Ecosystems and Environments Under Threat

(A2 Geography for OCR)

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Teacher's Notes

This full day study will introduce students to the nature and study of ecosystems around the Eagles Nest field centre on Mont Lozere, their main components and how they change over time and as a result of human activity. It considers what factors give environments or ecosystems their unique characteristics and how physical and human factors interact to create them. This study then considers how human impact threatens ecosystems through exploitation, by considering a case study of the impact of skiing on Mont Lozere, and how sustainable management can work in a National Park.

This day provides an excellent opportunity to develop some of the geographical skills which may be tested in A2 unit F764 (data response and extended writing).

Key Specification Areas

- What are the main components of ecosystems and environments and how do they change over time?
- What factors give the chosen ecosystem or environment its unique characteristics?
- In what ways are physical environments under threat from human activity?
- Why does the impact of human activity on the physical environment vary over time and location?
- How can physical environments be managed to ensure sustainability?

Bibliography

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Waugh, D. (1990) 'Geography - An Integrated Approach' Nelson.

What are the main componets of ecosystems and how do they change over time?

Mont Lozere has a microclimate that swings dramatically between an alpine climate in the winter and a Mediterranean climate in the summer. Winters are typically very cold with moderate snowfall – there is a small ski-resort on the summit. Summers are hot and drought conditions are frequent. Spring and autumn are typically short seasons, with significant rainfall and often high winds. The bedrock of the area is granite, and so non-porous and impermeable. There are many peat bogs on the summit as a result of this, and many surface drainage features. Granite weathers into slowly into coarse, thin, nutrient poor (due to leaching) acidic soils, with many large boulders.

During the last glacial advance, Mont Lozere was a periglacial environment, with permanent ice and snow fields on the summit. Tors and V-shaped valleys support this interpretation. 10 000 years ago, the landscape would have been rough and rocky, with virtually no soil – washed away as the water locked up in the perma-frost melted. When the climate began to gradually warm as the glaciers retreated, the bare rocks of Mont Lozere were slowly colonised. This process of gradual change in the plant (and animal) community in an area through time is called **succession**. In this case, because the start point in the sequence has no soil present, this is **primary succession**. Secondary succession occurs when there is a basic soil present, but no vegetation (for example, after a forest fire, or on waste land or farm land which had been ploughed). When this primary succession is on bare rock, the sequence of colonisation is called a **lithosere**. On bare

sand (ie. Sand dunes) this is called a **psammosere**. On open water this is a **hydrosere**, and around the margins of estuaries the succession sequence is called a **halosere**.

The first colonists of this rocky landscape would have been **lichens**. Highly specialised mutualists, (a lichen is 10% algae and 90% fungi and some species also have associated nitrogen fixing bacteria), they are carried in fragments or as spores by the wind from lower-lying areas. They were able to colonise bare rock, and gradually broke down its surface using organic acids to acquire minerals. Lichen growth is very slow – a millimetre in several years. When the centre of the lichen colony dies, the simple organic material and minerals provided all that was needed for the next community of colonists, the **mosses**.

Mosses cannot colonise bare rock, but thrived on the material left by the dead lichens. **Grass** seeds which fell in amongst the mosses grew, adding their own organic matter the surface of the rock – slowly a poor, thin soil began to form. These early colonisers are collectively known as **pioneer** species. With wind distributed seeds and shallow roots needing little soil, these species thrive in these conditions. Later, as the soil thickened, grasses are over shadowed, literally, and out-competed by taller plants – the **biennial, perennial** and **shrub** community. Eventually, **trees** are able to colonise. Their larger seeds mean that travel from the seed reservoirs on low lying ground is slow, taking thousands of years. After perhaps four thousand years, the succession sequence was complete – Mont Lozere would have been covered with thick forests of beech, birch and pine. There would have been few trees on the exposed summits, where harsh winter weather prevented even the conifers from surviving.

This temperate deciduous forest **biome** is typical of this latitude – it represents the **climatic climax community** – the dominant vegetation type which, without human interference, dominates in an area as a result of its climate. Other climactic climax vegetation types, or biomes, include tundra, coniferous forest (taiga), temperate grassland, desert, savannah and tropical rain forest.

