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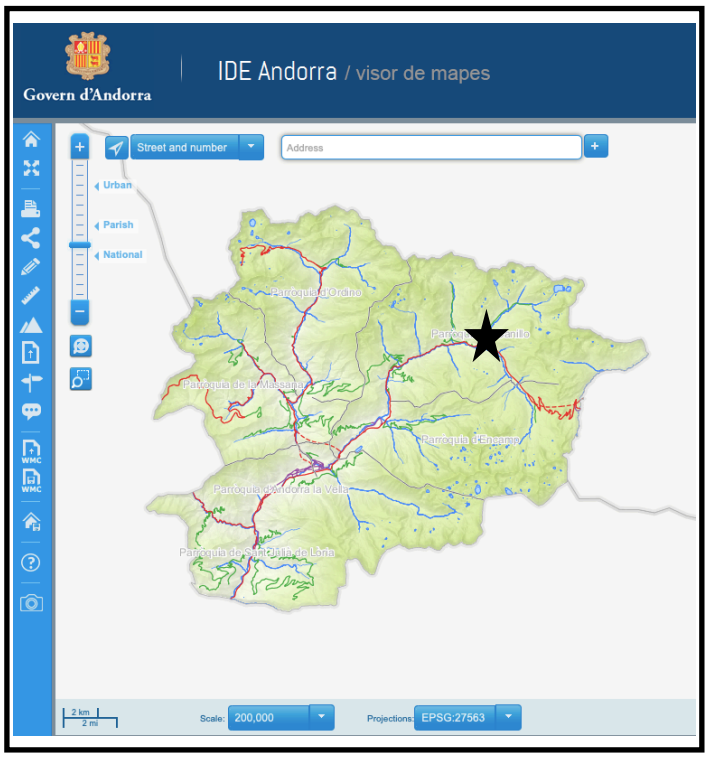
Residential field studies for GCSE and A Level Geography and Geology in the UK, Andorra and Spain.

VIRTUAL FIELDWORK ACTIVITY SEVEN

Studying the impact of the ski industry on the fragile ecology of alpine meadows in Andorra.

