To what extent does human activity impact on the sand dune ecosystem at Summerleaze and Widemouth Bay in Bude, Cornwall?

Introduction

Significance and Value of the Investigation:

Coastal dunes are **Aeolian Landforms** developing in coastal areas where there is a plentiful supply of appropriate sediment, a prevailing wind that carries sand in land and vegetation capable of sand stabilisation (Calvao, et al. 2013). Due to their position where the land and sea overlap the plants of coastal beaches occupy ecologically extremely sensitive and unique valuable habitats *(*Martins et al. 2013*).*

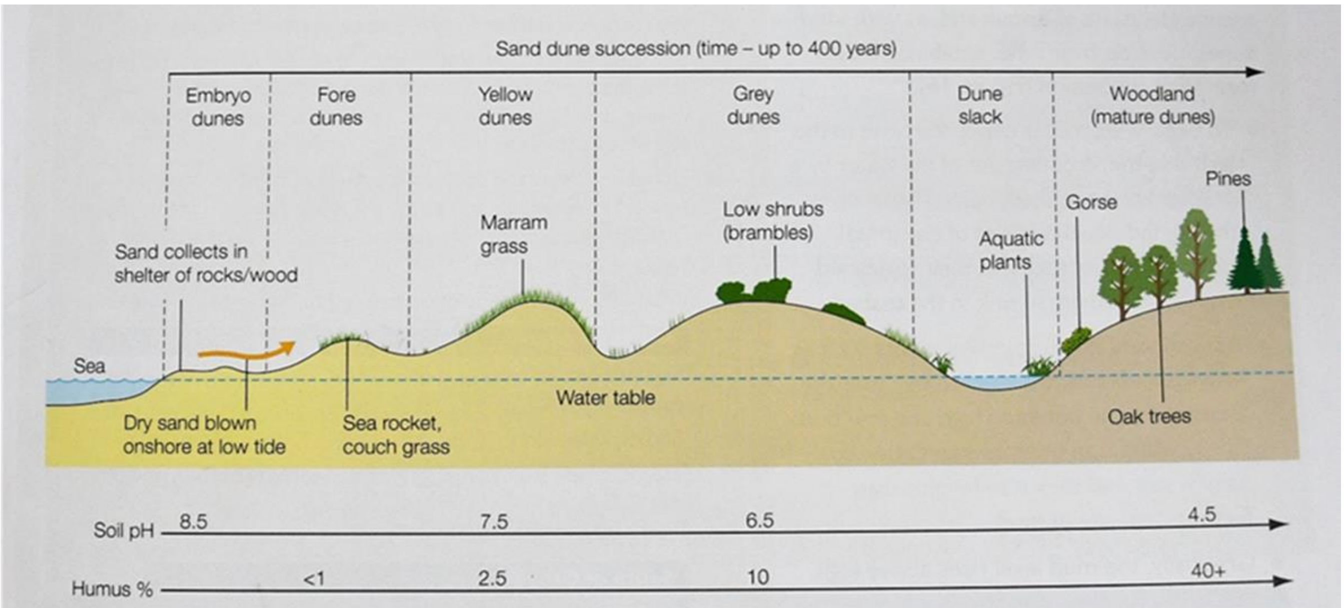


Fig. 1: Sand dunes and plant succession (Ross et al., 2016)

Sand Dunes develop (Fig.1) where sand becomes trapped by debris on the **strand line** creating **Embryo Dunes**. The first colonisers are **annual plants** which are adapted to survive in hostile environments. Tiny **Fore dunes** are swept away by winter storms, so **succession** starts when pioneer colonies trap sand during the growing season and **perennial** grasses begin to colonise. The grasses trap windblown sand increasing dune height and forming the **Yellow dunes.** Here species such as *Ammophila arenaria* (Marram Grass) are adapted to survive, growing quickly through new sand layers.

When new dunes form in front of existing ones, they offer protection from wind erosion and **succession** leads to colonisation by sand fixing plants with more diversity. As a vegetative mat forms the humus content of the dune increases resulting in a change in soil colour and giving the **Grey dunes** their colour.

The succession inland continues through scrub and if unchecked eventually reaches a state of equilibrium called the **climatic climax,** typically deciduous woodland.

It is recognised that dynamic dune systems protect land from inundation by storm surges, flooding and sea level rises due to global warming. This is reflected in Cornwall Council's (CC) Beach and Dune Management Plans (BDMPs) for Summerleaze and Widemouth beaches, where the primary objective is to ensure the beach and dune system fulfil their flood and coastal defence function to help protect communities from coastal flooding and erosion by the sea; whilst also considering the needs for management of habitat and amenity use in the area (CC, 2016). This statement also acknowledges the importance of coastal areas for tourism in Cornwall, a primary source of income. For summer/autumn 2018 Cornwall recorded 4.8m staying visitors and 14.7m day visitors generating £2.8 bn of business turnover in the county and supporting 54,000 jobs *(Bude TIC 2019)*. However, it is also accepted that tourism pressure can create negative impacts through land use changes including destruction to facilitate construction, improvement of human access, parking cars, and the creation of artificial spaces for beach recreation (Martins, et.al, 2013).

Investigation Aims:

Recognising the conflicting requirements between management of dunes for sea defence while allowing access to sandy shores for tourism and recreation, I identified the following aims for this study:

1. **To analyse the impact of human activity on the Sand Dune ecosystems at Widemouth Bay (WB) and Summerleaze (SL).**
   I will use land mapping and a combination of ecological surveying, visual observations, and secondary sources to evaluate the vegetation habitats at each site and use photographs to highlight areas most affected by human activity. I will also make an Environmental Quality survey (EQS) at each location recording the beach facilities available and levels and types of human activity.
2. **To evaluate the management and use of the Sand Dune areas in the context of observed impacts.**
   I will review the data collected during this investigation in the context of the BDMPs for SL and WB to determine which elements of the plans' recommendations have been implemented since publication in 2016. The rationale behind this is to see if actions aimed at changing or limiting human activity and reducing pressure on the environment have improved the condition of the dunes.
3. **To compare a coastal area covered by a BDMP with an area of Dune at Rock (RK) in the Camel Estuary with no BDMP in place.**
   As a "control" I will carry out an identical survey on an area of dune which is not covered by a BDMP. I decided to investigate this to compare a managed and an unmanaged dune, but also consider differences in environmental pressure at the sites and to evaluate whether the existence of a BDMP has made a difference to the level of human impact on the dunes at WB and SL.

How the aims and question link to the specification:

The study will look at the extent to which the sand dunes at WB and SL are affected by recreational use and management which links with -

3.1.6.6 Local Ecosystems: The main characteristics of a distinctive local ecosystem (such as a dune system). Local factors in ecological development and change. It will also consider physical processes which lead to the development of this ecosystem.

The **psammosere** is a distinctive sand-based ecosystem with a succession of vegetation developing over a long period to the ultimate formation of temperate deciduous woodland if unchecked, this links with -

3.1.6.4 Ecosystems in the British Isles over time: Succession and climatic climax as illustrated by lithoseres and hydroseres. The effects of human activity on succession – illustrated by one plagioclimax such as a heather moorland.

Hypotheses:

To analyse the impact of human activity on the sand dunes at each site I will challenge the following hypotheses -

Hypothesis 1: Human activity has a significant negative impact on vegetation cover in a sand dune environment.

Hypothesis 2: The primary succession (psammosere) is interrupted by the range of human influences and land uses.

Hypothesis 3: Soil depth and organic matter are adversely affected by interruptions to the natural development of vegetation and succession.

Initial Reading to Support Hypotheses:

In "Perspectives in Coastal Dune Management", a paper by P. Doody (1987) on the "Conservation and development of the coastal dunes of Great Britain" states that threats continue to arise from not only from direct developmental pressures but also from changes in management including recreational use. He then goes on to say that "access to beach from car parks, residential housing or holiday accommodation has some of the most damaging effects. Continued trampling along regular paths through a dune kills the vegetation, exposing the sand to the action of wind and rain." This paper provides support for hypothesis 1 and 2 and links closely with observations reported in Appendix C, Baseline Report for the WB and SL BDMP (CC, 2016) which lists under "the main human impact pressures affecting natural dynamics of these sites": recreational pressure and seasonal population influx, development pressure from tourism, trampling, erosion and loss of sand cover on the dune system.
Within Europe, academic research into human impact on dunes is predominantly focused on the Mediterranean coastline. A review by Calvao et al. (2013) considered the impact of urban pressure and tourism, recreation, and global climate change. They cited research showing that changes in dune vegetation zonation mostly occurs due to human activities; that man-made barriers prevent the dispersal and growth of dune species and that recreation activities produce various impacts, one of the most important being trampling. Research suggesting human activity impacts on sand dunes supports hypothesis 1 and 2. The report also recognised that "Vegetation plays an essential role in determining the size, shape and stability of dune systems." This emphasises the importance of dune ecosystems in maintaining dune integrity for their role in coastal defence, providing a link between this study and an issue of increasing global significance. Other research supporting hypotheses 1 and 2 included: Purvis et al. (2015) whose results indicate that beach access paths reduce biodiversity and density of dune vegetation; Santoro et al. (2012) comparing dune plant communities, found that species richness increased in fenced off areas and decreased slightly in the area of open access and Martins et al. (2013) showed that disturbances caused by human action damaged the integrity and normal sequence of dune plant communities.
A British study by Jones et al. (2008) presented data which supported Hypothesis 3, suggesting that dune soil development follows a sigmoidal curve, initially slow until full vegetation is established leading to a build-up of cover of organic matter and concluding that although it may seem obvious that soil development progresses faster under vegetation cover, it has strong implications for dune management.

Papers cited are published in peer reviewed journals with references and so considered reliable sources of information.

Locational Context:

The following map provides locational context for the study, showing Cornwall at the south west tip of the UK (Fig.2) and the location of the three survey sites on the north coast of the Cornish peninsula facing into the Atlantic Ocean (Fig.3):

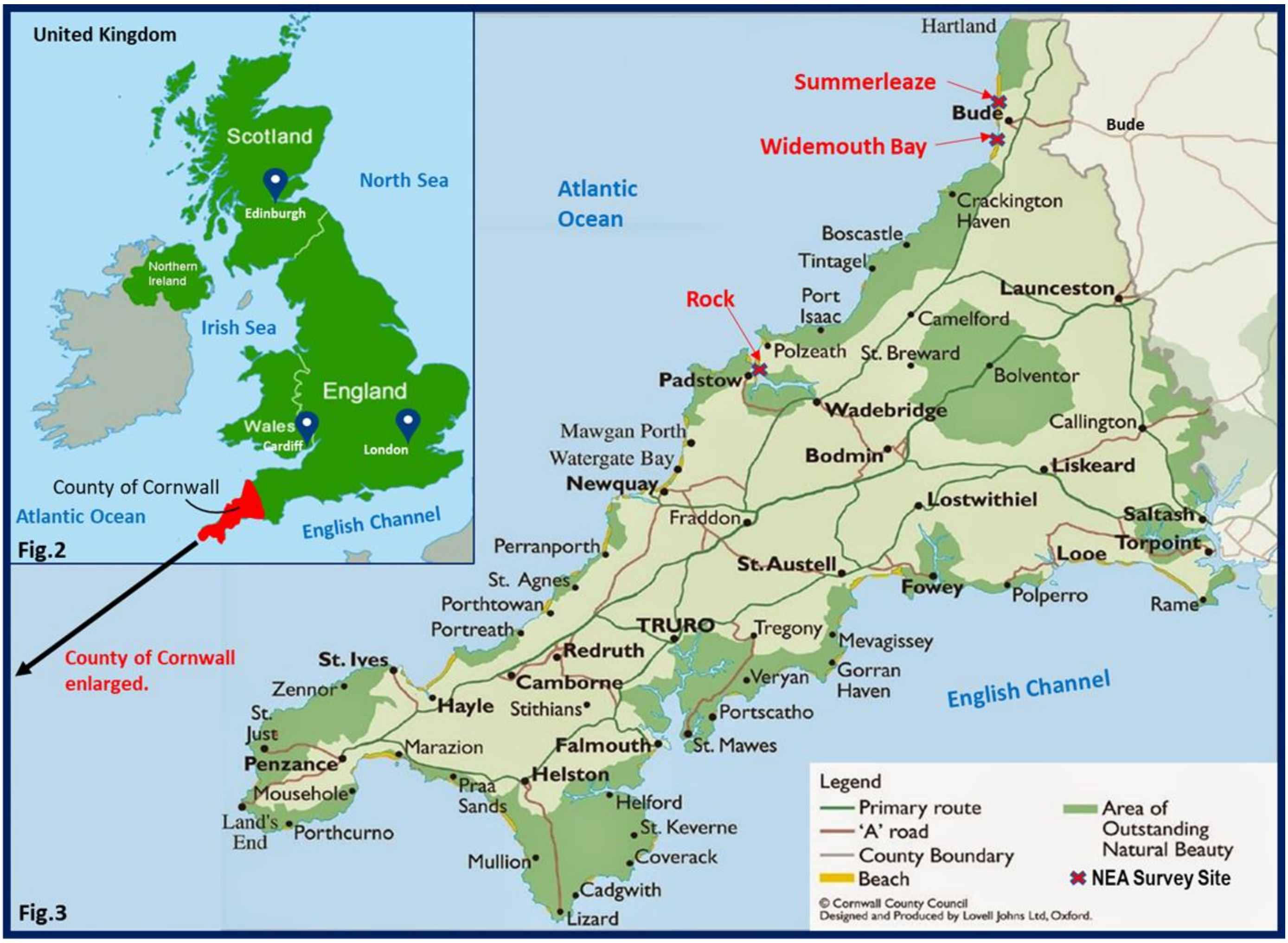


Fig.2: A map showing the county of Cornwall at the southwest tip of the United Kingdom, inset within
Fig.3: An enlarged map of Cornwall showing main settlements and the location of the survey sites.
Base map from cornwall council map – Bing images.

Cornwall has over 400 miles of coast, with different landscapes found on the peninsula's North and South coast. The North coast is flanked by the Atlantic Ocean and is exposed to the prevailing south-westerly to north-westerly winds associated with low pressure weather conditions which move in from the Atlantic. As a result, it has rugged sheer cliffs, steep valleys, and a greater number of dunes. The South coast, on the English Channel, contains more sheltered beaches and tree lined estuaries (CC,2020).

Many of the sand dunes and beaches around Cornwall's coast are experiencing erosion and sediment loss, a pressing concern as these sand dunes and associated beaches are one of the area's most important tourism resources (CC, 2016). From Cornwall's visitor survey 2018/19 the beaches and scenery were by far the overwhelming top "likes" coming out of the survey (Bude TIC, 2019). WB and SL are included in CC's BDMPs while also experiencing increasing levels of tourism. Between 2012 and 2017 in Bude, UK staying visitor numbers increased from 119,100 to 134,100 and overseas visitors increased from 5,300 to 8,500. (Bude TIC, 2019).

My interest in this project stems from holidaying in North Cornwall or the past 17 years and having witnessed the erosion of the sand dune areas.

The following maps provide locational context for each of the three survey sites, annotated with details of access, parking and facilities available at each location:

Widemouth Bay and Summerleaze:

Summerleaze (Fig.5) is in the holiday town of Bude while Widemouth Bay (Fig.4) is 2.3 miles south of Bude. Both beaches attract visitors from within the town or nearby holiday accommodation, but also accommodate visitors arriving by car, with large parking capacity. These sites are also accessible by bus and on foot via coastal paths.

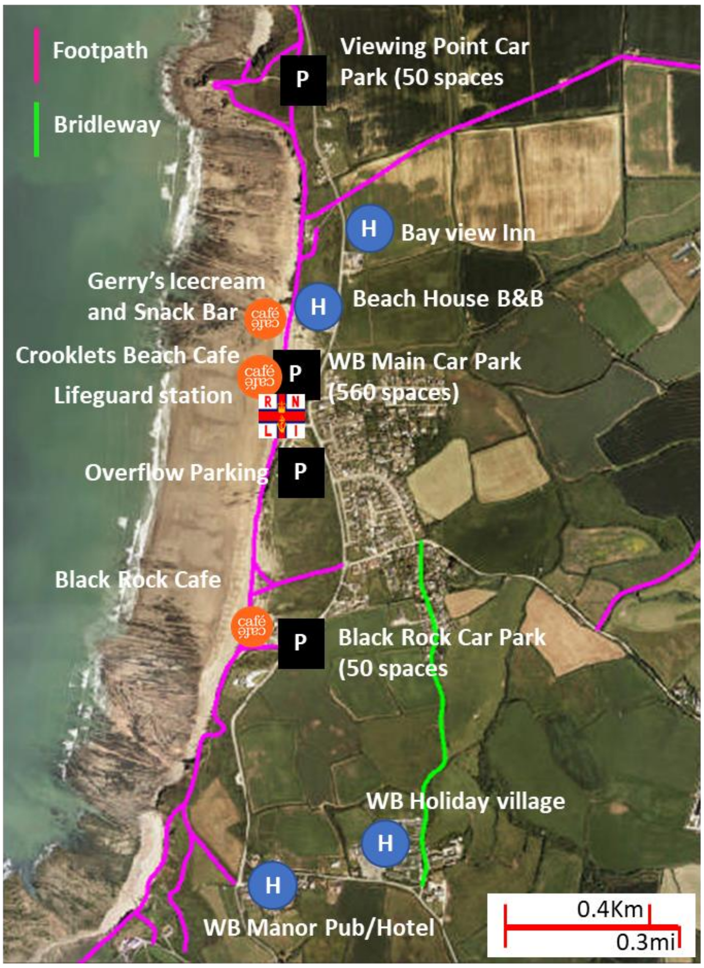


Fig. 4: WB showing Assets and Facilities. Base ariel map from Cornwall Council Interactive Map - https://map.cornwall.gov.uk/

Fig.5: SL Assets and Facilities. Base ariel map from Cornwall Council Interactive Map - https://map.cornwall.gov.uk/

The RNLI presence adds an element of safety at both sites making them popular with families as do other facilities such as toilets, showers, shops, cafes, and places to eat as well as recreational activities such as surf hire.

Rock:

Rock (Fig.6) with no BDMP was selected as the control site for comparison with WB & SL. Rock differs from Bude being located on the Camel Estuary rather than facing West directly into the Atlantic Ocean. However, like the other two beaches it is situated in an area of high tourism.

Rock

Fig. 6 Rk Assets and Facilities. Base ariel map from Cornwall Council Interactive Map - https://map.cornwall.gov.uk/

Rock attracts visitors from local holiday accommodation and from the larger holiday town of Padstow, who can arrive by the foot ferry which operates across the estuary. Rock is accessible by bus and via the coastal path but has limited car parking.

The village has a lifeboat station, but the local beaches do not have lifeguards. The village itself has shops, cafes and pubs which cater for tourists.

Methodology:

Who:

My family helped collect data. Clinometer measurements, vegetation recording, and the Environmental Quality Survey (EQS) were done by one person for consistency.

When:

Surveying & mapping was done between 04/08/20 and 08/08/20, early morning or evening (see risk assessment). EQS visits to observe human activities were made at busier times.

Risk Assessment:

Hazard	Control
COVID19: crowds	Survey at quiet times, social distancing.
Trip hazard: transect line	Survey at quiet times, wind in line as survey progresses if necessary.
Wildlife: Adders/Ticks	Boots and long trousers in overgrown areas.
Cut off	Check tide times.
Falls	Avoid cliffed dune faces.
Environmental	Minimise trampling & soil sampling, No litter.

Where:

Sites were chosen based on local knowledge. Research was done using OS Explorer Maps 111 (Bude, Boscastle and Tintagel) and 106 (Newquay and Padstow) Scale 1:25,000 and satellite imagery from Google Earth (dates unknown).

Widemouth Bay (WB) North dune (Fig.7) was chosen as South beach dune showed signs of cliffing (CC, 2016).

Fig.7 Widemouth Bay dune survey site. (https://osmaps.ordnancesurvey.co.uk, 2018)
Grid references for transects (see Fig. 20):
Transect 1: SS1989802590-SS1999802584
Transect 2: SS1989302563-SS1999202548

Summerleaze (SL) South dune (Fig.8) was wide enough for transects of up to 100m compared to the Northern dune.