Human activity can have huge impacts on climatic climax communities through burning, grazing of livestock, trampling and agriculture. Mont Lozere was heavily grazed by sheep brought to the upland pastures by transhumant farmers from the coastal plains every summer, for a period of several hundred years. Approximately 300,000 sheep were said to have been grazed on the massif every summer! This heavy grazing pressure has resulted in the development of a **plagioclimax** vegetation. The climatic climax vegetation was removed by forest clearance to open up areas of the mountain for grazing, and the never ending nibbling of millions of sheep teeth prevented the trees from re-growing. The dominant vegetation on Mont Lozere is now heather moorland. However, a lower level of grazing pressure since WW2 has meant Mont Lozere is now being re-colonised by trees, and scots pine, birch and beech trees are growing again on the summit plateau.

What facots give the chosen ecosystem or environment its unique characteristics?

Characteristics of Temperate deciduous woodland:

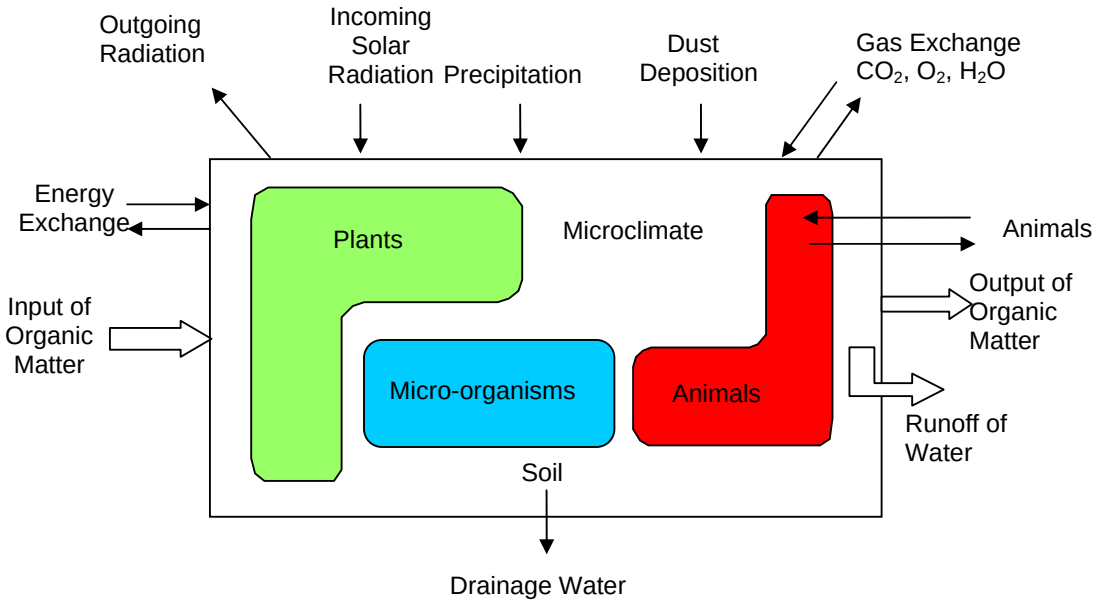
You will be taken to visit a beech woodland, which is typical of the climatic climax vegetation on Mont Lozere, around the Eagles Nest. Temperate deciduous woodland trees need plenty of sunlight, Warmth and moisture than many smaller plants. They need a long growing season for the growth and ripening of new

shoots. Annual rainfall must be at least 350mm, and low temperatures prevent roots taking up soil moisture, resulting in physiological drought – so deciduous trees loose their leaves in winter to reduce evapotranspirative water loss when ground water is frozen. This sets the upper limit of altitude for deciduous trees which is visible on Mont Lozere above about 1300m. Above this altitude, deciduous trees are replaced by conifers, which are better adapted to lower temperatures in winter and a shorter growing season.