**Location and background.**

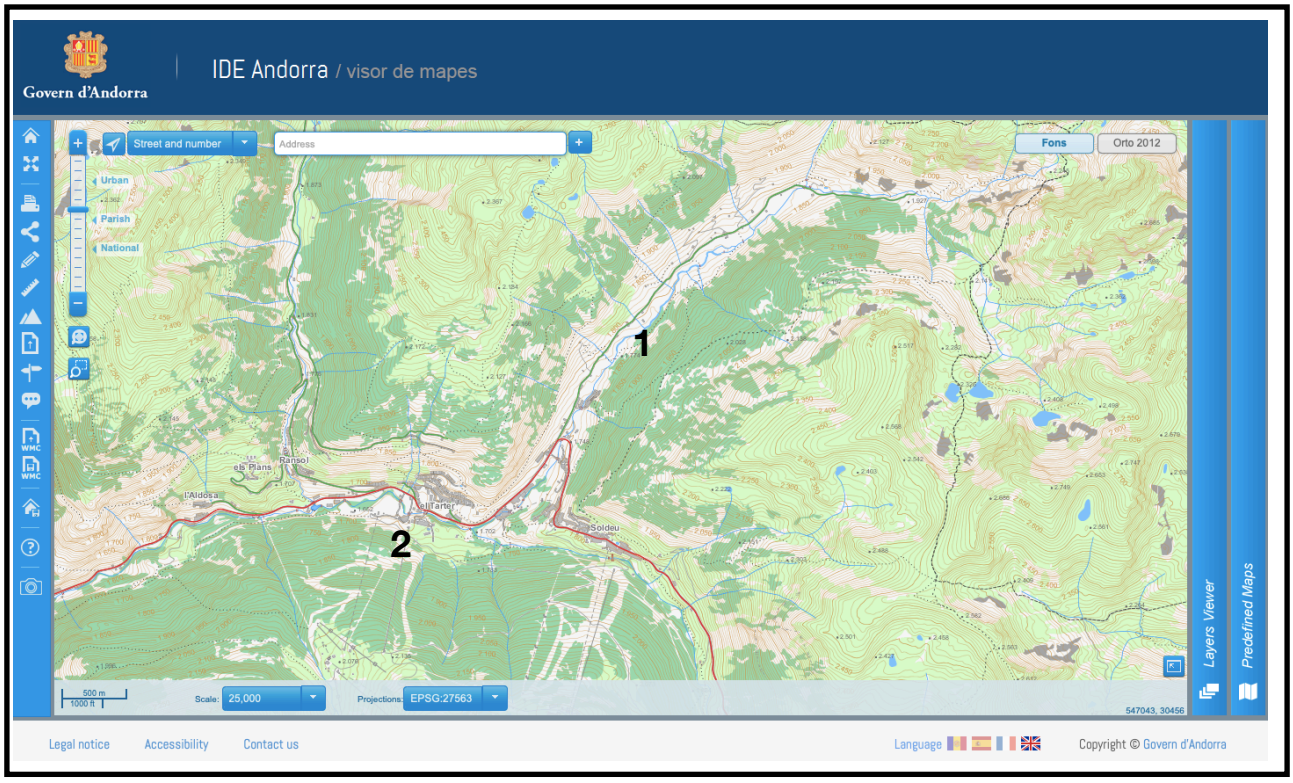



Andorra is a tiny principality sandwiched between France and Spain in the Pyrenees Mountain range.

Andorra is the sixth smallest nation in Europe with an area of 470 km2 and a population of just over 77,000, of which nearly 80% live in the capital city of Andorra La Vella. It has the highest life expectancy in the world at 81 years.

The country has a limited amount of agricultural land and this has traditionally been used for pasture and fodder crops. The country has very little industry but the lack of customs duties and low taxes has meant that is has long been an important trading centre.

Tourism started to develop in the 1960's and is now the main source of income from nearly 11 million visitors a year. Many of these visitors come for winter sports.




www.ideandorra.ad/geoportal/index.jsp?lang=en

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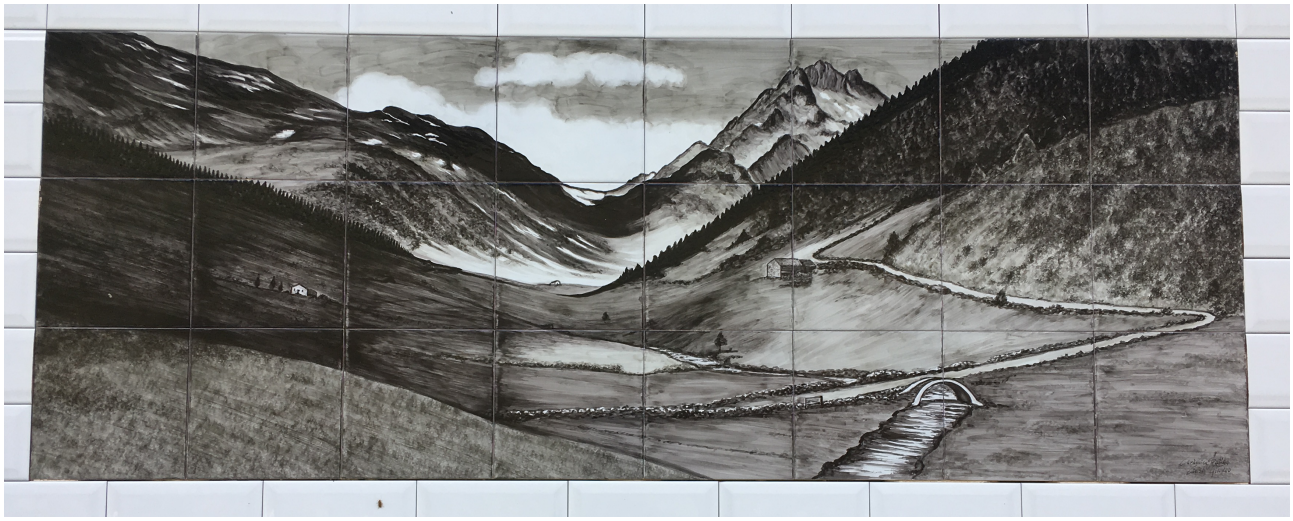
Our aim is to compare the diversity of flora and infiltration rates of the soil in two places of similar altitude and underlying geology.

Site one - this sample point is a traditionally managed hay meadow alongside the rivers in the Valle De Incles.

Site two - this sample point is at the bottom of a major ski run in the resort of El Tarter. This would have once been a hay meadow similar to site one.

## Andorra ecology study sites

| Site number | Latitude | Longitude | Description |
|---|---|---|---|
| One | 42.5907 | 1.6696 | Hay meadow |
| Two | 42.5771 | 1.6497 | Ski run |



An artists impression of the Valle De Incles in the early 20th Century.

Traditional hay making in the Valle De Incles 1920's

The Valle De Incles today.