Fig.8 Summerleaze dune survey site. (https://osmaps.ordnancesurvey.co.uk, 2018)
Grid references for transects (See Fig.25):
Transect 1: SS2046106464-SS2055106506
Transect 2: SS2049606421-SS2057506482

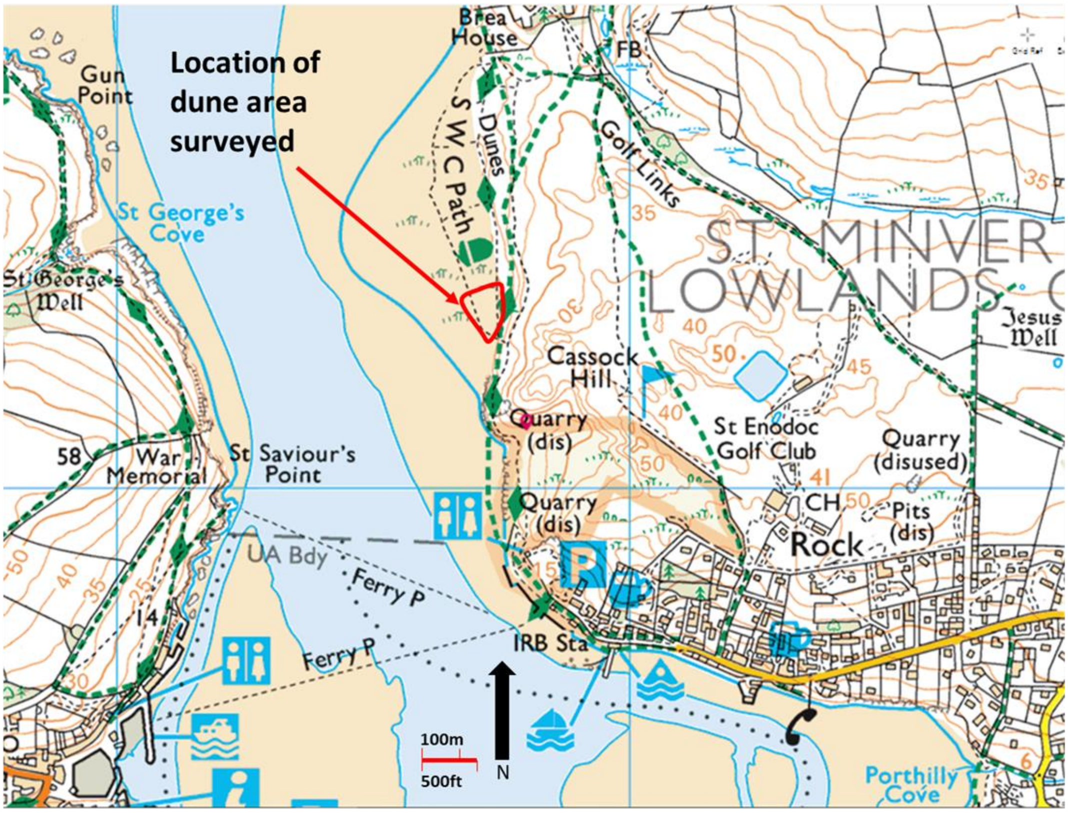


Fig. 9 Rock dune survey site. (https://osmaps.ordnancesurvey.co.uk, 2018)
Grid references for transects (See Fig. 30):
Transect 1: SW9265876269-SW9275976298
Transect 2: SW9265376280-SW9274476322

Rock was the first dune area reached from the beach. The beach to the North of the carpark is backed by low cliffs with a short walk (500m) around the estuary to the dune.

Interrupted Belt Transect

Data type	What	How	Why
Primary Data Collection	100m transect, 2 transects per site.	A 10-figure grid reference was recorded for the start and end of each transect using the "OSMap" app. A 100m surveyor's tape was run out on a compass bearing. Transects were plotted and the bearing checked using https://gridreferencefinder.com.	Systematic sampling was used to measure changes in vegetation with distance from the beach. Allows comparison of vegetation at the different survey locations. 2 transects for a more representative sample.
Links to - **Hypothesis 2:** The primary succession (psammosere) is interrupted by the range of human influences and land uses. **Hypothesis 3:** Soil depth and organic matter are adversely affected by interruptions to the natural development of vegetation and succession. The interrupted belt transects was used to sample and record the succession of vegetation and soil development with distance from the strandline.			

From measurements made on Google Earth I found that a 100m transect was the maximum at the Bude sites and that vegetation cover became denser from 60m, I used this information to design the sampling plan (Fig.10). The position of transect lines was chosen to be representative of the sample area:

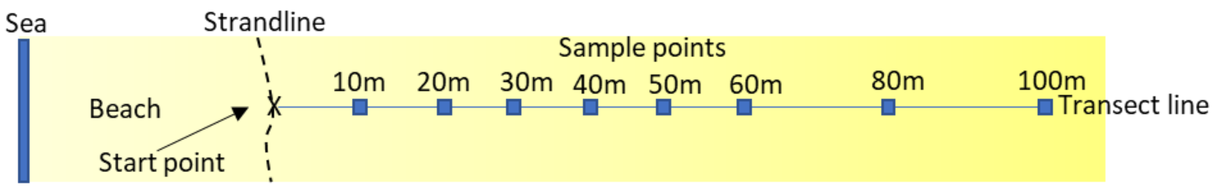


Fig. 10. Interrupted Belt Transect with Sampling Points: The later samples were more spaced as I expected less change in vegetation as cover stabilised and increased.

Strandline was used to start the transects because it could be seen on the beach.

Sources: Field Study Council. (2016). *Biology Fieldwork A Level: Fieldwork Techniques* and Willis et al (2016).

Limitations: A continuous belt transect would have provided more detailed information on changes in dune vegetation but was impractical over 100m.

Transects plotted on https://gridreferencefinder.com did not exactly fit the planned bearing, because the terrain made it difficult to walk in a straight line. For reproducibility, the actual transect bearing has been recorded.

Vegetation Sampling and Identification

Data type	What	How	Why
Primary Qualitative and Quantitative data	4x50cm^2 frame quadrats per sample point (Fig.11). The following were recorded for each quadrat: • Species • Frequency. • Coverage.	National Vegetation Council (NVC) Methodology from Magnificent Meadows (2014), (Fig.12). Field Identification used the FSC Key to Common Plants (1997). Survey data was reviewed using photographs and field sketches, (Fig.13 &14). Plant identification confirmed using Collins Wild-Flower Guide (2016). Survey data was analysed using: https://www.ceh.ac.uk/services/modular-analysis-vegetation-information-system-mavis. (MAVIS). British Plant Communities (2000) was used to check the output from MAVIS.	Vegetation coverage and frequency was recorded at each sample point. MAVIS analyses species present, frequency, and coverage to give a percentage match with a NVC plant community. The NVC plant communities can be checked against the expected changes in plant communities across a dune system. Rodwell (2000) (Fig. 15).

Links to -

Hypothesis 2: The primary succession (psammosere) is interrupted by the range of human influences and land uses.

Hypothesis 3: Soil depth and organic matter are adversely affected by interruptions to the natural development of vegetation and succession.

Vegetation sampling and recording was used to map the succession along each transect. Human influences, land use and humus/soil development were overlayed onto this data.

Positioning and size of quadrats:

FSC (2016) recommend 3-5 quadrats sampled at each point placed on either side of the transect line to cover a broader belt. 2 transects per site gave 8 quadrats at each distance from the strand line for a more representative sample.

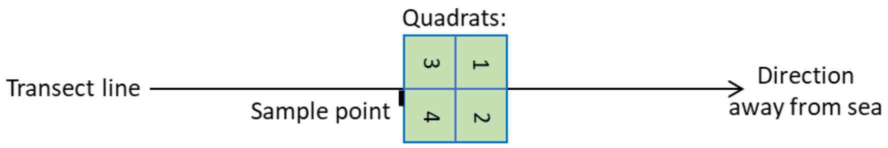


Fig. 11 Showing positioning of 50x50cm quadrats - 2 stacked squares on the inland side of each sample point with 2 either side of the transect line.

NVC Methodology for recording coverage and frequency:

The NVC plant communities are based on two parameters (for each species found in a quadrat) frequency and coverage:

- **Coverage**

DOMIN Scale

Cover	Domin
91-100%	10
76-90%	9
51-75%	8
34-50%	7
26-33%	6
11-25%	5
4-10%	4
<4% (many individuals)	3
<4% (several individuals)	2
<4% (few individuals)	1

The total percentage cover can be above 100% as plants often lay on top of one another)

- Frequency - this is the number of times the plant is found in the quadrats. 3 quadrats are the minimum number of samples that can be entered, but it is better to assess vegetation over 5 quadrats. The NVC tables (see the NVC books in the references), frequency is referred to using roman numerals:

Frequency class	Percentage of quadrats	Descriptive measure
I	1-20% (1 quadrat out of 3 or 5)	Scarce
II	21-40%	Occasional
III	41-60%	Frequent
IV	61-80%	Constant
V	81-100%	Constant

Fig. 12. Magnificent Meadows (2014)

FSC (2016) recommend the qualitative AFCOR system (Abundant, Frequent, Common, Occasional, Rare) to assess coverage. The NVC Methodology using the DOMIN Scale to give quantitative values which can be analysed and give more reliable conclusions.

Photographs and Sketches used to review and finalise field data :

Fig. 13. Field Sketch and Photograph

SL2.3 (40m) ID2986

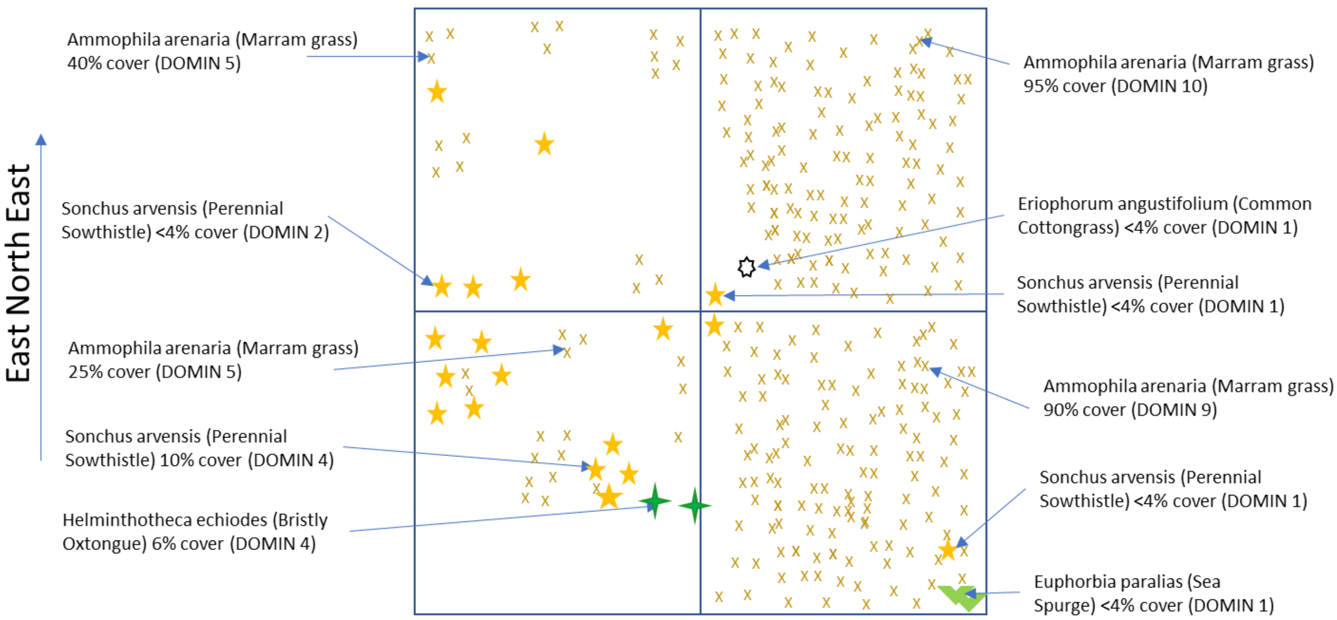


Fig. 14. Reviewed data from Field-sketch and Photograph – cover converted to DOMIN scale.

Strandline – fragmentary **SD2** *Honkenya-Cakile* vegetation with embryo dunes building around **SD4** *Elymys farctus*.
Mobile (Yellow) dune – **SD6** *Ammophila* vegetation.
Semi-fixed (Grey) dune – **SD7** *Ammophila-Fescue* community.
A large blow out (eroded sandy area) – **SD10** *Carex arenaria* community.
Fixed dune – **SD8** *Festuca-Gallium* grassland.

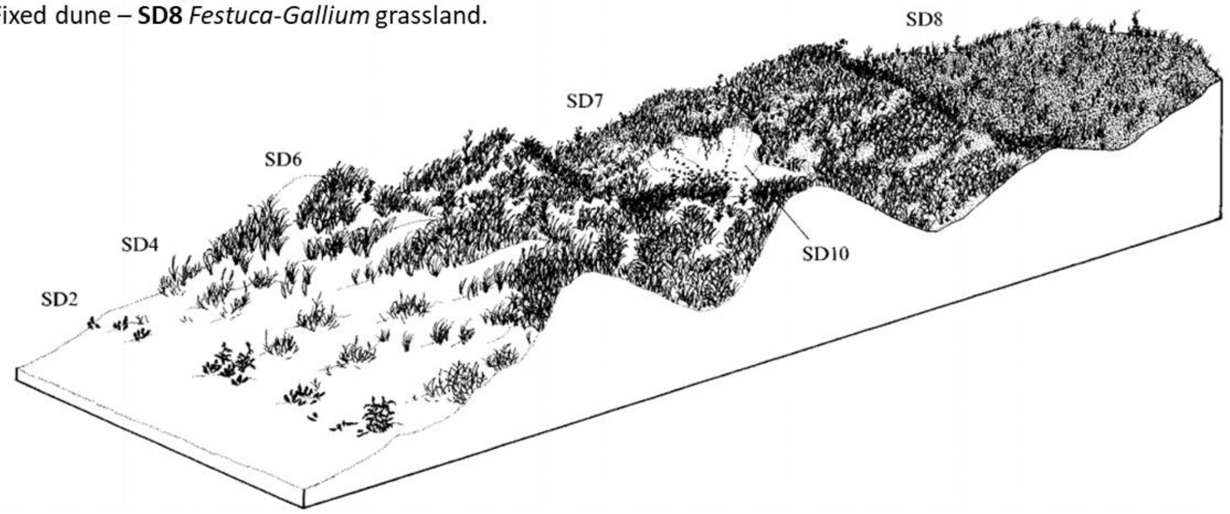


Fig. 15: Simplified zonation of sand dune vegetation types with NVC codes. (Rodwell, 2000)

Sources: Field Study Council. (2016). *Biology Fieldwork A Level: Fieldwork Techniques;* Willis et al (2016); Magnificent Meadows (2014); Collins Wild-Flower Guide (2016); Rodwell (2000).

Tools: MAVIS (Modular Analysis of Vegetation Information System), referenced in Magnificent Meadows (2014), is available free from the UK Centre for Ecology and Hydrology.

Limitations: 8x50cm^2 quadrats gave a survey of 200 cm^2 at each sample point. Magnificent Meadows (2014) recommends 3-5 x 200cm^2 for a larger and more representative survey area. My literature review found a range of quadrat sizes used in field surveys: 5x60cm^2 (Willis et al.,2016), 3-5x100cm^2 (FSC, 2016). I chose a smaller sample size for practical reasons.

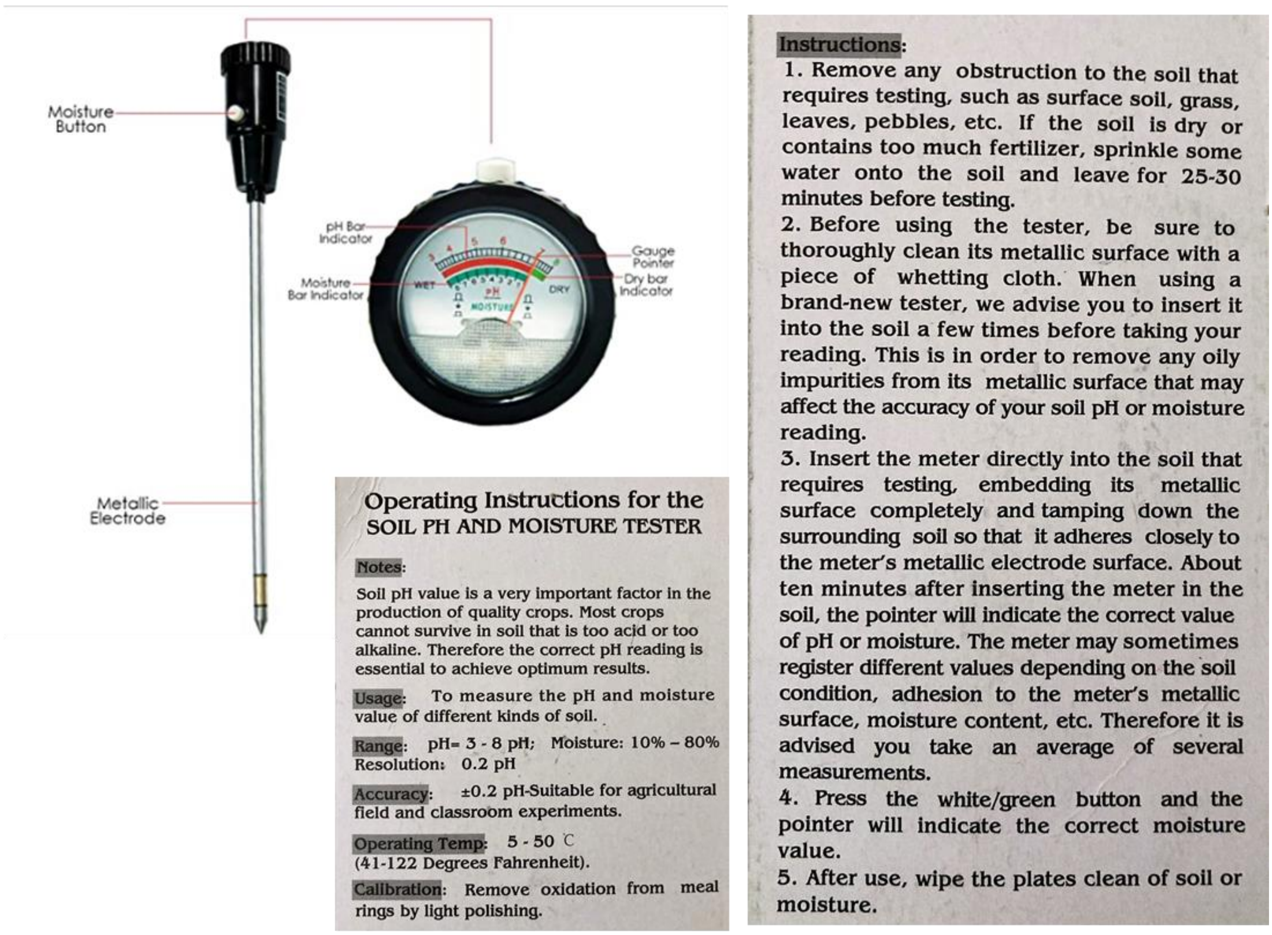
As non-specialists the accuracy of plant identification depended on correct use of the botanical information in the Collins Wild-Flower Guide (2016).

One team member made the quantitative assessments of coverage which were then scored to give a quantitative value. This may have led to bias if coverage was consistently over or underestimated.

Measurement of pH, Moisture and Organic Matter

Data type	What	How	Why
Primary Quantitative & Qualitative data.	At each sample point: pH (in duplicate) Organic Matter (OM)	Using a “Gain Express Soil pH Tester used in accordance with manufacturer’s instructions, (Fig.16). Soil samples from 15cm depth were bagged and were visually assessed for colour change and soil content.	Across a dune succession soil pH decreases as humus content increases (*Ross et al*. 2016) Duplicate pH readings were taken to improve accuracy and measurement reliability.
Links to – **Hypothesis 3:** Soil depth and organic matter are adversely affected by interruptions to the natural development of vegetation and succession. Soil pH was measured, and organic matter assessed to provide soil development data for each transect to be overlayed on data recorded for the development of succession.			

pH Measurement:



Operating Instructions for the
SOIL PH AND MOISTURE TESTER

Notes:
Soil pH value is a very important factor in the production of quality crops. Most crops cannot survive in soil that is too acid or too alkaline. Therefore the correct pH reading is essential to achieve optimum results.