Beech trees are better able to grow in the drier conditions experienced in the Cevennes during our relatively short but hot Mediterranean summer. However, other species of deciduous trees such as oak and ash are found at lower altitudes. This is complicated by the local geology, which on Mont Lozere is granite. Beech prefer the acidic, coarse soils produced by the weathering of granite rocks.

Beech has a very dense canopy, which enables it to out compete other species for light. It also produces a very thick layer of leaf litter every autumn, which decomposes very slowly. Much of the organic content in the soil of a beech forest is therefore locked up in this leaf litter, again making it difficult for other species to compete with beech for soil nutrients. For these reasons, beech woodland is characteristically species-poor in terms of other ground flora. Low soil temperatures in the winter slows decomposition, and trees take up fewer soil nutrients through their roots as the ground water freezes.

Diagrammatic representation of an ecosystem exchanging energy and compounds with its environment



Nutrient Cycling

The term 'nutrient cycling' refers to the circulation of minerals around an ecosystem. Nutrients are taken up by the root system of plants; these are then used and released as the plants shed organic matter such as leaves or when the plant dies. The litter which accumulates on the surface is broken down by micro-organisms and fungi, which return nutrients to the soil store to be used in the cycle again. There are three main storage areas to the cycle: - litter, soil and biomass. The relative importance and hence size of these stores and transfers depends upon the nature of the biome (figure 2):-

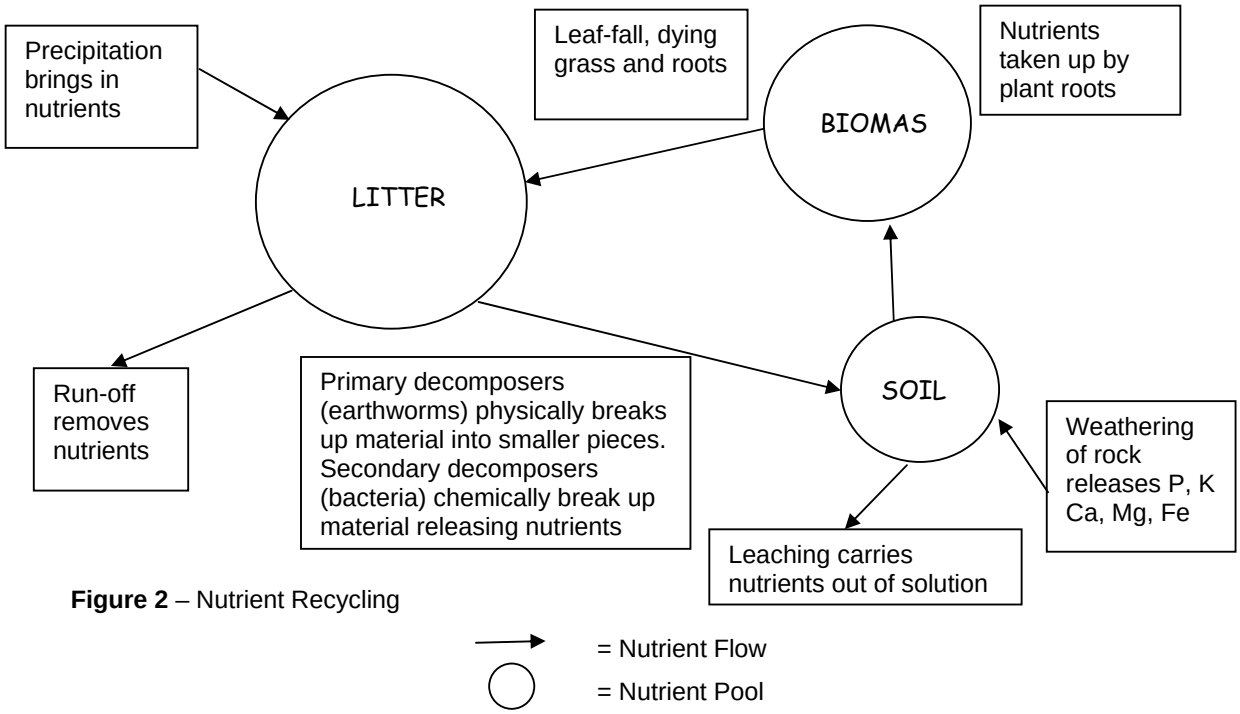
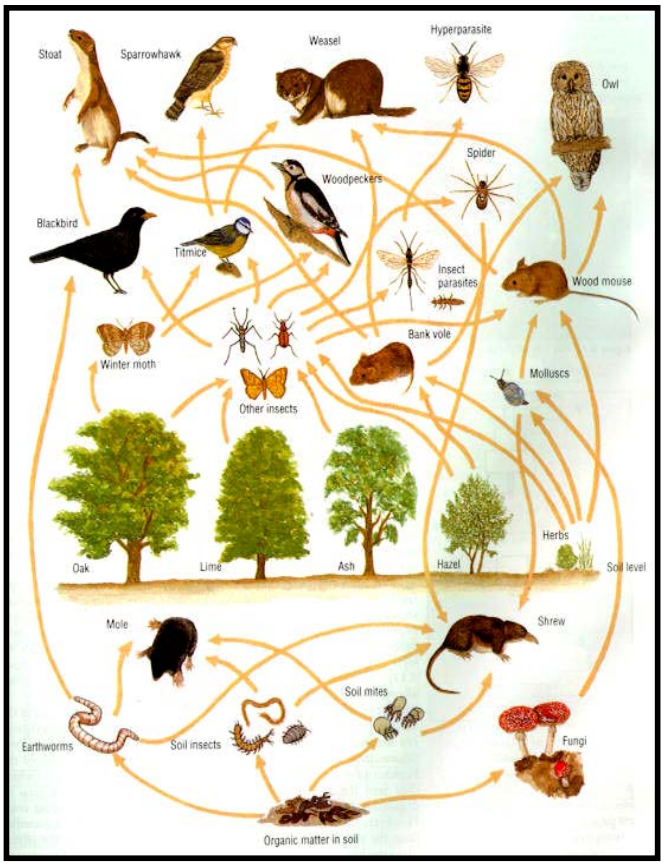