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Ski runs and a golf course near El Tarter and Soldeu, 2019

Fieldwork

We did two investigations at each site. One was a study of the diversity of the flora and the second a study of infiltration rates. We used a random sampling strategy at each site by setting out a series of 10m by 10m grids and using randomly generated numbers to locate sampling points within the grids.

Diversity

We used a 0.25m2 quadrat divided into 25 and recorded
a) the total number of different plant species within each quadrat and
b) the total number of squares out of 25, that each species was observed in.
We didn't need to identify the plant species as we were simply studying the diversity although we did notice that the species on the ski run were different to those in the hay meadow, flatter and with thicker leaves and stems.

Infiltration

We used a small section of plastic drainpipe (an infiltration tube) with one end sharpened. This was hammered into the soil to a depth of 3 cms and a spirit level was used to ensure it was upright. A ruler was placed inside the tube and water poured into the tube to the top. A stopwatch was used to time how long it took for the water level to drop by 2 cms.

These experiments were repeated 5 times in each of the two field sites.

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Field data / species diversity and infiltration rates

| **SIte one** | Quadrat 1 | Quadrat 2 | Quadrat 3 | Quadrat 4 | Quadrat 5 |
|---|---|---|---|---|---|
| Species a | 16 | 11 | 10 | 17 | 14 |
| Species b | 13 | 17 | 0 | 3 | 8 |
| Species c | 11 | 7 | 1 | 0 | 0 |
| Species d | 0 | 16 | 15 | 3 | 8 |
| Species e | 4 | 1 | 7 | 0 | 7 |
| Species f | 0 | 0 | 3 | 8 | 4 |
| | | | | | |
| Time for 2 cms of water to infiltrate into the soil (secs) | 33 | 87 | 21 | 38 | 42 |
| | | | | | |
| **SIte two** | Quadrat 1 | Quadrat 2 | Quadrat 3 | Quadrat 4 | Quadrat 5 |
| Species a | 22 | 19 | 25 | 16 | 22 |
| Species b | 18 | 13 | 6 | 17 | 12 |
| Species c | 2 | 5 | 21 | 6 | 0 |
| Species d | 0 | 3 | 7 | 0 | 0 |
| | | | | | |
| Time for 2 cms of water to infiltrate into the soil (secs) | 67 | 125 | 59 | 102 | 93 |

Data presentation and statistical analysis.

Infiltration

Consider the best way to present the infiltration data for both sites such that an easy visual comparison can be made.

Do the results match your expectations? Why?

Diversity

We will use Simpsons Index of Diversity to analyse the data of diversity of the flora.

This is an excellent introduction to the various ways of calculating the Simpsons Index.

http://www.countrysideinfo.co.uk/simpsons.htm

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A worked example of the Simpsons Index of Diversity for quadant 1 site one.

$$D = \frac{\Sigma\, n(n-1)}{N(N-1)}$$

| **SIte one** | n | n - 1 | n ( n-1 ) |
|---|---|---|---|
| Species a | 16 | 15 | 16 x 15 = 240 |
| Species b | 13 | 12 | 13 x 12 = 156 |
| Species c | 11 | 10 | 11 x 10 = 110 |
| Species d | 0 | 0 | 0 x 0 = 0 |
| Species e | 4 | 3 | 4 x 3 = 12 |
| Species f | 0 | 0 | 0 x 0 = 0 |
| N | 44 | | |
| N - 1 | 43 | **Total of n ( n - 1 )** | 240 + 156 + 110 + 12 = **518** |
| **N ( N - 1 )** | 44 x 43 = **1892** | | |

Simpsons Index of Diversity = 1 - (518 / 1892)
= 1 - 0.27
**= 0.73**

The value of Simpsons Index of Diversity ranges from 0 (NO diversity) to 1 (infinite diversity).

The result of 0.73 indicates a high level of diversity.

Is this what one would expect in a traditionally managed hay meadow?

Calculate the results for the other quadrats in the hay meadow and then do the same for the five sets of data from the ski run.

How do the results compare?

Is this what one would have expected?

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Conclusion and evaluation.

What does this small study tell us about the impact of the ski industry on the ecology and soils in Andorra?

How significant an impact is this? How does this impact compare to the economic importance of the ski industry here? Is there any way in which the impact could be minimised whilst still allowing the ski industry to develop and operate?

The capital city of Andorra La Vella has a major river running through it and this river has extremely high discharge levels during the snow melt season. What can our results tell us about parts of the water cycle within the catchment of this river?

How could you extend this field study? How accurate was the method for measuring infiltration? Should we have identified the plant species - would this have enhanced our understanding of the impact?