Usage: To measure the pH and moisture value of different kinds of soil.

Range: pH= 3 - 8 pH; Moisture: 10% – 80%
Resolution: 0.2 pH

Accuracy: ±0.2 pH-Suitable for agricultural field and classroom experiments.

Operating Temp: 5 - 50 ℃
(41-122 Degrees Fahrenheit).

Calibration: Remove oxidation from meal rings by light polishing.

Instructions:
1. Remove any obstruction to the soil that requires testing, such as surface soil, grass, leaves, pebbles, etc. If the soil is dry or contains too much fertilizer, sprinkle some water onto the soil and leave for 25-30 minutes before testing.
2. Before using the tester, be sure to thoroughly clean its metallic surface with a piece of whetting cloth. When using a brand-new tester, we advise you to insert it into the soil a few times before taking your reading. This is in order to remove any oily impurities from its metallic surface that may affect the accuracy of your soil pH or moisture reading.
3. Insert the meter directly into the soil that requires testing, embedding its metallic surface completely and tamping down the surrounding soil so that it adheres closely to the meter's metallic electrode surface. About ten minutes after inserting the meter in the soil, the pointer will indicate the correct value of pH or moisture. The meter may sometimes register different values depending on the soil condition, adhesion to the meter's metallic surface, moisture content, etc. Therefore it is advised you take an average of several measurements.
4. Press the white/green button and the pointer will indicate the correct moisture value.
5. After use, wipe the plates clean of soil or moisture.

Fig.16. Gain Express Soil pH and Moisture Tester

Limitations:

The pH probe had a resolution 0.2 units (Fig.15) and relied on inbuilt calibration and correct use for accuracy.

Visual assessment was used to assess soil content of samples as there were no quantitative methods available for field use.

<u>Dune Profiling</u>

Data type / Links	**What**	**How**	**Why**
Primary Quantitative data.	For each100m transect starting from the strandline, measure: Changes in angle of slope. Distance between changes in slope angle.	The transect was divided into sections where slope angle changed, and these lengths recorded. Angle of slope was measured with an Invicta Education clinometer and ranging pole between each change of slope. Measurements were converted into a dune profile using trigonometry, (Fig.17 &18). The profile was created by plotting the data on a graph showing height and distance.	For comparison with the expected profile of dune development. For locational context for the vegetation communities. To map impact of human activity on the landform.

Links to -

Hypothesis 1: Human activity has a significant negative impact on vegetation cover in a sand dune environment.

Hypothesis 2: The primary succession (psammosere) is interrupted by the range of human influences and land uses.

The dune profile was measured for each transect to be compared with the expected series of ridges and troughs. Changes to the profile were linked human activities and land use and analysed with data from vegetation sampling.

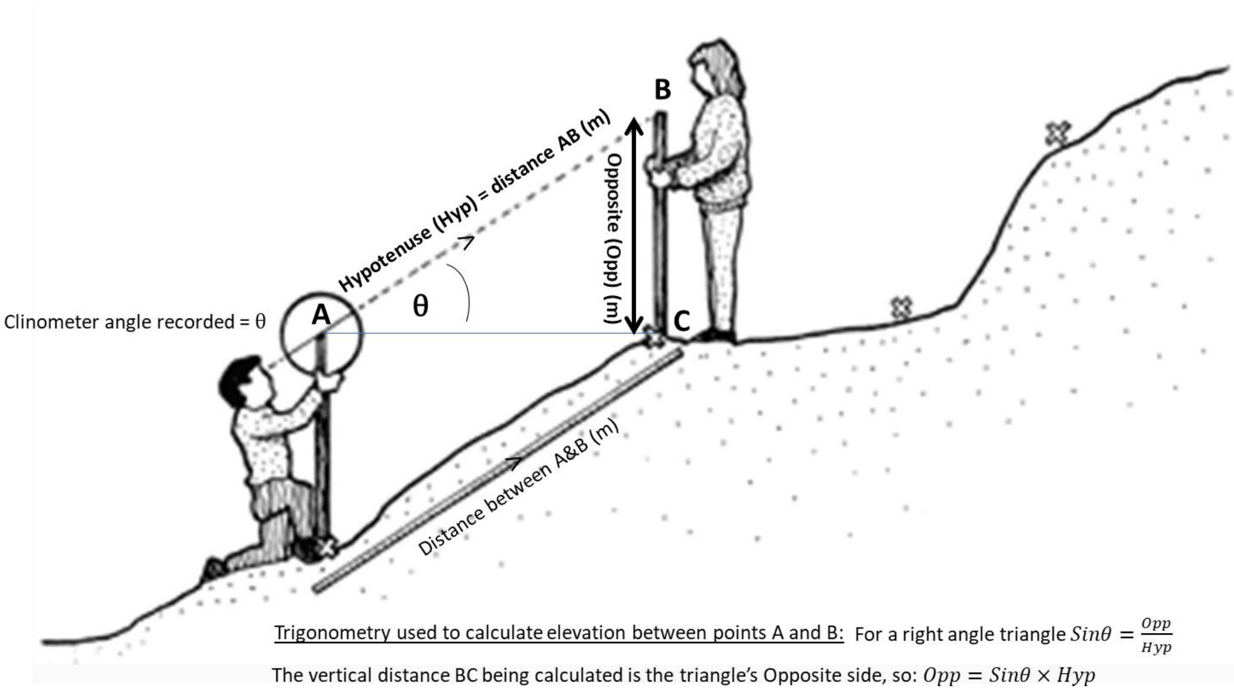


Fig.17. Measuring a beach gradient using a measuring tape, clinometer and ranging pole. (FSC 2016)

Fig. 18. Field photograph – Dune Profiling

Sources: Field Study Council. (2016). *Geography Fieldwork A Level.*

Limitations: The clinometer was hand-held. This may have led to inaccuracies in holding it at the right height while reading the angle. Accuracy could be improved by designing a fixed height mounting block for the ranging pole. Precision could have been improved by one person sighting the clinometer and another person making the scale reading through the side window.

Environmental Quality Survey (EQS)

Data type	What	How	Why
Qualitative & Quantitative data	For each site: EQS questionnaire. (Primary data) Mapping survey (Primary data) Amenities research (Secondary data)	Recommendations from the WB and SL BDMPs were used in the questionnaire, Fig. 19. Results were scored 1 - 6 and plotted on a radar chart. Dune paths were recorded using the OS Maps app and photographs. Human activities were also recorded. Amenities research was used to check details of local facilities mainly using OS Explorer maps and Cornwall Council website.	BDMP recommendations were used to evaluate improvements and as a basis for comparison with RK. The mapping survey collected site information for each site. The Amenities research was used to provide background data. This provided the context for evaluating Hypothesis 1.
Links to – **Hypothesis 1:** Human activity has a significant negative impact on vegetation cover in a sand dune environment. The EQS provided data on the types of human activities at each survey site and allowed comparison between sites. This information was overlayed onto the data from the dune profile and vegetation survey.			

Sources: Field Study Council. (2016). *Geography Fieldwork A Level.*

Subject	Negative evaluation	1	2	3	4	5	6	Positive evaluation
Footpath erosion & number of paths through Dune	Public roam free, no definitive pathways, access points for dune or beach.							Carefully managed access around the dune and beach with board walks, restricted access zones, signage.
Dune Erosion	Dune front cliffing with danger to assets and coastal paths. No sand trapping dune conservation systems observed.							Sand trapping techniques are utilised to retain sand in the dune system such as fencing off the dune or planting Marram Grass/Christmas trees/Willow. No cliffing keeping assets and coastal paths secure. Signage to stop visitors trampling the dune vegetation, affecting dune stability.
Presence of vehicles	Vast areas of car parking close to the beach where blown sand collects and is then removed from the system as contaminated waste.							Car parking remote from the dune system, infrastructure in place to promote sustainable transport and access to coast. Systems to safely collect and recycle blown sand.
Human activity	No attempt to inform the public about dune conservation and no restricted access zones. Damaging human activity observed.							Educational signage presenting information on dunes explaining the BDMP. Restricted access zones and clear pathways following around the natural contours of the dune rather than cutting through it. Public compliance observed.
Waste disposal and litter	Heavily littered and few bins (3>)							Little litter and many bins (10<). Bins for litter, dog waste and even barbeque safe bins strategically placed on the beach around access points. Signage to encourage beach visitors to use the bins and not to litter.
Assets	Many assets close to the beach							Assets remote from the dune system allowing Dune to develop and stabilize naturally.

Fig19 EQS Questionnaire

The FSC recommended a bi-polar scale to clearly present positive and negative evaluations in an EQS. I adapted this to a 1-6 scale to allow plotting of data on a radar chart.

Limitations: Survey scores were based on my personal judgements potentially resulting in bias. A less subjective result would be achieved if the criteria were independently scored by several observers and combined for analysis.

Statistical Methods:

Data type	What	How	Why
Primary Quantitative data	Analysis of the combined transect data for each site. Is there a significant difference between sites in the number of species found at each distance from the strandline?	Mann-Whitney U Test using the method for large samples (n_2 larger than 20) (Seigel, 1956). Used to test the **null hypothesis**: The first step in the decision-making process is to state the null hypothesis. The null hypothesis is a hypothesis of **no difference.** It is usually formulated for the purpose of being rejected. The **alternative hypothesis** is the operational statement of the experimenter's research hypothesis. The research hypothesis is the prediction arrived at from the theory under test. (Seigel, 1956)	Data type –discrete Testing for – difference Data not expected to be Normally distributed as the variety of species should become more diverse with distance from the strandline. However, U is converted to z because, "as n_1 and n_2 increase in size, the sampling distribution of U rapidly approaches the Normal distribution". (Seigel, 1956)

Links to –
Aim 3 - allows comparison of the vegetation profiles from Bude sites (with a BDMP) with the control site at Rock (no BDMP).

Hypothesis 1: Human activity has a significant negative impact on vegetation cover in a sand dune environment.

Hypothesis 2: The primary succession (psammosere) is interrupted by the range of human influences and land uses.

The statistical test fulfils aim 3 by making a comparison between the survey sites. It also links indirectly with hypotheses 1&2 when combined with the evidence from the vegetation survey, dune profiling and EQS.

Analysis: Dune Mapping, Profiling and Vegetation Survey

Widemouth Bay (WB)

Details of the survey location and positioning of the transect lines are shown below (Fig.20):

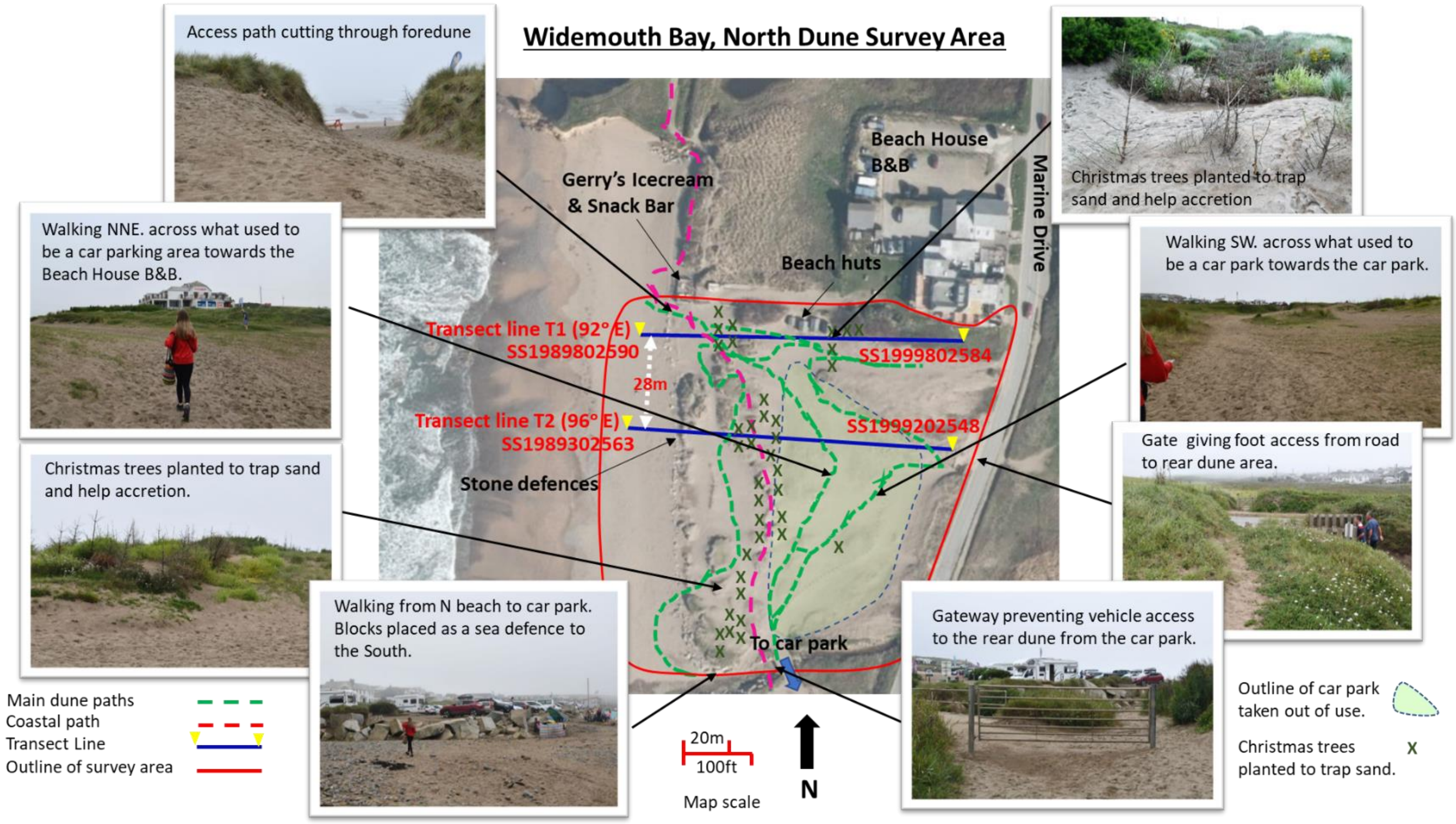


Fig. 20: WB Ariel map showing transects, dune mapping routes and photographic records.
Ariel map: (https://osmaps.ordnancesurvey.co.uk ,2018)

WB Dune Profiles:

The dune profiles for T1 and T2 (Fig. 22 & 23) both peak between 30 and 40m from the strandline but show differences in shape and height.

Overall, T1 had a flattened profile with one clear ridge and trough. The photographs (Fig. 22) show the cross-dune path, running alongside T1 up to 60m, has no stabilising vegetation. This supports Hypothesis 1, that human activity has a significant negative impact on vegetation cover in the sand dune environment. Calveo et al. (2013) report that "a permanent loss of vegetation may occur in cases of high intensity trampling." They also emphasise the importance of perennial species such as *Ammophila arenaria* stating that "where vegetation cover is incomplete loose sand is subject to wind-blow" which may account for the flattened profile seen in T1.

The T2 profile has 2 dune ridges at 22m and 37m and then falls away to a point lower than the strandline in the area historically flattened to form a carpark. The removal of the rear dune for car parking would have interrupted the natural process of dune formation. The car park has been closed for at least 10 years, but the area still has low vegetation cover, so sand blown from the foredune is not trapped and accretion has not occurred. This observation links to Hypotheses 1 and 2 that human activity has a significant negative impact on vegetation cover and the primary succession is interrupted by the range of human influences and land uses. In terms of recovery, Calveo et al. (2013) mention research showing that, "if certain thresholds are reached, irreversible damage can occur and then recovery is unlikely to happen."

Fig. 21: WB T2 SP5 shows vegetation colonising area planted with Christmas trees

Interestingly on both transects where conifers have been planted to assist dune recovery, there is visual evidence that vegetation has started to colonise these areas (Fig.21), except on the T1 cross-dune pathway, 30-40 from the strandline, where the path has remained in use. This again supports Hypothesis 1 suggesting that trampling by humans has a significant negative impact on vegetation cover and shows the importance of managing access points through dunes.

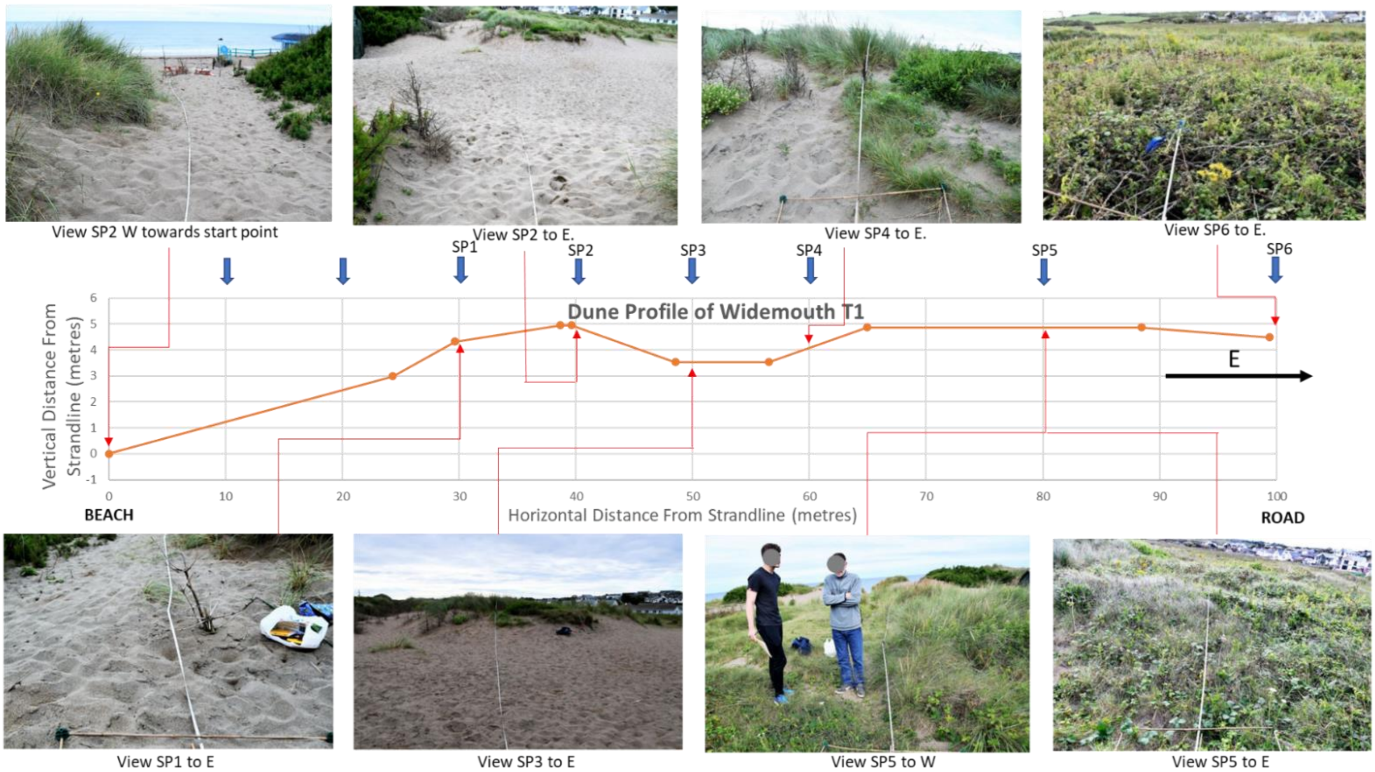


Fig. 22: WB Dune Profile T1

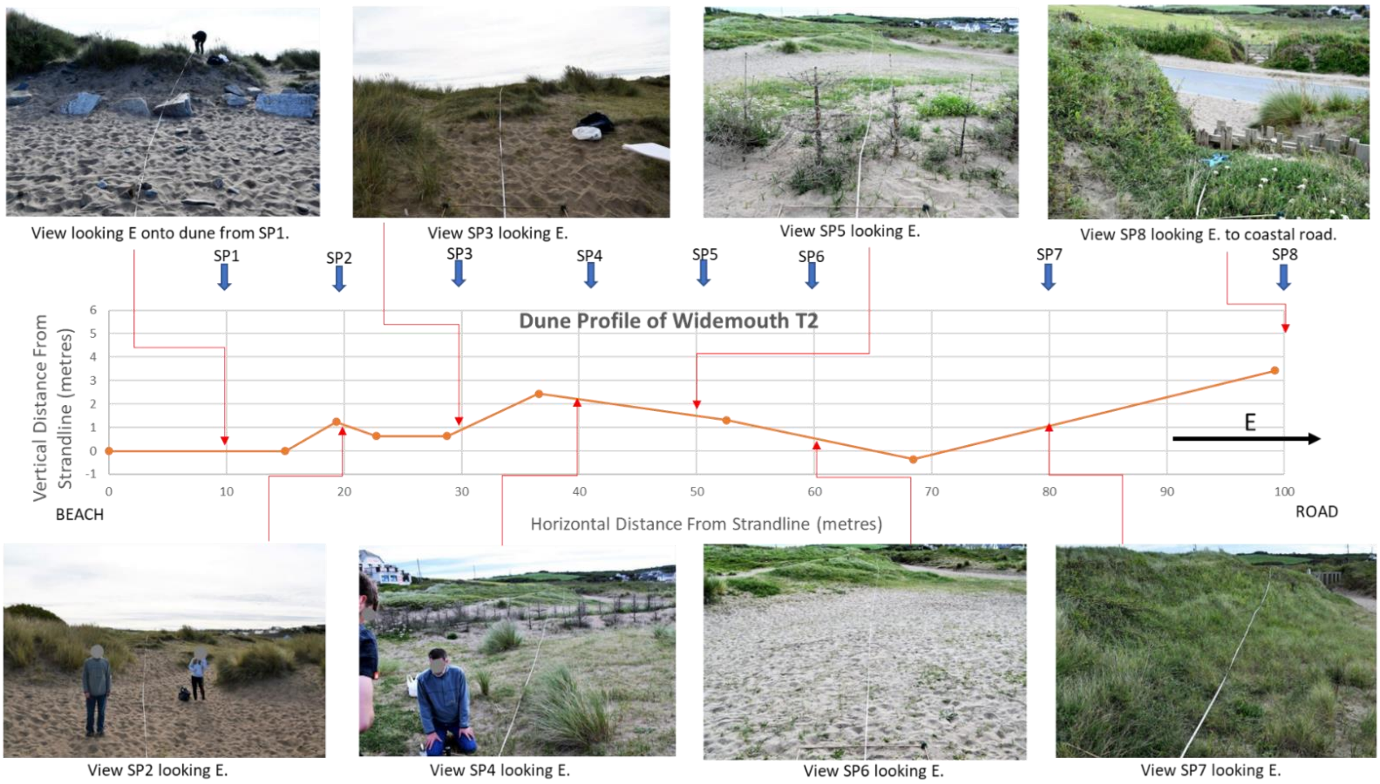


Fig. 23: WB Dune Profile T2

WB Vegetation survey:

10 species were recorded in both T1 and T2 with 5 common to both transects. A total of 15 species were identified. For full details of the vegetation survey results see Appendix I.