Figure 2 – Nutrient Recycling

Food chains and food webs



Temperate deciduous woodland biomes can have very large and complex **food webs**, an example of which is shown here (figure 3). **Food chains** and food webs are diagrammatic representations of **energy flow** through living systems, from producer (ie. Green plants) to consumers. Macronutrients used by organisms such as carbon, nitrogen, hydrogen and micronutrients such as sulphur, potassium, phosphates and iron are recycled back into the soil by detritivores such as earthworms and woodlice, and decomposers (bacteria and fungi). The energy found in the chemical bonds of these 'building blocks' cannot be recycled once those chemical bonds are broken during digestion, so the energy in ecosystems passes in only one direction through food webs – from producer to consumer – most of the energy (90%) being lost at each **trophic level** as heat.

Figure 3.

Physical environments under threat from human activity, and sustainable management of ecosystems in a National Park : CASE STUDY OF SKIING IN THE CEVENNES NATIONAL PARK

The study sites are in the core or peripheral zone of the Cevennes National Park (PNC). There are only five main land National Parks in France, and the PNC is the only one with a permanent resident population. A National Park is an area of exceptional landscape where it is considered in the national interest to protect and manage its ecology, cultural richness and historical characteristics.

French National Parks are divided into a core and buffer zone. The strongly protected core zone, or 'zone centrale', is protected by ministerial decree, whilst the other is a peripheral zone which includes the communes that rely on the advantages brought about by the Park for their long term development (Figure 4). In the core zone, the authority of the Park is widespread and the legislative powers far reaching. In the boundary zone, the strict regulations of the core zone do not apply and the management is geared towards the development of the buffer zone whilst protecting the core.

