	2.048	2.467	2.763	3.408	3.674
29	1.699	2.045	2.462	2.756	3.396	3.659
30	1.697	2.042	2.457	2.750	3.385	3.646
40	1.684	2.021	2.423	2.704	3.307	3.551
60	1.671	2.000	2.390	2.660	3.232	3.460
120	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.645	1.960	2.326	2.576	3.090	3.291

t =

d.f =

Critical value =

Therefore we can **accept/ reject** the null hypothesis