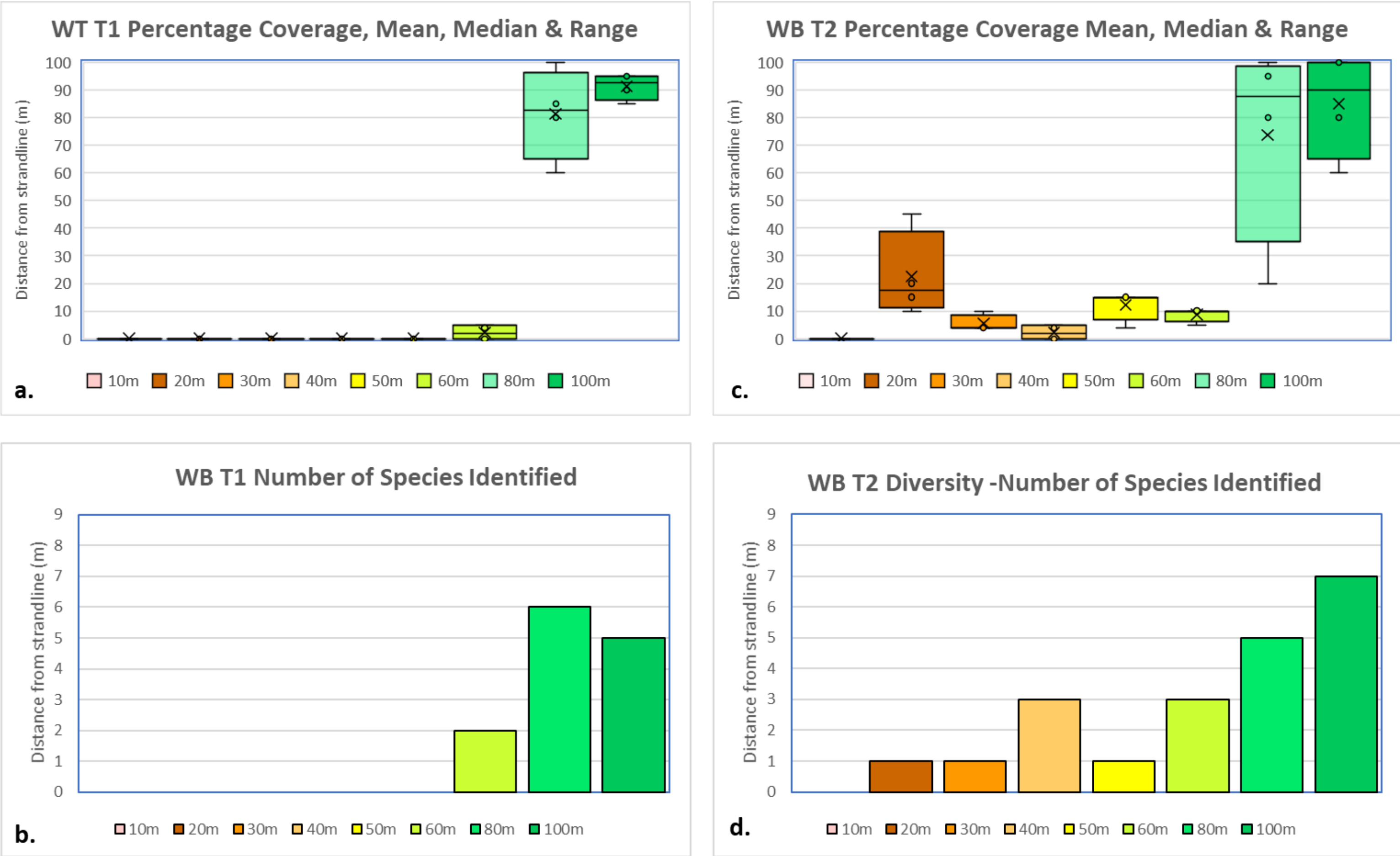


Fig. 24: WB vegetation survey results

For T1 no vegetation was counted until 60m from the strandline (Fig.24 a&b), while for T2 the overall trend was increasing diversity with varying levels of coverage from 20m (Fig.24 c&d). This links with the dune profile data to support Hypothesis 1, that human activity has a significant negative impact on vegetation. The data supports the idea that on T1, trampling on the cross-dune path has worn away vegetation up to 60m, while for T2, with no cross-dune path, vegetation was recorded from the first dune ridge at 20m.

For T2, mean coverage of 22.5% at 20m, drops to lower levels between 30 and 60m (Fig.24c) suggesting that even after 10 years the dune area in the out of use carpark has not recovered. This would support Hypotheses 1 and 2, that human activity has a significant negative impact on vegetation cover and the primary succession is interrupted by the range of human influences and land uses. T2 vegetation data also supports this conclusion (Appendix I): In T2, *Ammophila arenaria* cover and frequency fell and then increased again between 30-50m. In this section *Carex arenaria* was identified at high frequency. The presence of *C. arenaria*, a low growing grass not adapted to cope with being engulfed indicates that blown sand is not settling on the ex-carpark.

Fig. 24 shows coverage and diversity increased significantly on both transects at 80 & 100m with less variation in the level of cover at 100m.

Fig. 25:

NVC Vegetation Habitat Code: Code (% match)

WB Transect	**10m**	**20m**	**30m**	**40m**	**50m**	**60m**	**80m**	**100m**
T1						SD6d (58.82)	SD6e(23.53)	SD6e (22.32)
T2		SD6d (71.43)	SD6d (71.43)	SD6g (88.11)	SD6g (63.69)	SD6g (72.87)	SD6g (56.78)	SD6g (43.72)
Combined T!&T2						SD6g (72.87)	SD6e (37.81)	SD6e (38.76)

NVC habitat codes were all SD6, representing subpopulations of the *Ammophila arenaria* mobile or **yellow dune** community (Rodwell, 2000). The survey suggests that within the 100m transects the WB dune succession does not develop beyond yellow dune.

However, the percentage match with SD6 was reduced at 80 and 100m due to a combination of *A. arenaria* at lower frequency and the presence of plants not typical for yellow dune (Appendix I). This is supported by the transect photographs which show increased vegetation cover in the last 20 metres of both transects with bramble patches in T1 and a dune grassland in T2, but in both cases the communities did not match the expected transition to SD7 (semifixed or **grey** dune). The species found would be expected in woodland scrub or open vegetation communities found on waste ground (Rodwell, 2000).

Together this data supports Hypotheses 1&2 that human activity has a significant negative impact on vegetation cover and the primary succession is interrupted by the range of human influences and land uses. The data indicates that the primary succession across the WB dune does not follow the expected pattern and linked to the dune profile data, this is likely to be related to human activities such as trampling and mechanical modification. Martins (2013) reported that activities such as the opening of paths can lead to "habitat fragmentation and windows of opportunity to invasion by opportunistic plants" which may explain the unexpected plant species recorded at 80 and 100m.

Summerleaze (SL)

Details of the survey location and positioning of the transect lines are shown below (Fig.26):

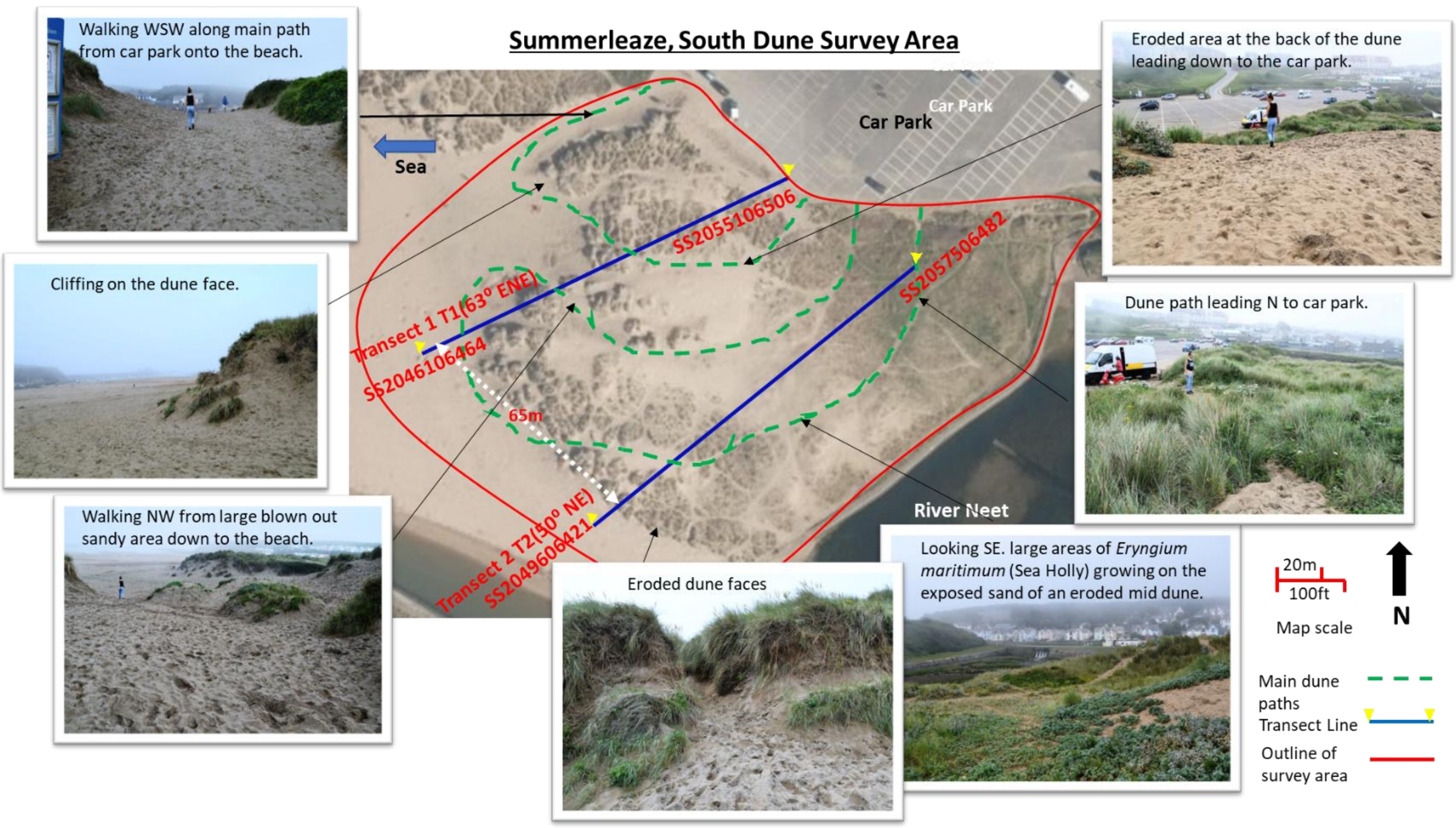


Fig. 26: SL Ariel map showing transects, dune mapping routes and photographic records.
Ariel map: (https://osmaps.ordnancesurvey.co.uk,2018)

SL Dune Profiles

There are no similarities between the SL dune profiles other than at 100m, close to the carpark, both transects end at a level below the strand line (Fig 27 & 28). Neither profile shows the expected series of dune ridges and troughs, there is a slight suggestion of these in T2 but in T1 the dune seems to have continued accreting and gaining height.

The photographs show that both transects cross areas of bare sand with signs of trampling suggesting they are used as paths; this was particularly evident on the dune face for T1 (Fig.27 SP1 &2). Higher mounds of dune topped with *Ammophila arenaria* have exposed roots where sand has eroded (Fig 27 SP4). Calvao et.al. (2013) explains that "destruction of plants that trap and hold sand particles exposes the underlying sand to onshore wind promoting the development of breaches, called blowouts. After a blowout is initiated, its margins continue to erode which results in extensive areas of open sand." These observations link to Hypothesis 1 suggesting that human activity is having a significant negative impact on vegetation cover at SL.

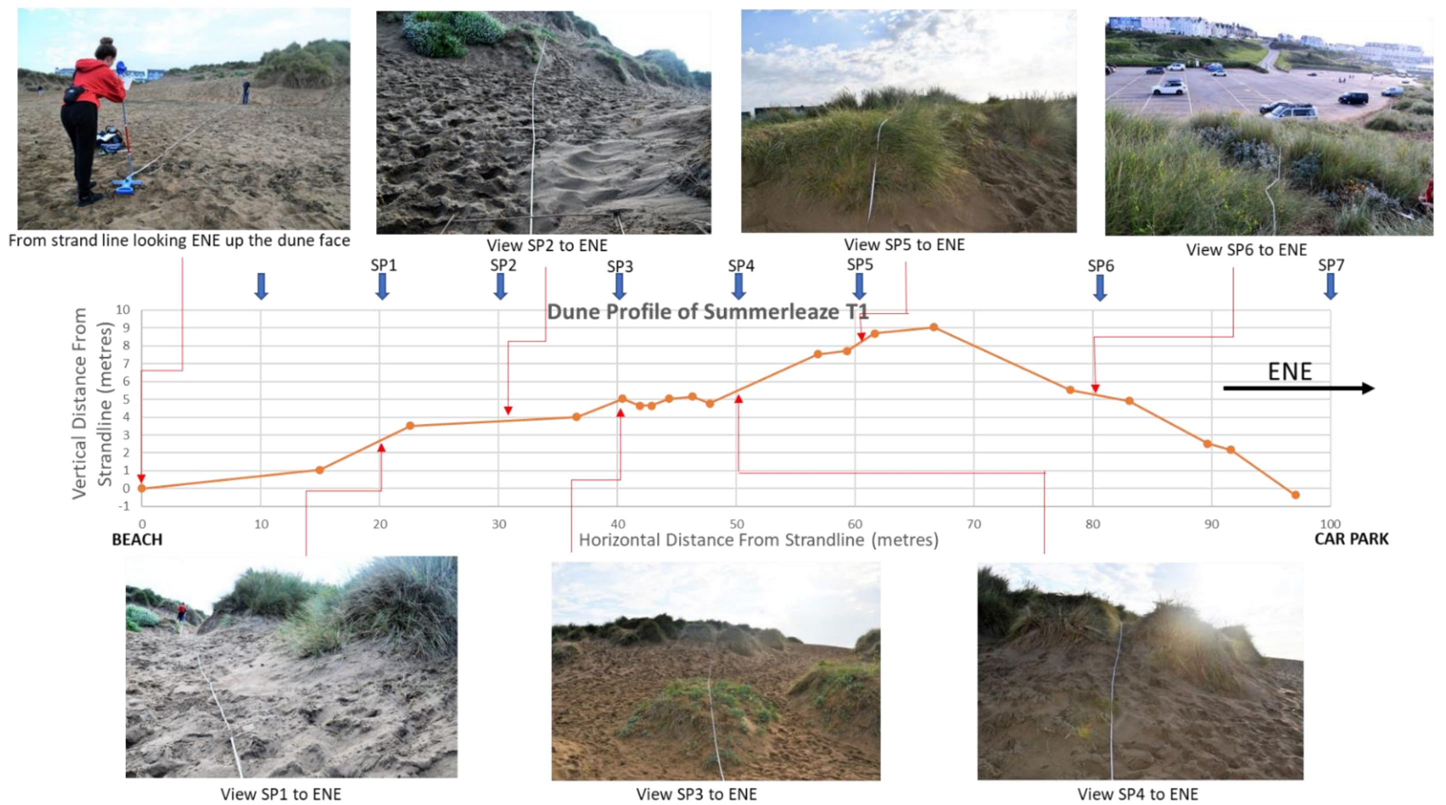


Fig. 27: SL Dune Profile T1

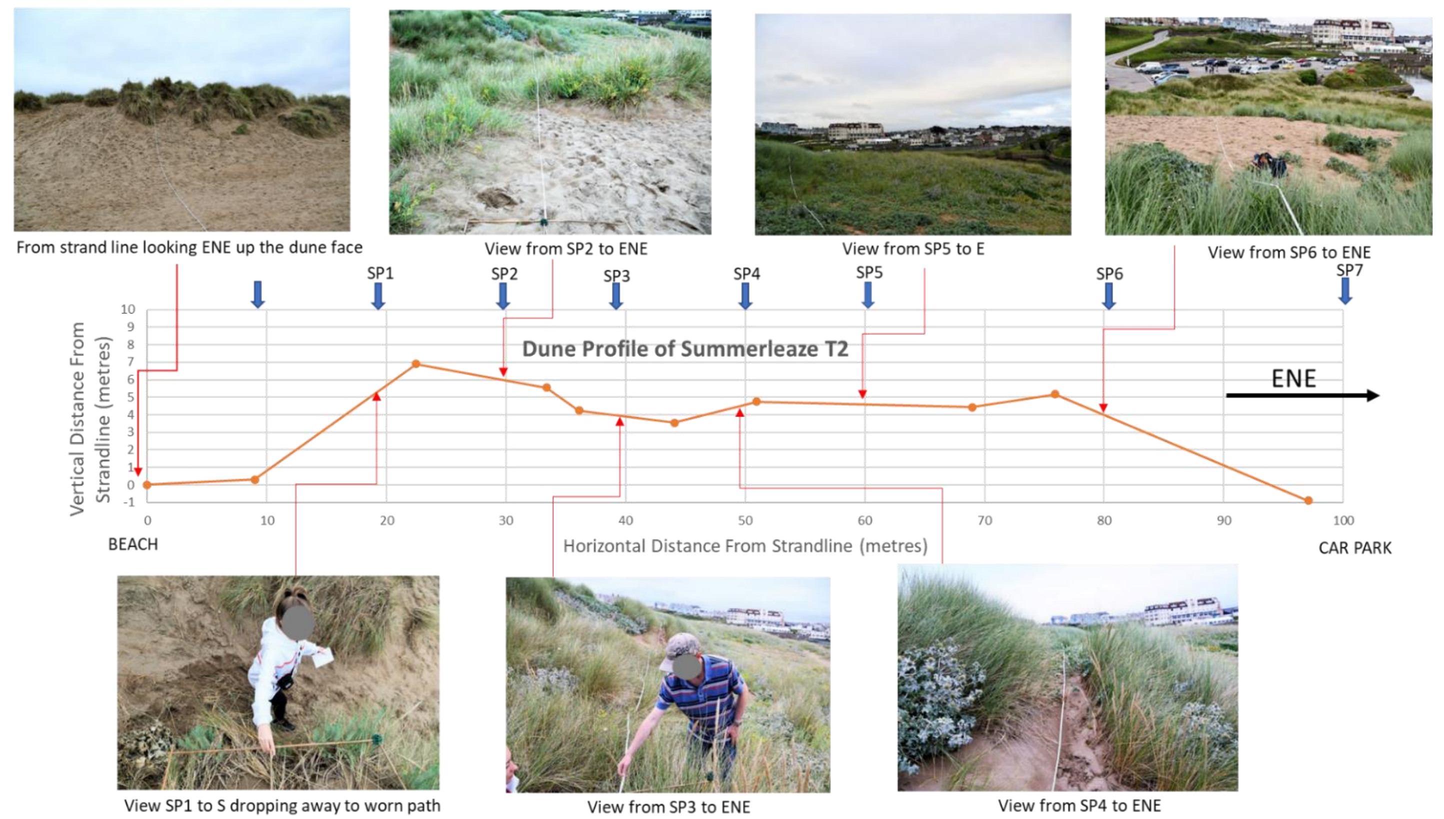


Fig. 28: SL Dune Profile T2

SL Vegetation survey:

T2 showed more species diversity at SL, with 6 species were recorded in T1 and 16 species in T2. 3 species were common to both transects. 19 species were identified here in total. (Appendix I)

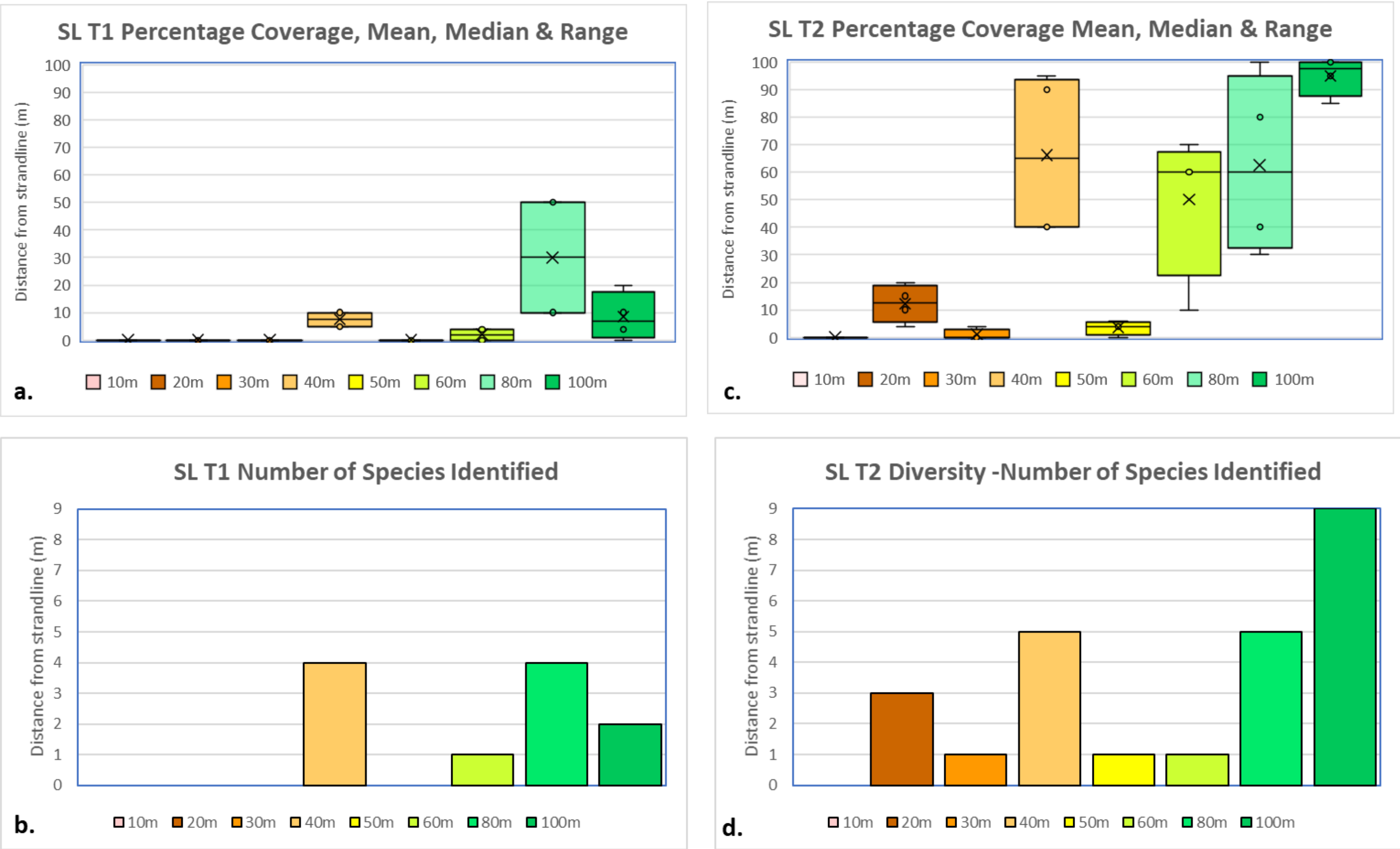


Fig. 29: SL vegetation survey results

On T2 vegetation was counted continuously from 20m from the strandline while for T1 continuous vegetation started at 60m (Fig.29 b&d). This may be because T1 was more easily accessible on foot, causing trampling, due to its lower the gradient when compared to T2 (Fig.27 &28). T1 was also situated closer to the access point and the centre of the beach and so may experience more visitors (Fig. 26). This would support Hypothesis 1 and 2 that human activity has a significant negative impact on vegetation cover and the primary succession is interrupted by the range of human influences and land uses.

For T2 diversity and coverage (Fig.29 c&d) generally increased with distance from the strand line, but with considerable variation within the samples. Pathways may explain this variation; diversity drops at 30m and between 50 and 60m, coverage also falls to a low level at 30 and 50m both of which coincide with pathways shown on the dune profile photographs (Fig.28 SP2 & SP4). Trampling on paths clearly affects cover supporting Hypothesis 1 that human activity has a significant negative impact on vegetation cover.

T1 has low diversity and cover across its length (Fig.29 a&b). The vegetation at 40m represents a small mound of stabilised dune surrounded by exposed sand (Fig.27 SP3). Coverage increased slightly from the high point around 60m where vegetation is in the lea of the dune (Fig.27). T2 reaches its high point at 23m (Fig. 28) which might also help to account for the higher coverage levels seen across this transect, with shelter provided much closer to the strandline.

Fig. 30:

NVC Vegetation Habitat Code: Code (% match)

SL Transect	10m	20m	30m	40m	50m	60m	80m	100m
T1				SD6d (46.33)		SD6d (71.43)	SD6d(45.66)	SD6e (22.32)
T2		SD6d (57.42)	SD6d (71.43)	SD6d (46.33)	SD6d (71.43)	SD6d(13.42)	SD6d (55.75)	SD6g (43.72)
Combined T!&T2				SD6d (50.36)		SD6d (37.74)	SD6d (57.76)	SD6e (38.76)

The vegetation survey for SL gave SD6 NVC habitat codes representing mobile or **yellow dune** communities. As with WB, this suggests that within the 100m transects the SL dune succession does not develop beyond yellow dune.

This data supports Hypothesis 2, the primary succession is interrupted by the range of human influences and land uses, by suggesting that the primary succession across the SL has been unable to develop beyond yellow dune due to the position of the car park behind the dune (Fig. 26). Both, Calvao et.al. (2013) and Martins et.al. (2014) discuss how construction and other land uses often starting in the grey and mature dunes block the development of dune systems inland as there is no available space and that these man-made barriers prevent plant species from dispersing and growing.

Rock (RK)

Details of the survey location and the position of the transect lines are shown below (Fig. 31):

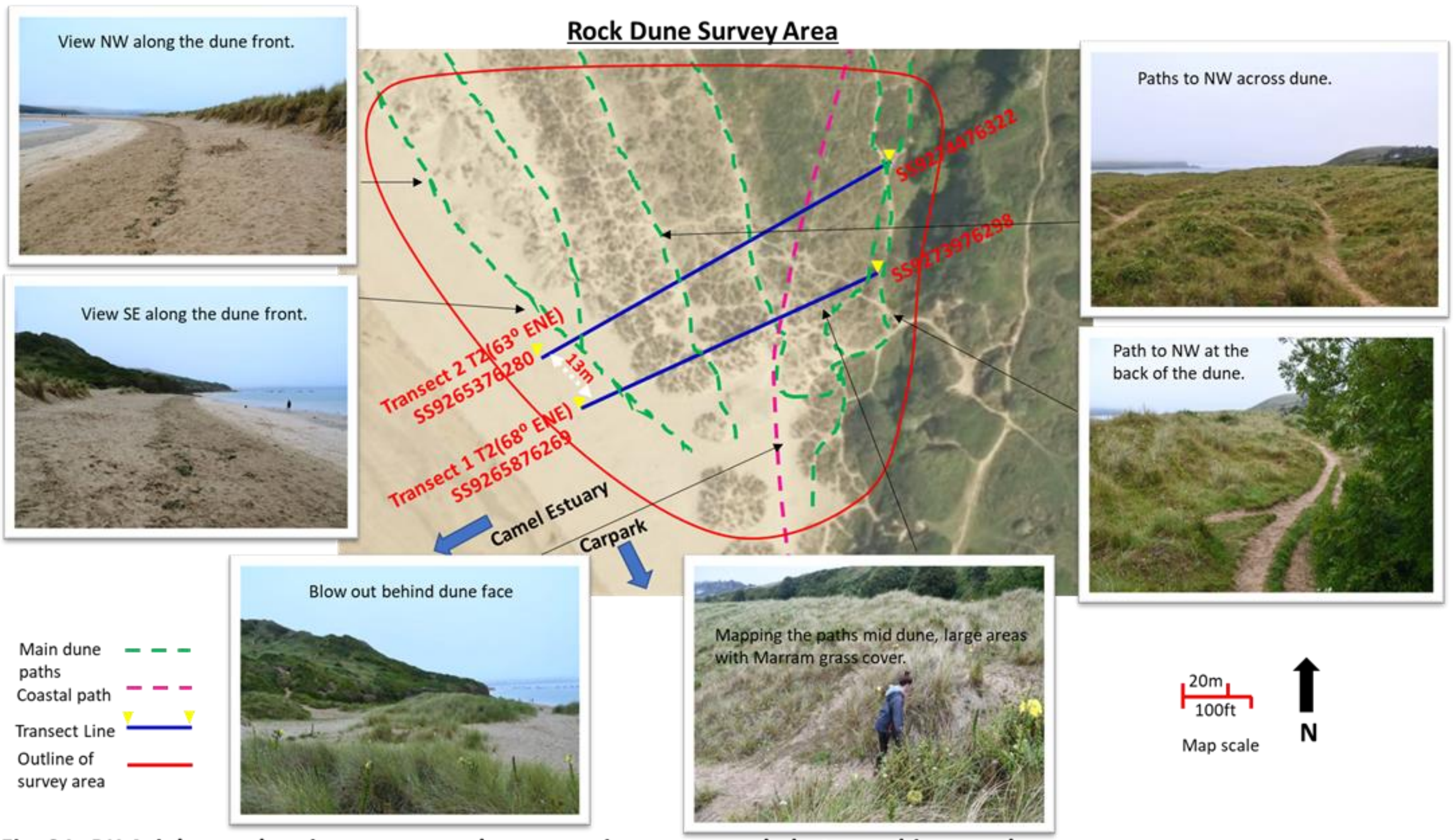


Fig. 31: RK Ariel map showing transects, dune mapping routes and photographic records.
Ariel map: (https://osmaps.ordnancesurvey.co.uk ,2018)

RK Dune Profiles

The dune profiles for T1 and T2 are almost identical up to 40m (Fig.32&33). From this point T1 continues to rise to a height of 5m above the strandline at 55m and from 90m the profile falls away into an inaccessible gully. T2 has a typical dune profile with 4 dune ridges, reaching a maximum height of 3.5m above strandline. Compared to WB and SL the profiles at RK did not drop below the strand line at any point.

The dune profile photographs show that vegetation cover was more continuous (Fig.32&33) compared to the other sites. Apart from where the coastal path leaves the beach to join the dune, there were few paths cutting across the dune front, suggesting that human access occurs from this point rather than from the beach. Paths mostly ran parallel to the dune front (Fig.31) and the photographs show narrow sandy strips rather than exposed areas of sand. This indicates that where paths exist, trampling has impacted on vegetation cover supporting Hypothesis 1, human activity has a significant negative impact on vegetation cover, although to a lesser extent at RK. The presence of fewer paths at RK, particularly those cutting across the dune, and the observation of more continuous vegetation cover links to results from Purvis et.al. (2015) who found "higher vegetation density and greater dune stability in areas with low path densities."

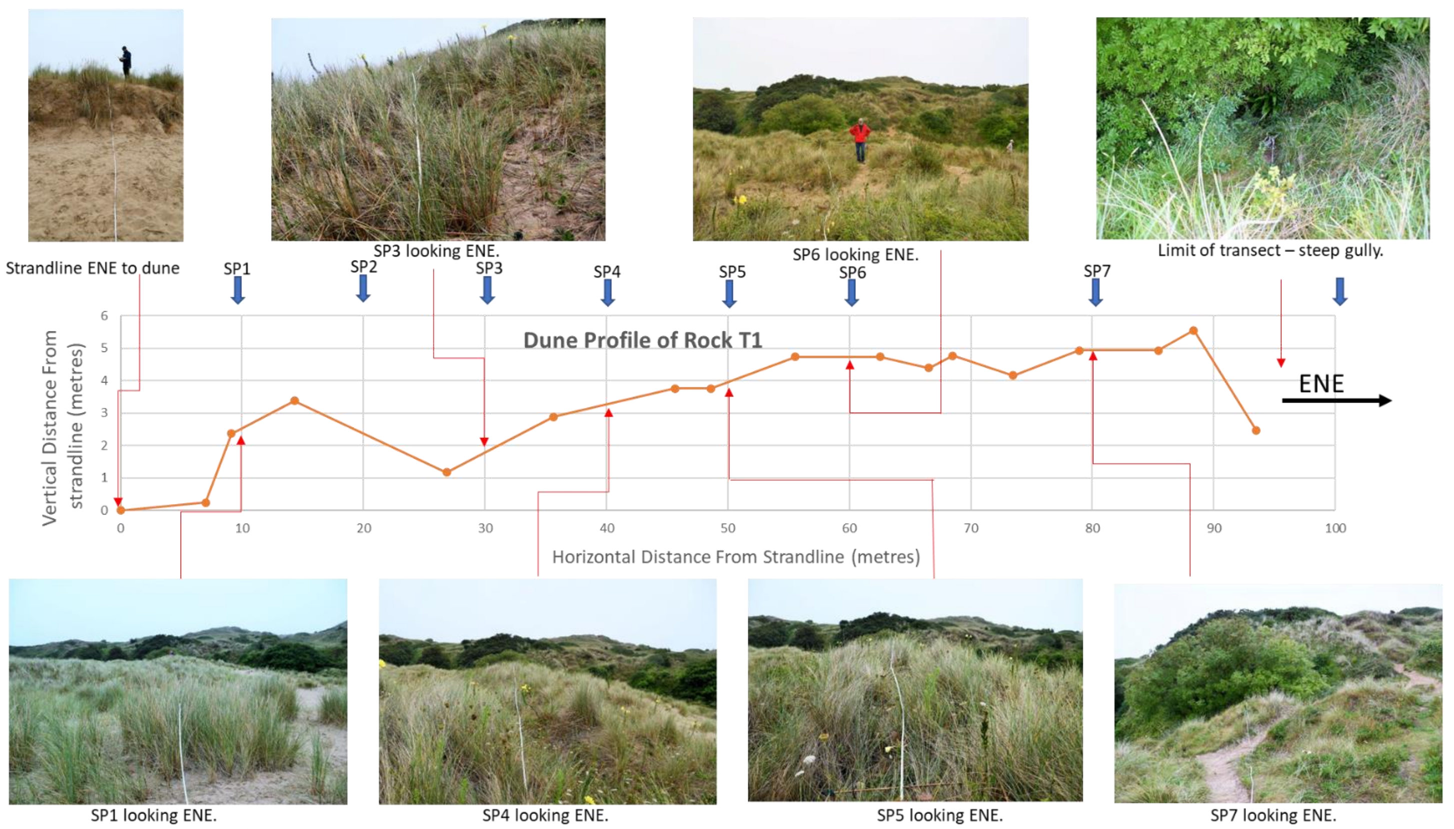


Fig. 32: RK Dune Profile T1

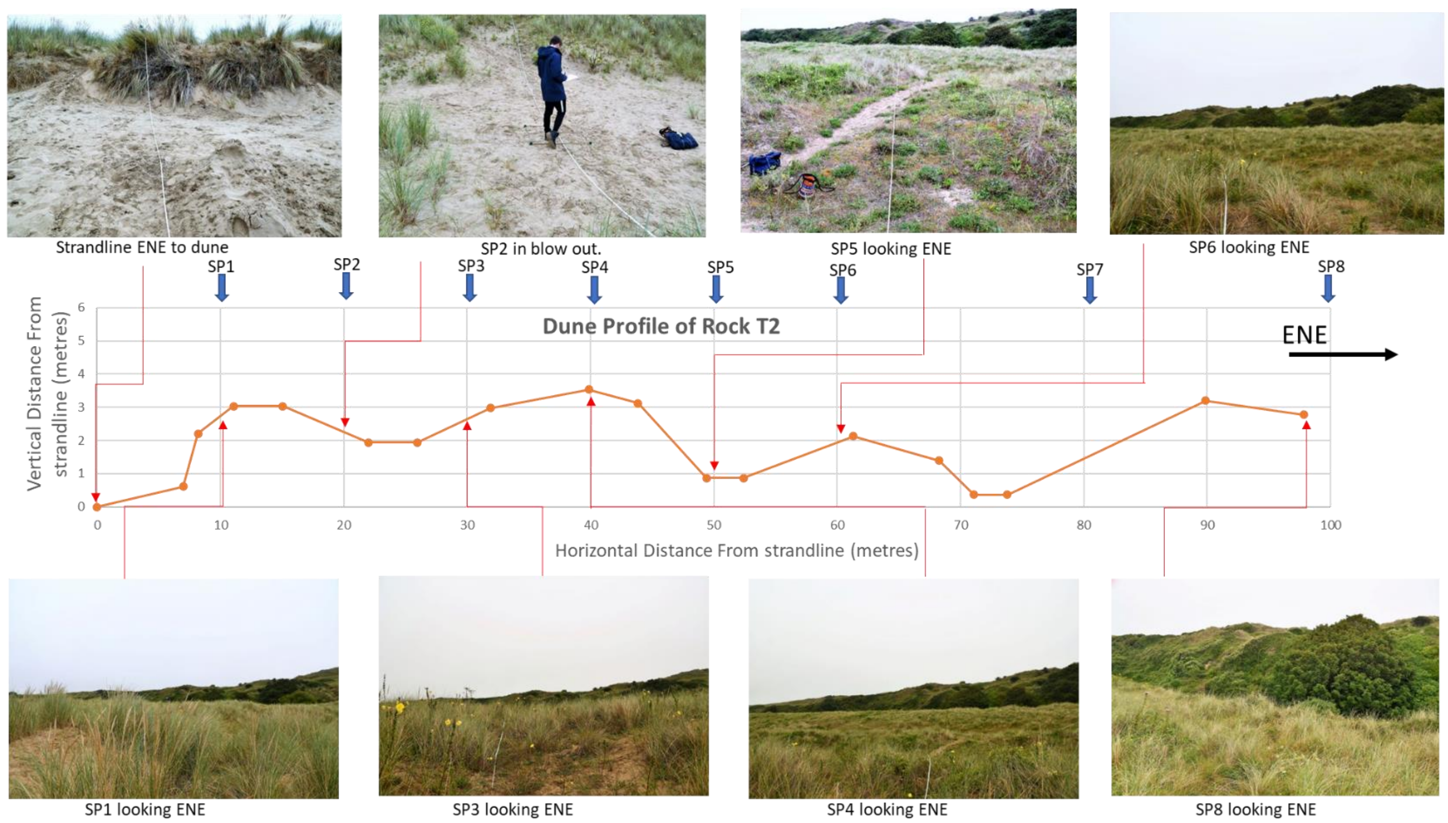


Fig. 33: RK Dune Profile T2

RK Vegetation survey:

A total of 24 species were identified, the highest level of diversity of the 3 survey sites. 10 species were recorded in T1 and 22 inT2 with 7 common to both transects (Appendix I).

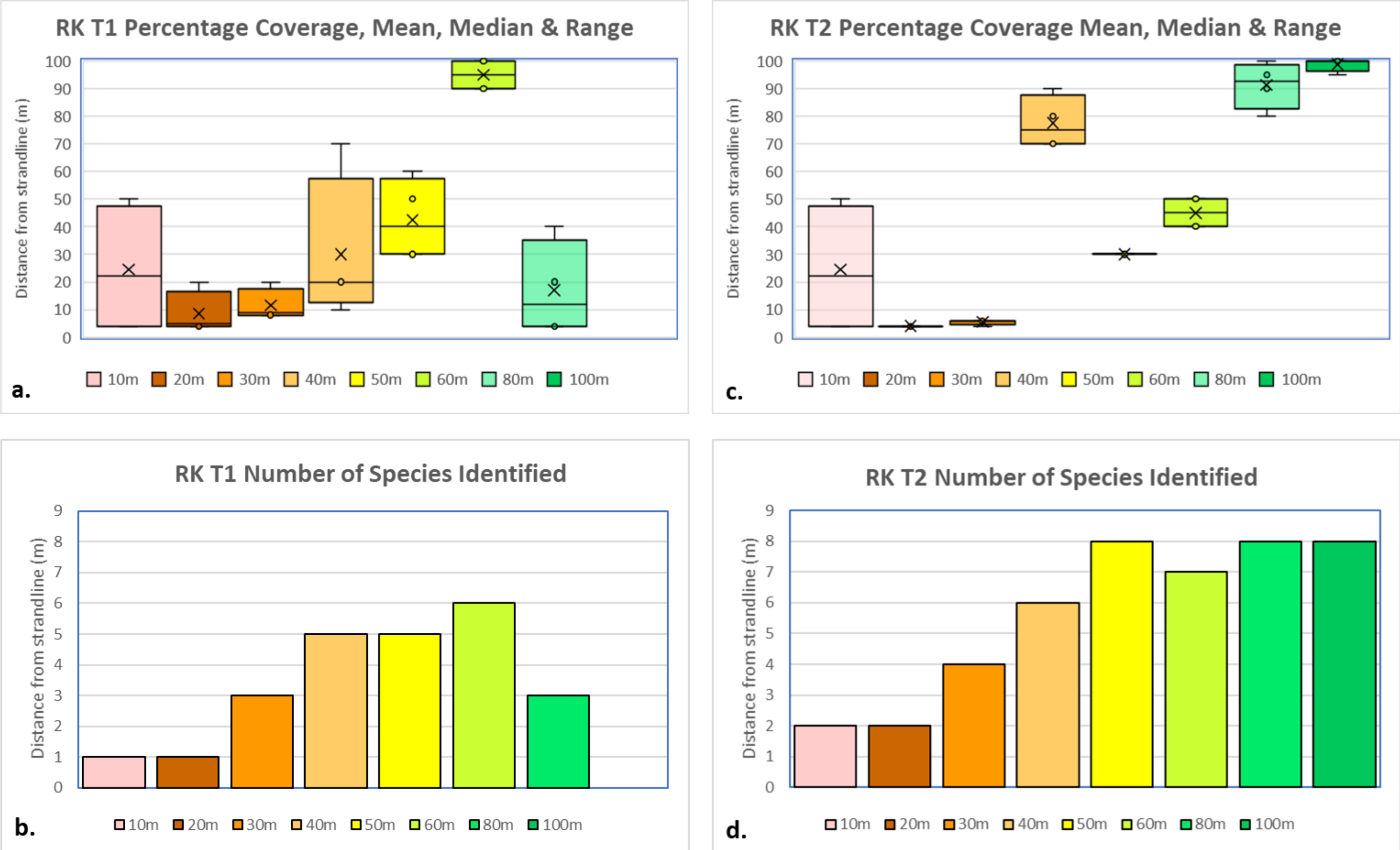


Fig. 34: RK vegetation survey results

For T1 and T2 overall, species diversity and cover increased with distance from the strandline (Fig.34). T1 diversity and coverage deceased at 80m, which did not fit the trend, but this explained by the 80m sample point falling on a track (Fig.32 SP7), supporting Hypothesis 1, human activity has a significant negative impact on vegetation cover. No sample was taken for T1 at 100m as the transect entered a densely vegetated gully with a rocky outcrop on the farthest side (Fig.32 – Limit of transect).

RK was the only site where species diversity increased with distance from the strand line along both transects. According to Purvis et.al (2015)" foredune areas have lower species richness, while areas in the back dune have greater species richness", as confirmed by their data. Calvao et.al. (2013) explain this trend is due to "beach zonation" where "sand dune ecosystems consist of a succession of shore-parallel bands." "The high beach being a highly selective environment" results in lower diversity, while further inland where "the substrate is more fixed", and "the influence of salt and wind less" more species can colonise.

Compared to the other sites, at RK vegetation began closer to the strandline, present from 10m (Fig 32&33 SP1). Variations in coverage across the transects may be explained by small blowouts (exposed sand) or paths, but unlike the other 2 sites the erosion did not lead to large areas of bare sand.

Fig. 35:

NVC Vegetation Habitat Code: Code (% match)								
RK Transect	**10m**	**20m**	**30m**	**40m**	**50m**	**60m**	**80m**	**100m**
T1	SD6d (71.43)	SD6d (71.43)	SD6d (45.45)	SD6d (35.71)	SD6d (32.26)	SD6g (48.78)	SD6g(70.04)	
T2	SD6g (79.10)	SD6d (59.17)	SD6a (66.01)	SD6d (33.33)	SD6d (38.89)	SD6d(31.25)	SD6g (42.25)	SD7c (52.98)
Combined T!&T2	SD6g (71.86))	SD6d (75.47)	SD6a (54.61)	SD6d (32.26)	SD6d (40.00)	SD6a (37.63)	SD6g (53.19)	

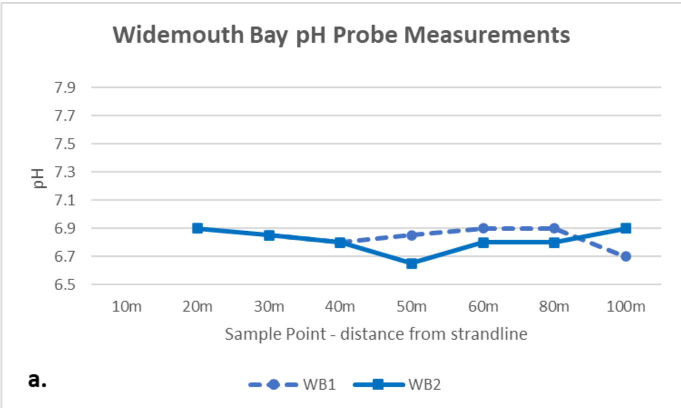
The NVC Habitat codes for the populations identified were again sub-populations of habitat SD6 up to 80m, representing mobile or **yellow dune** communities. However, T2 100m community matched SD7c *Ammophilia arenaria-Fescu rubra* semi fixed or **grey dune** community, showing a progression in the psammosere not seen at the other 2 sites. This evidence supports Hypothesis 2; at RK data suggest much lower levels of human impact and with less the interruption, succession of psammosere **has** occurred.

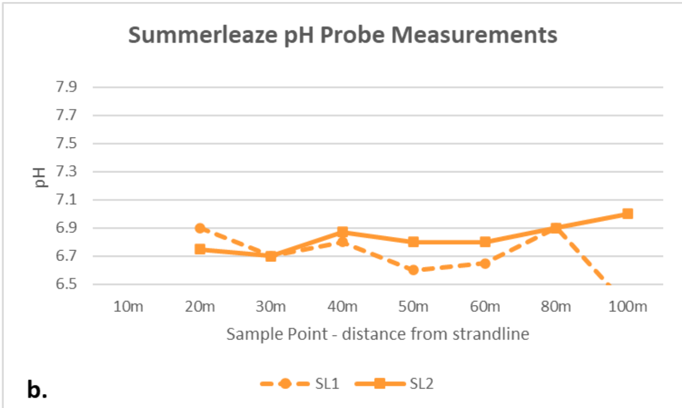
<u>Common Observations:</u>

SD2 (**strandline**) and the SD4 (embryonic **shifting** dune) communities were not found on any transects at any site. Calvao et.al (2013) report that “embryonic shifting dunes are particularly vulnerable to trampling by beach users” due to their location on the high beach.

Where a low percentage match with the SD code occurs, this is usually because *Ammophilia arenaria,* the main colonising plant is present at a low frequency or because non-typical plants were found – these are highlighted in Appendix I.

<u>Results: Soil Measurements</u>:





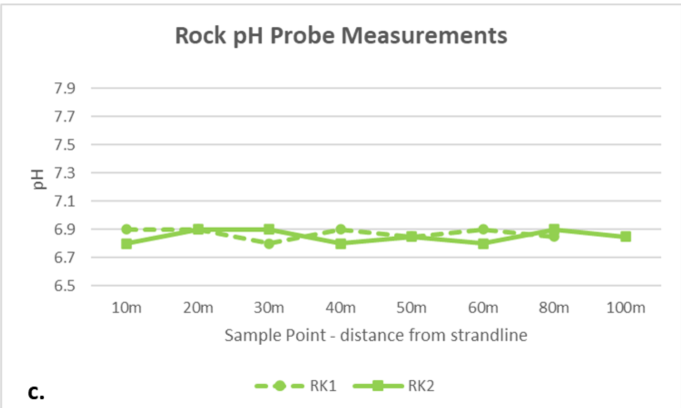


Fig. 36: pH Probe Measurements

A pH gradient across a dune system is usually pH8.5 – 4.5 with succcession from embryo dune to mature dune (Fig. 1). Soil acidity generally increases moving inland across dune ecosystems. Yellow dune have a neutral or alkaline soil, grey dunes are moderately acidic, while mature dunes have a highly acid soil (Isherman, 2005).

pH measurement across all transects (Fig. 36) fell withing a range of 0.5 units showing small variation and were slightly basic to neutral as might be expected for yellow dune. The SL T2 probe results may show an increase in pH of 0.3 units between 20 and 100m from the strand line. However, the best conclusion overall is that pH did not changed with distance from strandline. This ties in with vegetation survey which showed that other than at RK T2 100m the plant communities did not develop beyond yellow dune so little change in pH would be expected.

Soil samples showed no visual change is colour, texture, or humus content with increasing distance from the strandline other than from RK T2 100m (Fig. 37).

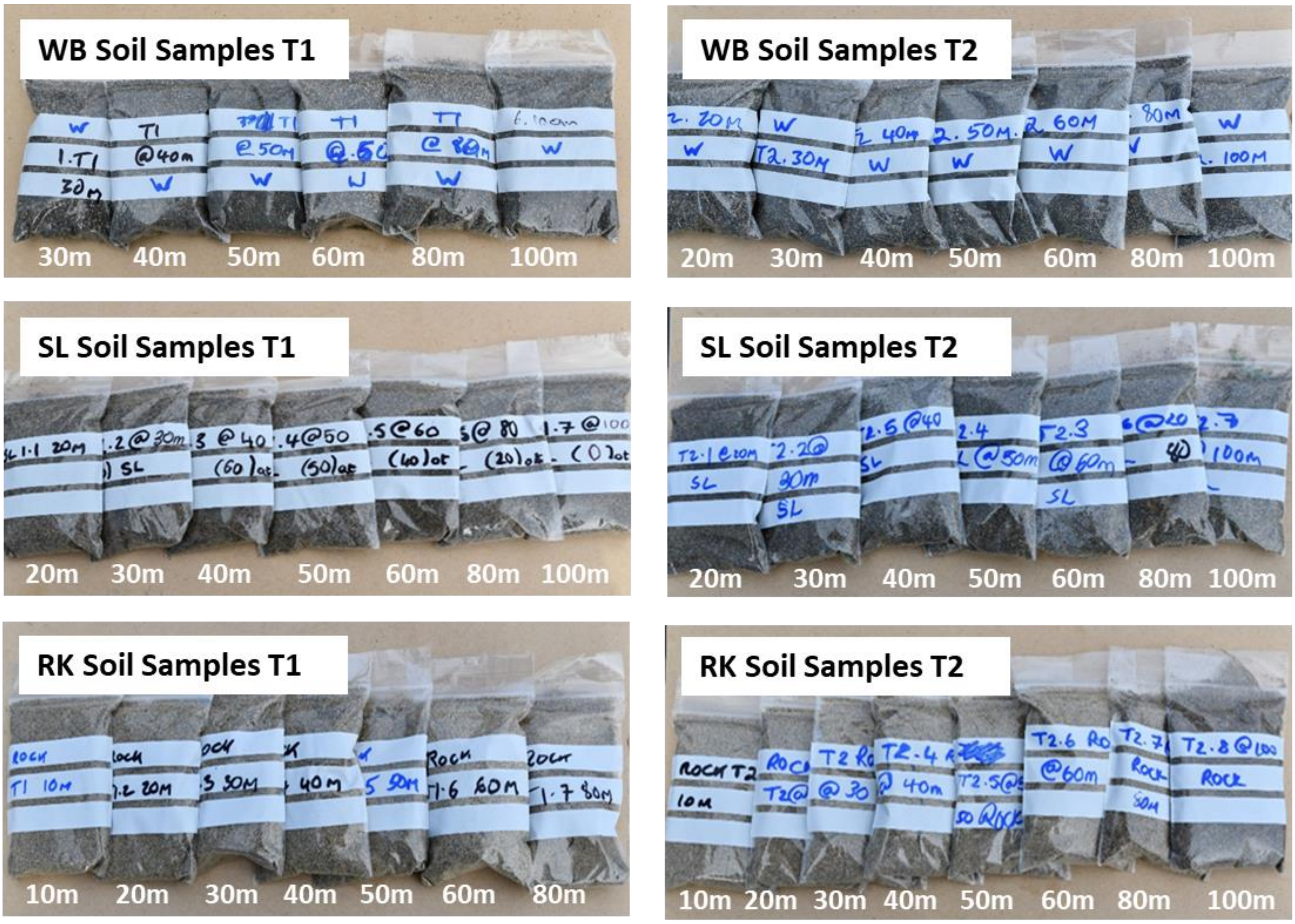


Fig. 37: Soil samples – in order of distance from strandline.

These observations tie in with the results of the vegetation survey, because other than at RK T2100m the plant communities did not develop beyond yellow dune so little change in soil composition would be expected. Where the vegetation survey detected a shift to Grey dune at RK T2100m, the soil sample was daker in colour and contained more organic matter. These observations supports Hypothesis 3, soil depth and organic matter are adversely affected by interruptions to the natural development of vegetation and succession. They indicate that soil does not develop where the succession of vegetation does not occur possibly because, "plant productivity controls the supply of organic matter to the soil" (Jones, et.al. 2008).

Results: Statistical Analysis

One of the aims of this investigation was to compare WB and SL both covered by a BDMP with the control site RK with no BDMP. Comparison of species diversity for the combined transect data (T1 and T2) from each site was analysed using the Mann-Whitney U test:

Comparison of species diversity: Null hypothesis tested – there is no difference between plant species per unit area for the 2 sites:	Value of z (z at 5% confidence = -1.644)
WB & SL	z = -0.30 (<-1.644)
WB & RK	Z = -4.71 (>-1.644)
SL & RK	Z = -5.36 (>-1.644)

The results indicate that:

Comparing WB and SL, the **null hypothesis is accepted** at 95% confidence, indicating there is no statistically significant difference between plant species per unit area for the 2 sites.

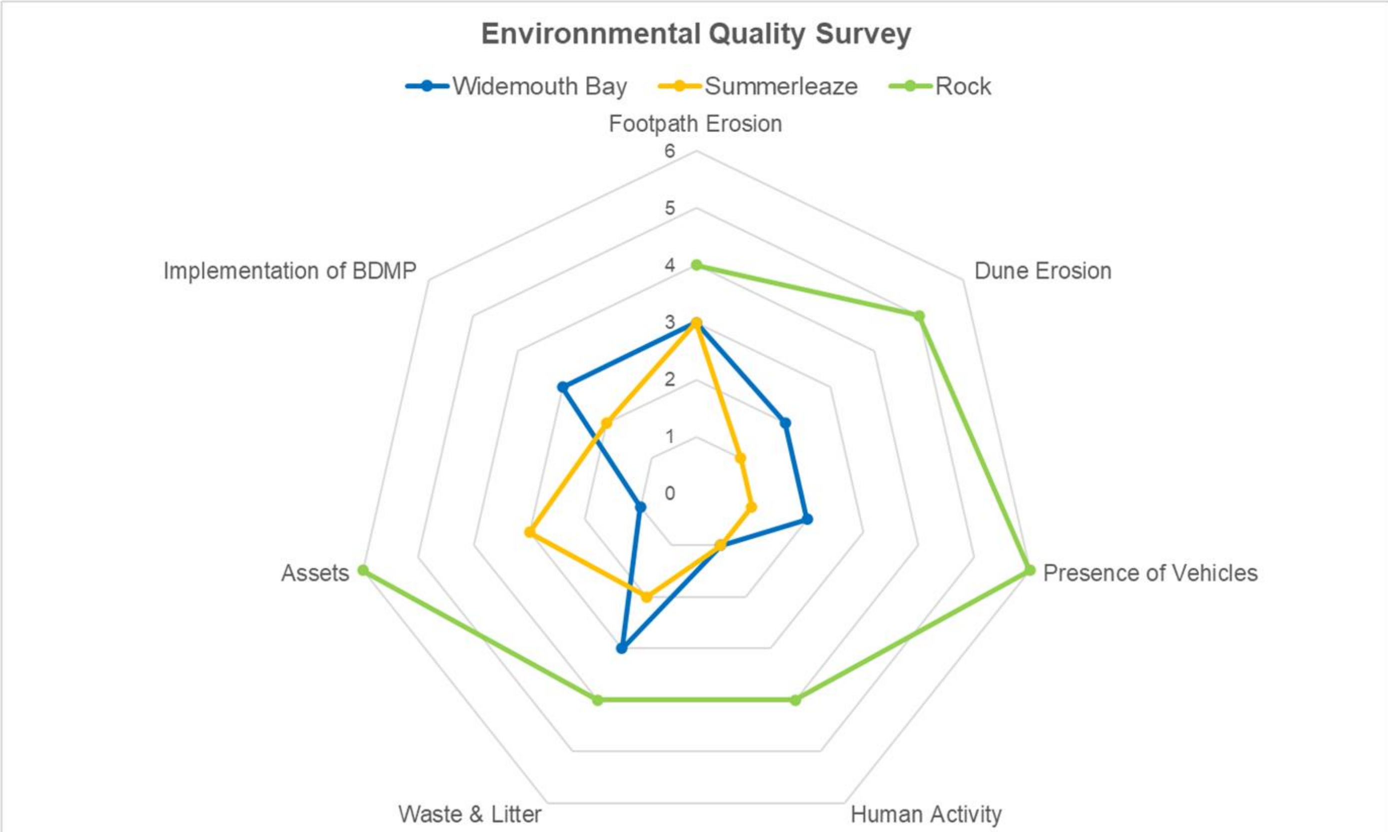
WB and SL are both covered by a BDMP (CC, 2016) aimed at managing and improving their dune systems. You might expect, with these plans in place since 2016, that the condition of the dunes would be similar with similar levels of biodiversity, which according to this test they had.

However, comparing WB and SL with the control site RK, the **null hypothesis is rejected** at 95% confidence meaning that the alternative hypothesis is accepted in these cases - there is a statistically significant difference between plant species per unit area for the sites.

You might also expect that with a BDMP in place, the dunes at WB and SL would have more biodiversity than the unmanaged dune at the control site RK. The data shows this is not the case. There is a significant difference in biodiversity between WB, SL and the control site RK with higher numbers of species (more biodiversity) at the control site.

Analysis: EQS

RK achieved a higher positive EQS evaluation than WB and SL, highlighting key differences between the locations.



Overall EQS Scores:

Widemouth Bay	15 (36%)
Summerleaze	13 (31%)
Rock	29 (81%)

The percentage scores were calculated excluding the score for "Implementation of the BDMP as Rock was not scored on this parameter.

Fig. 38: Environmental Quality Survey Results

Footpath and dune erosion were more pronounced at WB and SL (Fig. 39) compared to RK, this can be seen in the photographic evidence from the Mapping surveys and the Transects presented earlier. Visitor numbers may be linked to this, noting these sites also received lower scores for presence of vehicles and assets:

Fig39: Summerleaze – Exposed roots on an erroded dune face

- WB located 2.3 miles south of Bude is likely to attract visitors arriving by car from the surrounding area. With 1000 parking spaces (Jones, 2013) this equates to at least 4000 visitors a day in peak season (assume 4 per car) in addition to tourists staying at the local holiday village.
- SL in the holiday town of Bude, is visited by locals and tourists on foot in addition to over 1000 parking spaces (CC, 2020), probably attracting similar visitor numbers to WB.
- WB and SL are accessible throughout the tidal range which may mean the estimated peak visitor numbers are conservative, with different beach users arriving at different times of day.
- Both WB and SL have a variety of assets on location including toilets, RNLI, surf schools, shops, cafes – key assets are marked on the site maps in the Introduction (Figs 4, 5 & 6). The presence of these businesses widens the appeal of these locations encouraging more visitors, possibly over a longer season.

In comparison:

- RK beach is situated in a village on the opposite side of the Camel estuary to the much larger tourist town of Padstow. Limited car parking in the village (180 spaces) restricts numbers arriving by car. Locals and tourists from the village may arrive on foot, as was observed during the survey, and the Padstow foot ferry also brings visitors across, but it is unlikely that total daily visitor numbers at Rock are as high as the other sites.
- RK beach is also tidal so the dune area can only be reached via the beach at low tide limiting, accessibility.
- At RK the types of asset are primarily hospitality in the village, rather than linked to the beach, and a golf course.

Higher levels of erosion at WB and SL may be linked to higher footfall at the sites compared to RK boosted by large car parks and the additional facilities provided at these locations, which would support Hypothesis 1, human activity has a significant negative impact on vegetation cover in a sand dune environment.

No signage related to dune conservation was present at any of the survey sites, despite being one of the easier BDMP recommendations to implement. The serious erosion seen at WB and SL may also be linked to the types of human activity taking place:


Fig 40 Widemouth Bay - Digging a channel into exposed dune face .

- At WB and SL, the dunes were used for exercising (Bude Surf Lifesaving Club was using the steep dune face at SL for hill training), but also for sunbathing, barbeques, and excavations (sandcastle building (Fig. 40) and fire pits (Fig. 41).
- Visitors to RK dunes were involved in less destructive activities (walkers/dog walkers/runners) explaining the higher EQS score for human activity.


Fig 41: Summerleaze – Pit excavated into a section of eroded dune.

With dunes directly behind the main beach at WB and SL, the dune is potentially seen as an extension of the beach open to wider recreational uses, this is also supported may by the higher levels of litter seen at these locations.

The RK dune is 500m from the car park, majority of beach users were observed in the area behind a low cliff close to the car park rather than in front of the dune. Data from the Mapping Survey showed more cross dune paths with direct access from the beach at WB and SL compared to RK, where paths ran parallel to the dune front, which would also support this and link to Hypothesis 1, human activity has a significant negative impact on vegetation cover in a sand dune environment.

Conclusion and Evaluation:

To what extent does human activity impact on the sand dune ecosystem at Summerleaze and Widemouth Bay in Bude, Cornwall?

Aim 1: To analyse the impact of human activity on the Sand Dune ecosystems at Summerleaze and Widemouth Bay.

Hypothesis 1: **Human activity has a significant negative impact on vegetation cover in a sand dune environment.**

In this study data presented from the dune mapping and vegetation surveys indicate that human activity has had a negative impact on vegetation cover at all three survey locations however the level of impact is greater at WB and SL than at the control site of RK. The results show that areas of exposed sand on dune paths link to reduced cover of stabilising vegetation and reduced biodiversity. The removal of dune to create assets such as car parks, seen at WB and SL, also clearly impact negatively on vegetation and the study indicates that WB car park (taken out of use at least 10 years ago) is not yet showing significant regeneration.

Research by Martins et.al. (2014) found that while the high beach and yellow dune were usually under more pressure from human activity, these ecosystems could recover more quickly from disturbance because the plants were highly adapted to withstand high tides and storms and were often annual plants reliant on seeds. However, in the grey and mature dune areas, where there is more biodiversity, the ecosystems are less resilient because the plants here have "slower growing rates and longer life cycles," and so are less able to respond to disturbance. This emphasises the need to focus on the complete dune succession for conservation and shows how simply removing a car park from use will not quickly lead to recovery of the grey and mature dune.

Hypothesis 2: The primary succession (psammosere) is interrupted by the range of human influences and land uses.

The results of the vegetation survey also indicate that primary succession (psammosere) is interrupted by the range of human influences and land uses. The process of dune formation with new foredunes protecting and sheltering those behind enables the development of vegetation and stabilisation of the system.

At WB and SL succession did not develop beyond yellow dune. Rock T2 was the only site showing a typical profile of ridges and troughs and where succession occurred from yellow to grey dune (Rock T1 was inaccessible at100m). Dune profiles for the other transects with higher numbers of paths and, in the case of WB and SL, interrupted by hard engineering showed only one clear ridge or none.

Hypothesis 3: Soil depth and organic matter are adversely affected by interruptions to the natural development of vegetation and succession.

There was no evidence of soil development other than RK T2, which linked to transition from yellow to grey dune, supporting the hypothesis that soil depth and organic matter are adversely affected by interruptions to the natural development of vegetation and succession.

Aim 2: To evaluate the management and use of the Sand Dune areas in the context of observed impacts.

WB and SL achieved low scores of 36% and 31% respectively in the EQS (based on BDMP recommendations). Comparing the BDMP (CC, 2016) with the finding of this study, there is no evidence of improvement to dune erosion levels, while the recommendations made in 2016 remain relevant to address the issues highlighted here. The recommendations from the BDMP are summarised in Fig. 42. Of these, only the planting of Christmas trees at WB was observed, with limited impact in areas where the public do not continue to walk through the plantation.

Some actions are difficult to verify, but it seems unlikely that liaison with regular users such as Bude Beach Lifesaving Club had occurred, as they were observed training on the dune face.

Issue.	Recommendations from the WB and SL BDMP	Observed implementation?
Dune erosion caused by recreational pressure and trampling	• Fence off vulnerable areas and set up planned access routes. • Construct boardwalks /steps at key erosion focus points. • **Implement stabilisation techniques in key locations such as planting Christmas trees and willow fencing, where necessary matting/binding to stabilise vulnerable areas.**	**No** **No** **Widemouth Bay only**
Uncontrolled public access within the dunes resulting in dune erosion.	• Fence off vulnerable areas and set up planned access routes. • Construct boardwalks/steps at key erosion focus points. • Implement a zoning scheme discouraging visitors from vulnerable zones and providing facilities such as barbecue areas in less vulnerable zones. • Careful placement of beach huts and associated access routes to avoid damage to the dune system. • Where bare sand areas do not re-establish implement stabilisation techniques such as planting and where necessary matting/ binding to stabilise vulnerable areas. • Education of beach users so the sensitivity of the dunes is understood. • Design information boards and leaflets outlining the importance of the dunes and the vulnerability of the dune system. • Place boards and repeater signage at strategic locations throughout the site. • Employ a designated warden to patrol the site. • Liaise with regular beach users, local outdoor instructors and owners of the leisure complex to improve understanding of the dune system and encourage users to be considerate of the dune system. • A local user group to be developed to facilitate this.	No No No No No No No No Unable to find out Unable to find out

Fig 42: Data from WB and SL BDMPs (CC, 1016, Table 4.1)

The key to the lack of action may lie in the final recommendation in the BDMPs, "there is "limited funding to undertake management activities", and "if funding is not available, then there is a risk that no work will occur"?

Aim 3: To compare the effect of a coastal area covered by a BDMP with an area of Dune at Rock in the Camel Estuary with no BDMP in place.

Statistical analysis was used to compare species diversity at the three survey sites. The data indicated that species diversity was higher at RK than at either of the other two locations and the analysis showed that the difference was statistically significant. At RK vegetation cover started closer to the strand line, was less interrupted by erosion throughout the transects and RK T2 was the only place where succession occurred from yellow to grey dune. The EQS also scores RK much higher (81%) than the other two sites despite no BDMP being in place.

I had expected that sites covered by a BDMP would be in a better state of management and conservation. However, this was clearly not the case. From the EQS comparison of WB, SL and RK, it seems likely that visitor numbers linked to geographical factors such as location and proximity of assets are probably closely related to levels of human impact on sand dunes. However, without specific total visitor numbers for the sites surveyed, this view is based on assumptions about numbers of car parking spaces at each location. The location of dunes directly behind a popular beach may also affect the types of recreational pressure they experience.

It would be interesting to extend this study to examine these relationships in more detail, possibly studying human impact in relation to distance from car parking or dune erosion liked to measurement of visitor numbers and activity. This study was also carried out during peak season, potentially the time of highest stress to the dune systems, so it would be interesting to understand the impact of human activity throughout an annual cycle.

RK is also different because the back of the dune has not been excavated for car parking. The BDMPs for both WB and SL discuss sand blown onto car parks and surrounding roads which is removed to landfill due to potential contamination. Taking away the rear dunes impacts on succession and prevents formation of a stable dynamic dune. Removal of the blown sand also takes sediment out of the system which, over time will make it more vulnerable to storm impacts and increased risk of erosion leading to breaching and possible flooding (CC, 2016). The Shore Management Plan (SMP) for the study areas are shown below (Fig: 43):

Location:	SMP Policy Plan:			Comment:
	2025	2055	2105	
Rock Dunes and Daymer Bay	NAI	NAI	NAI	This approach best meets the objectives of allowing natural change and supporting nature conservation values, with little change to the position of the shoreline expected over the three epochs.
North Widemouth	MR	MR	NAI	Realignment efforts to re-establish naturally functioning dune system – provide improved natural defence and buffer zone, improve habitat status. Roll-back may require support from land use planning system.
Summerleaze	MR	MR	NAI	Objective is to reduce risks by establishing more robust natural defence and naturally responding buffer zone by Improvement of dunes and moving tourist based infrastructure and commercial development away from the erosion and flood risk zones.
NAI – No Active Intervention MR – Managed Realignment				

Fig 43: Data from SMP (Royal Haskoning CC, 2011)

From the SMP, Rock Dunes are seen as stable features, while for WB and SL, the strategy requires the re-establishment of a functioning dune system to provide improved natural defence against flooding. To make this possible the plans indicate the need to roll back assets such as car parks and possibly coastal roads in these areas.

Conclusion: To what extent does human activity impact on the sand dune ecosystem at Summerleaze and Widemouth Bay in Bude, Cornwall?

This study has demonstrated that human activities such as trampling, and land use for beach amenities have impacted on the sand dune ecosystems at SL and WB with negative effects on vegetation cover and diversity. These impacts resulted in interruptions to the psammosere so that within 100m from the strand line neither dune system developed beyond yellow dune. Visual checks on soil samples also indicated that soil development has not progressed, but a more detailed analysis of soil samples is required to confirm this. The EQS highlighted that virtually none of the recommendations from the 2016 BDMP for these sites could be seen to have been implemented. Comparison with the control site of Rock (no BDMP in place) found the unmanaged dune to be in a better state of conservation that the Bude sites, potentially due to more limited access, remoteness of assets, and lower visitor numbers. However, further study is required to confirm these relationships.

The data from this study highlights a concern that lack of action in reducing the human impact on the vegetation critical to stabilising dune systems at WB and SL may have a long-term impact on their critical role in flood defence. However, as highlighted in the introduction, the beaches and dunes are one of the area's most important tourism resources requiring a balance between restoring the dune systems and maintaining the local tourist industry.

Evaluation:

This study used maps available from Ordinance Survey, with ariel maps showing survey areas and landmarks. 10 figure grid reference with bearings were used to describe the transect lines. Together this information would make it possible for future study of the same locations.

The sampling of vegetation by interrupted belt transect was a practical way to collect data on vegetation cover and number of species over 100m and worked well to show the impact of paths and blown out areas when overlayed with dune profiling and mapping data. More frequent sampling and larger quadrat sizes would have given a more detailed description of the site, as would sampling every 10m throughout the transect. However, the results showed that, other than RKT2 100m, the dunes remained classified Yellow dune SD6, so it is unlikely that collection of extra samples would have changed the conclusions.

The use of the DOMIN scale to provide a quantitative value for cover and NVC methodology to assign habitat code at each sample point made identifying the dune type less subjective. As non-botanists there may have been some inaccuracy in plant identification. However, this is unlikely to have had an impact on the habitat codes because MAVIS looks mainly for the plants that represent each habitat code. The specialist dune plants were easier to identify than the opportunists which have less impact on the NVC code allocated.

Measurement of pH and organic matter were both made in the field. The pH probe relied on inbuilt calibration and the results fell within the range expected for yellow dune and within 0.5 pH units across all transects. As discussed, this was not an unexpected result, but in a future study confidence could be improved by checking the field probe against pH measurements from a laboratory to validate its results. Visual assessment was used to assess levels of organic matter in soil, but this could also be improved by making quantitative measurements using Loss on Ignition (LOI) which also needs a laboratory.

The basis for the EQS was the BDMP for the Bude sites providing a clear reference point for comparison. However, the scores allocated were based on a single personal judgement which could be subject to bias. If I were repeating this work, I would ask other members of the team to score the survey independently to remove this possible error.

This study takes a snapshot of the condition of the Bude dunes and might be relevant to CC in highlighting the lack of action taken since publication of the BDMP in 2016. There are lots of ways in which this piece of work could be developed, some of which have already been mentioned earlier in conclusions. It would also have been useful to find someone from CC or the local area to understand what was stopping action or whether there were any activities due to start. What came across when doing my research is that there is a lot of information available on the problems for these dune sites and plans to address them. Rather than more studies highlighting problems, it would be good to link a future study to dune improvement activities whereby showing a benefit this might encourage people to want to do more to care for these important ecosystems.

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Appendix I: Details of Plant Species Found in Dune Survey

Widemouth Bay Transect 1

Date	**04/08/2020**							What 3 words
Start Grid ref	SS1989802590	50	47	41 N	4	33	25 W	classic.agreed.nags
Finish Grid ref	SS1999802584	50	47	41 N	4	33	20 W	composers.workflow.thumb
Bearing	90 deg East (actually 92deg)							
Elevlation	Start 4m / Finish 9m							
Survey time	06:30 - 10:00							
Weather conditions	Dry, Cloudy, Visibility good, Wind SSW 15-24Km/hr							Preceeding week mainly dry, few light rain showers
Temperature	14-17°C							

Sample point												1					2				
Photo ref												DSC_2407.jpg					DSC_2419.jpg				
Distance from High Water												30m					40m				
Min /Max min veg height												0		0			0		0		
Probe PH												6.9		6.8			6.8		6.8		
Quadrat		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species		0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
Total % coverage est.		0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0	
		Coverage (DOMIN Scale) & Frequency Class (Frq)																			
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Fescue	Festuca rubra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Sedge	Carex arenaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dewberry	Rubus caesius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bramble	Rubus fruticosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Yarrow	Achillea millefolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Fleabane	Pulicaria dysenterica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Groundsel	Senecio vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perennial Sowthistle	Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribwort Plantain	Plantago lanceolate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Cinquefoil	Potentilla reptans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Restharrow	Ononis reclinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Rocket	Cakile maritama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total specied per sample point		**0**					**0**					**0**					**0**				
NVC Habitat coode (% match)																					

Sample point		3					4					5					6				
Photo ref		DSC_2432.jpg					DSC_2440.jpg					DSC_2448.jpg					DSC_2478.jpg				
Distance from High Water		50m					60m					80m					100m				
Min /Max min veg height		0		0			0.5cm		40cm			0.5cm		30cm			0.5cm		40cm		
Probe PH		6.9		6.8			6.9		6.9			6.9		6.9			6.7		6.7		
Quadrat		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species		0	0	0	0		0	2	0	1		6	5	6	5		4	4	4	3	
Total % coverage est.		0	0	0	0		0	5	0	<4		60	85	80	100		95	95	85	90	
		Coverage (DOMIN Scale) & Frequency Class (Frq)																			
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	0	0	0	0	0	0	4	0	1	III	0	0	0	0	0	0	0	0	0	0
Red Fescue	Festuca rubra	0	0	0	0	0	0	0	0	0	0	7	6	7	7	V	0	0	0	0	0
Sand Sedge	Carex arenaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	1	0	0	II	1	1	1	1	V	4	4	4	4	V
Dewberry	Rubus caesius	0	0	0	0	0	0	0	0	0	0	5	6	1	1	V	0	0	0	0	0
Bramble	Rubus fruticosus	0	0	0	0	0	0	0	0	0	0	4	7	6	7	V	9	9	8	9	V
Common Yarrow	Achillea millefolium	0	0	0	0	0	0	0	0	0	0	2	4	2	1	V	0	0	0	0	0
Common Fleabane	Pulicaria dysenterica	0	0	0	0	0	0	0	0	0	0	1	0	1	0	III	0	0	0	0	0
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	4	IV
Common Groundsel	Senecio vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	II
Perennial Sowthistle	Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	0	IV
Ribwort Plantain	Plantago lanceolate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Cinquefoil	Potentilla reptans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Restharrow	Ononis reclinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Rocket	Cakile maritama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total specied per sample point		**0**					**2**					**6**					**5**				
NVC Habitat coode (% match)							**SD6d (58.82)**					**SD6e (23.53)**					**SD6e (22.32)**				

Total species found for Widemouth transect 1	**10**	
No. Species common to Transect 1 &2	**5**	Highlighted

Numbers in red are for species not listed for the habitat code given.

Widemouth Bay Transect 2

Date	04/08/2020								What 3 Words
Start Grid ref	SS 1989302563	50	47	40 N	4	33	25	W	dude.pining.expensive
Finish Grid ref	SS1999202548	50	47	40 N	4	33	20	W	aimlessly.headrest.trickles
Bearing	91 deg East (actually 96 deg)								
Elevation	Start 4m/ Finish 9m								
Survey time	06:30 - 10:00								
Weather conditions	Dry, Cloudy, Visibility good, Wind SSW 15-24Km/hr								Preceeding week mainly dry, few light rain showers
Temperature	14-17°C								

Coverage (DOMIN Scale) & Frequency Class (Frq)

Sample point		1					2					3					4				
Photo ref		DSC_2498.jpg					DSC_2503.jpg					DSC_2515.jpg					DSC_2521.jpg				
Distance from High Water		10m					20m					30m					40m				
Min /Max min veg height							3cm		50cm			2cm		50cm			3cm		60cm		
Probe PH		6.4		6.5			6.9		6.9			6.8		6.9			6.8		6.8		
Quadrat		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species		0	0	0	0		1	1	1	1		1	1	1	1		0	2	0	1	
Total % coverage est.		0	0	0	0		20	15	10	45		10	<4	<4	<4		0	5	0	<4	
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	0	0	0	0	0	5	5	4	7	V	4	3	3	2	V	5	3	3	4	V
Red Fescue	Festuca rubra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Sedge	Carex arenaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	5	5	6	V
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dewberry	Rubus caesius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bramble	Rubus fruticosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Yarrow	Achillea millefolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Fleabane	Pulicaria dysenterica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Groundsel	Senecio vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perennial Sowthistle	Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribwort Plantain	Plantago lanceolate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	II
Creeping Cinquefoil	Potentilla reptans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small Restharrow (v. rare)	Ononis reclinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Rocket	Cakile maritama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total speced per sample point		**0**					**1**					**1**					**3**				
NVC Habitat coode (% match)							**SD6d (71.43)**					**SD6d (71.43)**					**SD6g (88.11)**				

Sample point		5					6					7					8				
Photo ref		DSC_2534.jpg					DSC_2545.jpg					DSC_2554.jpg					DSC_2567.jpg				
Distance from High Water		50m					60m					80m					100m				
Min /Max min veg height		2cm		10cm			0.5cm		10cm			0.5cm		40cm			0.5cm		30cm		
Probe PH		6.6		6.7			6.9		6.7			6.8		6.8			6.9				
Quadrat		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species		1	1	1	1		3	2	3	3		3	4	4	5		4	4	6	4	
Total % coverage est.		<4	15	15	15		10	5	10	10		80	20	100	95		80	100	60	100	
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	0	0	0	0	0	3	0	1	1	IV	7	2	7	7	V	5	3	4	5	V
Red Fescue	Festuca rubra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Sedge	Carex arenaria	3	5	5	5	V	3	2	2	3	V	0	2	2	2	IV	2	0	0	0	II
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	4	IV
Dewberry	Rubus caesius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bramble	Rubus fruticosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	II
Common Yarrow	Achillea millefolium	0	0	0	0	0	4	4	4	4	V	0	0	0	0	0	4	4	4	3	V
Common Fleabane	Pulicaria dysenterica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	1	0	1	III	0	0	0	0	0
Common Groundsel	Senecio vulgaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perennial Sowthistle	Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribwort Plantain	Plantago lanceolate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Cinquefoil	Potentilla reptans	0	0	0	0	0	0	0	0	0	0	1	0	1	1	IV	0	0	0	0	0
Small Restharrow (v. rare)	Ononis reclinata	0	0	0	0	0	0	0	0	0	0	7	5	8	7	V	8	9	6	8	V
Sea Rocket	Cakile maritama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	II
Total speced per sample point		**1**					**3**					**5**					**7**				
NVC Habitat coode (% match)		**SD6g (63.69)**					**SD6g (72.87)**					**SD6g (56.78)**					**SD6g (45.72)**				

Total species found for Widemouth transect 2	10	Numbers in red are for species not listed for the habitat code given.
No. Species common to Transect 1 &2	5	Highlighted

Summerleaze Transect 1

Date	**07/08/2020**									What 3 Words
Start Grid ref	SS 20461 06464	50	49	47	N	4	33	3	W	mixer.towel.blinking
Finish Grid ref	SS2055106506	50	49	49	N	4	32	58	W	magnum.ventures.limits
Bearing	63 deg East North East									
Elelvation	Start 2m / Finish 7m									
Survey time	06:00 - 07:30									
Weather conditions	Dry, Partially cloudy, Visibility good, Wind SSW 18Km/hr.									Preceeding week mainly dry, few light rain showers
Temperature	16°C									

Sample point							1					2					3				
Photo ref							DSC_3041.jpg					DSC_3056.jpg					DSC_3073.jpg				
Distance from Strand line		10m					20m					30m					40m				
Min /Max min veg height																	5cm		10cm		
Probe PH							6.9		6.9			6.6		6.8			6.8		6.8		
Quadrat							1	2	3	4		1	2	3	4		1	2	3	4	
Total species		0	0	0	0		0	0	0	0		0	0	0	0		3	4	3	3	
Total % coverage est.		0	0	0	0		0	0	0	0		0	0	0	0		10	10	5	5	
		Coverage (DOMIN Scale) & Frequency Class (Frq)																			
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	2	1	V
Red Fescue	Festuca rubra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Sedge	Carex arenaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cotton Grass	Eriophorum angustifolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	1	1	V
Bramble	Rubus fruticosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Yarrow	Achillea millefolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perennial Sowthistle	Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	II
Ribwort Plantain	Plantago lanceolate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Spurge	Euphorbia paralias	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesser Hawkbit	Leontodon saxatilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bristly Oxtongue	Picris echiodes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Holly	Eryngium maritimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	IV
Sea Bindweed	Calystegia soldanella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bird Vetch	Vicia cracca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dandelion	Taraxacum spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Bird's-foot Trefoil	Lotus corniculatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Colt's-foot	Tussilago farfara	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total specied per sample point		**0**					**0**					**0**					**4**				
NVC Habitat coode (% match)																	**SD6d (46.33)**				

Sample point	4					5					6					7				
Photo ref	DSC_3104.jpg					DSC_3126.jpg					DSC_3155.jpg					DSC_3174.jpg				
Distance from Strand line	50m					60m					80m					100m				
Min /Max min veg height						5cm		40cm			10cm		30cm			3cm		40cm		
Probe PH	6.6		6.6			6.7		6.6			7.0		6.8			6.6		6.1		
Quadrat	1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species	0	0	0	0		1	0	1	0		3	1	2	2	2	1	2	0	0	
Total % coverage est.	0	0	0	0		<4%	0	<4%	0		50	10	50	10		20	10	<4	0	
	Coverage (DOMIN Scale) & Frequency Class (Frq)																			
Common name	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	0	0	0	0	0	2	0	4	0	0	2	4	0	4	IV	5	4	0	0	III
Red Fescue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Sedge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	III
Cotton Grass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field bind weed	0	0	0	0	0	0	0	0	0	0	1	0	1	1	IV	0	0	0	0	0
Bramble	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Yarrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Thistle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perennial Sowthistle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribwort Plantain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Spurge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesser Hawkbit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bristly Oxtongue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Holly	0	0	0	0	0	0	0	0	0	0	0	0	7	0	II	0	0	0	0	0
Sea Bindweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bird Vetch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dandelion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Bird's-foot Trefoil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Colt's-foot	0	0	0	0	0	0	0	0	0	0	7	0	0	0	II	0	0	0	0	0
Total specied per sample point	**0**					**1**					**4**					**2**				
NVC Habitat coode (% match)						**SD6d (71.43)**					**SD6d (45.66)**					**SD6e (25.48)**				

Total species found for Summerlease transect 1	6		Numbers in red are for species not listed for the habitat code given.
No. Species common to Transect 1 &2	3	Highlighted	

Summerleaze Transect 2

Date	**06/08/2020**									What 3 Words
Start Grid ref	SS 20496 06421	50	49	46	N	4	33	1	W	burglars.potential.cleans
Finish Grid ref	SS 2057506482	50	49	48	N	4	32	57	W	savings.farmer.cashiers
Bearing	50 deg North East									
Elelvation	Start 2m / Finish 7m									
Survey time	18:00 - 19:15									
Weather conditions	Dry, Cloudy, Visibility good, Wind S 21Km/hr					Preceeding week mainly dry, few light rain showers				
	18°C									

Sample point							1					2					3					4					5					6					7				
Photo ref							DSC_2860.jpg					DSC_2882.jpg					DSC_2896.jpg					DSC_2921.jpg					DSC_2934.jpg					DSC_2974.jpg					DSC_2990.jpg				
Distance from Strand line							20m					30m					40m					50m					60m					80m					100m				
Min /Max min veg height							10cm		40cm			3cm		15cm			0.5cm		60cm			10cm		30cm			5cm		15cm			30cm		60cm			2cm		60cm		
Probe pH							6.7		6.8			6.6		6.8			6.6		6.8			6.8		6.8			6.8		6.8			6.8		7.0			7.0		7.0		
Quadrat							1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species							2	3	2	1		1	0	0	0		2	3	3	3		1	1	0	1		1	1	1	1		4	2	3	3		7	5	5	7	
Total % coverage est.							15	10	20	<4		<4	0	0	0		40	95	40	90		6	<4	0	<4		10	70	60	60		80	100	30	40		95	100	85	100	
		Coverage (DOMIN Scale) & Frequency Class (Frq)																																							
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	0	0	0	0	0	5	2	5	2	V	1	0	0	0	II	5	10	5	9	V	4	1	0	1	IV	0	0	0	0	0	9	10	6	7	V	2	5	4	5	V
Red Fescue	Festuca rubra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	5	5	V
Sand Sedge	Carex arenaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cotton Grass	Eriophorum angustifolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bramble	Rubus fruticosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	II
Common Yarrow	Achillea millefolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	4	5	V
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	III	0	0	0	0	0
Perennial Sowthistle	Sonchus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	4	1	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribwort Plantain	Plantago lanceolate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	5	5	1	V
Sea Spurge	Euphorbia paralias	0	0	0	0	0	1	4	1	0	IV	0	0	0	0	0	0	0	0	1	II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesser Hawkbit	Leontodon saxatilis	0	0	0	0	0	0	1	0	0	II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	II
Bristly Oxtongue	Picris echiodes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Holly	Eryngium maritimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	8	8	8	V	0	0	4	0	II	0	0	0	0	0
Sea Bindweed	Calystegia soldanella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	IV	0	0	0	1	II
Bird Vetch	Vicia cracca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	III	0	0	0	0	0
Dandelion	Taraxacum spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	II
Common Bird's-foot Trefoil	Lotus corniculatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	7	5	7	V
Colt's-foot	Tussilago farfara	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total specied per sample point		**0**					**3**					**1**					**5**					**1**					**1**					**5**					**9**				
NVC Habitat coode (% match)							**SD6d (57.42)**					**SD6d (71.43)**					**SD6d (46.33)**					**SD6d (71.43)**					**SD6d (13.14)**					**SD6d (55.75)**					**SD6g (43.72)**				

Total species found for Summerlease transect 2	**16**	Numbers in red are for species not listed for the habitat code given.
No. Species common to Transect 1 &2	**3**	Highlighted

Rock Transect 1

Date	**08/08/2020**			What 3 Words
Start Grid ref	SW 92658 76269	50 32 58 N	4 55 41 W	multiply.fastening.brotherly
Finish Grid ref	SW9273976298	50 32 59 N	4 55 37 W	overlaps.teaches.reeling
Bearing	68 deg East North East			
Elevation	Start 2m / Finish 22m			
Survey time	06:30 - 07:40			
Weather conditions	Dry, Cloudy, Visibility good, Wind NW 12Km/hr	Preceeding week mainly dry, few light rain showers		
Temperature	16-18°C			

Sample point		1					2					3					4					5					6					7					8				
Photo ref		DSC_3920.jpg					DSC_3934.jpg					DSC_3948.jpg					DSC_3969.jpg					DSC_3992.jpg					DSC_4011.jpg					DSC_4029.jpg					DSC_2990.jpg				
Distance from Strand line		10m					20m					30m					40m					50m					60m					80m					100m				
Min /Max min veg height		10cm		50cm			10cm		60cm			0.5cm		60cm			0.5cm		50cm			0.5cm		60cm			5cm		70cm			1cm		15cm							
Probe PH		6.9		6.9			6.9		6.9			6.8		6.8			6.9		6.9			6.8		6.9			6.8		7.0			6.8		6.9							
Soil sample pH		8.5					8.0					7.5					7.5					7.5					7.0					8.5									
% Moisture		10%		10%			21%		21%			28%		21%			19%		20%			20%		18%			19%		12%			27%		19%							
Quadrat		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species		1	1	1	1		1	1	1	1		2	2	2	3		4	3	2	4		4	5	4	4		3	2	4	4		3	3	3	2						
Total % coverage est.		<4	<4	<4	<4		6	20	<4	<4		20	10	8	8		10	70	20	20		30	50	60	30		100	100	90	90		20	<4	40	<4						
		Coverage (DOMIN Scale) & Frequency Class Frq																																							
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	2	2	3	2	V	4	5	2	2	V	4	4	2	2	V	1	8	2	2	V	5	7	3	3	V	8	9	9	9	V	2	2	0	2	IV	0	0	0	0	0
Red Fescue	Festuca rubra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Sedge	Carex arenaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	II	5	3	3	2	V	0	0	0	0	0
Sand crouch	Elytrigia juncea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smooth meadow Grass	Poa pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Fleabane	Conyza canadensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	II	0	0	0	0	0	0	0	0	0	0
Common Ragwort	Senacio Jacobaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smooth sowthistle	Sonchus oleraceus	0	0	0	0	0	0	0	0	0	0	4	2	2	2	V	4	2	5	1	V	1	2	4	3	V	2	0	2	1	IV	2	1	1	0	IV	0	0	0	0	0
Lesser Hawkbit	Leontodon saxatilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bristly Oxtongue*	Picris echiodes*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Holly	Eryngium maritimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Bindweed	Calystegia soldanella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bird Vetch	Vicia cracca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kidney Vetch	Anthyllis vulneraria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Bird's-foot Trefoil	Lotus corniculatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Lettuce	Lactuca virosa	0	0	0	0	0	0	0	0	0	0	0	0	1	1	III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Evening Primrose	Oenothera biennis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	III	0	1	0	0	II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large-flowered Evening Primrose	Oenothera glazioviana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Valerian	Centranthus ruber	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	III	5	1	7	5	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wild Carrots	Daucus carota carota	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	V	0	0	2	0	II	0	0	0	0	0	0	0	0	0	0
Old Man's Beard	Clematis vitalba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5	0	1	IV	0	0	0	0	0	0	0	0	0	0
Spotted Cat's-ear	Hypochaeris Maculate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moss		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total specied per sample point		**1**					**1**					**3**					**5**					**5**					**6**					**3**									
NVC Habitat coode (% match)		**SD6d (71.43)**					**SD6d (71.43)**					**SD6d (45.45)**					**SD6d (35.71)**					**SD6d (32.26)**					**SD6g (48.78)**					**SD6g (70.04)**									

Total species found for Rock transect 2	10		
No. Species common to Transect 1 &2	7	Highlighted	

Numbers in red are for species not listed for the habitat code given.

Names in red are considered Alien species

* Picris echiodes is classified as an Archaeophyte - a non-native species introduced in ancient times

Rock Transect 2

Date	**08/08/2020**			What 3 Words
Start Grid ref	SW9265376280	50 32 58 N	4 55 42 W	barstool.breed.unique
Finish Grid ref	SW9274476322	50 32 59 N	4 55 37 W	whisker.sleepy.decoder
Bearing	63 deg East North East			
Elevation	Start 2m / Finish 22m			
Survey time	08:15-09:30			
Weather conditions	Dry, Cloudy, Visibility good, Wind NW 12Km/hr Preceeding week mainly dry, few light rain showers			
Temperature	16-18°C			

Sample point		1					2					3					4				
Photo ref		DSC_4054.jpg					DSC_4070.jpg					DSC_4085.jpg					DSC_4100.jpg				
Distance from Strand line		10m					20m					30m					40m				
Min /Max min veg height		5cm		60cm			1cm		10cm			1cm		30cm			5cm		60cm		
Probe PH		6.8		6.8			6.9		6.9			6.9		6.9			6.8		6.8		
Quadrat		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species		1	2	1	1		1	1	1	2		3	3	2	4		3	3	4	5	
Total % coverage est.		50	40	<4	<4		<4	<4	<4	<4		<4	6	6	6		90	70	70	80	
		Coverage (DOMIN Scale) & Frequency Class																			
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	7	7	1	2	V	1	0	1	1	IV	2	2	1	2	V	9	8	7	9	V
Red Fescue	Festuca rubra	0	0	0	0	0	0	1	0	1	III	0	0	0	0	0	0	0	0	0	0
Sand Sedge	Carex arenaria	0	2	0	0	0	0	0	0	0	0	0	0	0	1	II	0	0	0	0	0
Sand crouch	Elytrigia juncea	0	0	0	0	0	0	0	0	0	0	2	3	0	1	IV	0	0	0	0	0
Smooth meadow Grass	Poa pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canadian Fleabane	Conyza canadensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	IV
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Ragwort	Senacio Jacobaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smooth sowthistle	Sonchus oleraceus	0	0	0	0	0	0	0	0	0	0	2	3	4	4	V	1	2	5	3	V
Lesser Hawkbit	Leontodon saxatilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bristly Oxtongue*	Picris echiodes*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Holly	Eryngium maritimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Bindweed	Calystegia soldanella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bird Vetch	Vicia cracca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	II
Kidney Vetch	Anthyllis vulneraria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Bird's-foot Trefoil	Lotus corniculatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Lettuce	Lactuca virosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	III
Common Evening Primrose	Oenothera biennis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large-flowered Evening Primrose	Oenothera glazioviana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Valerian	Centranthus ruber	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wild Carrots	Daucus carota carota	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	II
Old Man's Beard	Clematis vitalba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Cat's-ear	Hypochaeris Maculate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moss		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total specied per sample point		**2**					**2**					**4**					**6**				
NVC Habitat coode (% match)		**SD6g (79.10)**					**SD6d (59.17)**					**SD6a (66.01)**					**SD6d (33.33)**				

Sample point		5					6					7					8				
Photo ref		DSC_4125.jpg					DSC_4144.jpg					DSC_4164.jpg					DSC_4183.jpg				
Distance from Strand line		50m					60m					80m					100m				
Min /Max min veg height		0.5cm		40cm			0.5cm		40cm			0.5cm		50cm			0.5cm		60cm		
Probe PH		6.8		6.9			6.8		6.8			6.9		6.9			6.9		6.8		
Quadrat		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Total species		6	6	6	5		5	6	6	4		6	6	5	6		5	4	7	5	
Total % coverage est.		30	30	30	30		50	40	40	50		80	90	100	95		100	100	95	100	
		Coverage (DOMIN Scale) & Frequency Class																			
Common name	**Latin name**	% Cover				Frq	% Cover				Frq	% Cover				Frq	% Cover				Frq
Marram Grass	Ammophilia areniaria	2	4	4	4	V	5	3	3	2	V	1	2	0	2	IV	4	2	1	2	V
Red Fescue	Festuca rubra	0	0	0	0	0	0	0	0	0	0	7	9	10	10	V	10	10	10	10	V
Sand Sedge	Carex arenaria	0	2	0	0	II	0	0	0	0	0	3	0	2	2	IV	2	2	2	0	IV
Sand crouch	Elytrigia juncea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smooth meadow Grass	Poa pratensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	III
Field bind weed	Convolvulus arvensis	0	0	0	0	0	0	0	0	0	0	0	0	2	2	III	0	0	0	0	0
Canadian Fleabane	Conyza canadensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creeping Thistle	Cirsium arvense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Ragwort	Senacio Jacobaea	1	2	1	0	IV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smooth sowthistle	Sonchus oleraceus	1	2	0	0	III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesser Hawkbit	Leontodon saxatilis	0	0	0	0	0	0	4	2	2	IV	0	0	0	0	0	1	0	0	0	II
Bristly Oxtongue*	Picris echiodes*	0	0	0	0	0	0	0	0	0	0	4	2	2	2	V	0	0	0	0	0
Sea Holly	Eryngium maritimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea Bindweed	Calystegia soldanella	0	0	0	0	0	0	0	0	0	0	4	1	0	0	III	0	0	2	0	II
Bird Vetch	Vicia cracca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kidney Vetch	Anthyllis vulneraria	0	0	0	0	0	5	5	5	5	V	0	0	0	0	0	0	0	0	0	0
Common Bird's-foot Trefoil	Lotus corniculatus	0	0	0	0	0	0	0	0	0	0	2	2	2	2	V	0	0	1	1	III
Great Lettuce	Lactuca virosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Evening Primrose	Oenothera biennis	0	0	0	0	0	0	4	4	6	IV	0	0	0	0	0	0	0	0	0	0
Large-flowered Evening Primrose	Oenothera glazioviana	1	0	1	1	IV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Valerian	Centranthus ruber	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wild Carrots	Daucus carota carota	0	2	1	1	IV	1	0	0	0	II	0	1	0	0	0	0	0	0	0	0
Old Man's Beard	Clematis vitalba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	4	2	V
Spotted Cat's-ear	Hypochaeris Maculate	4	4	4	4	V	4	2	4	0	IV	0	0	0	0	0	0	0	0	0	0
Moss		3	0	3	4	IV	2	3	3	0	IV	0	0	0	0	0	0	0	0	0	0
Total specied per sample point		**8**					**7**					**8**					**8**				
NVC Habitat coode (% match)		**SD6d (38.89)**					**SD6d (31.25)**					**SD6g (42.25)**					**SD7c (52.98)**				

Numbers in red are for species not listed for the habitat code given.

Total species found for Rock transect 2	**22**	
No. Species common to Transect 1 &2	**7**	Highlighted

Names in red are considered Alien species

* Picris echiodes is classified as an Archaeophyte - a non-native species introduced in ancient times