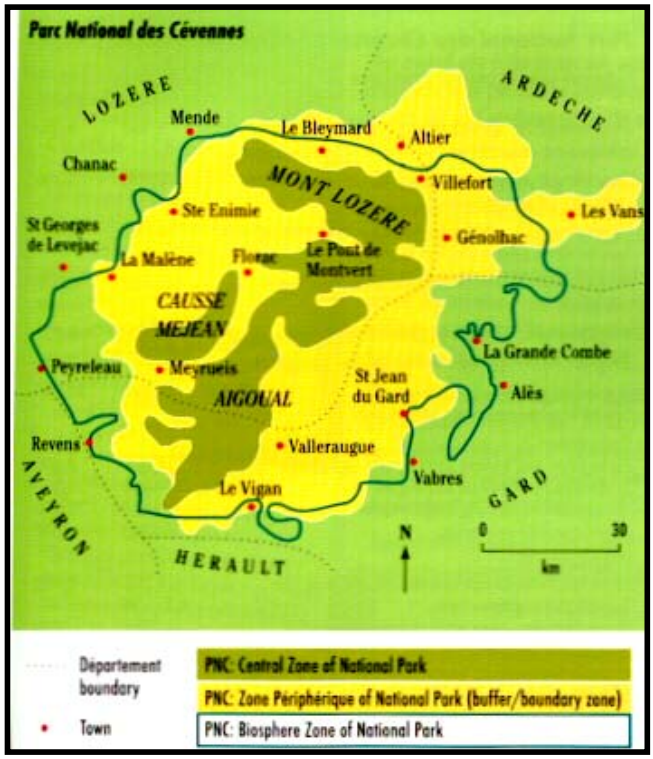


Figure 4 The Cevennes National Park, showing the core zone, buffer zone and the boundary of the UNESCO World Biosphere Reserve.

This plan of strict protection distinguishes the National Park from a Regional Park, which is only governed by a "Code of good conduct". This law is maintained by elected administrators and cannot be questioned by members of the public or other third parties. In a National Park, a public body specific to each National Park and answerable to the Ministry for the environment puts to work the principals of protection and management established for this natural and cultural entity. It is managed by a director and his team, an administrative council made up of representatives of the local population, state administrators, and other qualified personnel.

There are seven National Parks in France. Only five of these are on the mainland (Guadeloupe National Park is on Guadeloup, in the French Caribbean and Port Cros is a small island in the Mediterranean). The five mainland Parks are in mountainous areas, being the Vanoise, Pyrenees, Cevennes, Ecrins and Mercantour:

Park	Year Opened	Central zone (Ha)	Peripheral zone (Ha)	Total area (Ha)
Vanoise	1963	53,000	145,000	198,000
Pyrenees	1967	475,000	206,000	253,500
Cevennes	1970	91,416	237,000	328,416

Ecrins	1973	91,800	178,600	270,400
Mercantour	1979	68,500	145,400	231,900

Many of the National Parks are twinned with other National Parks around the world, facilitating exchange of information, data, research and staff. The PNC is twinned with the Monseny Biosphere Reserve in Spain and the Saguenay Biosphere Reserve in Quebec, Canada.

At the end of the nineteenth century in France, there was a growing awareness of a need to protect the great landscapes of the Cevennes and the Causses. It led to the original idea behind the creation of the National Park, which was suggested as early as 1913 by E. A. Martel (of Aven Armand cave fame) and the 'Club Cevenole'. It was not until 1955 that the idea resurfaced, following a large rural exodus that was threatening the character of the region. In order to restore the nature of the landscape that had been so deeply altered by man, the General Council of Lozere, the State Administration, and other influential local people united their efforts to secure the creation of a National Park.

The new law in the 1960's on National Parks and the designation of the Cévennes as a National Park on 2nd September, 1970 created a new concept in National Parks. The protection of nature no longer consisted of 'putting it under a big cover', but in managing its richness by involving all local partners (farmers, craftsmen, foresters, officials, hunters…). As in all other National Parks any artificial alterations that would threaten its character were prevented.

The National Parks are required to submit a seven-year management plan in which the aims and objectives of the council are laid out. The management of the PNC is the responsibility of the Director du Parc, his Deputy and team. This team contains a scientific committee and a council of experts with special commissions: Agriculture and forest, Architecture and sites, Cynegetics, Water and fishing, Tourism and information, Culture and education. There are 70 permanent staff, including wardens, administration personnel, and an additional 20 staff are taken on seasonally. The separate management strategy for the buffer zone also has to be approved by an inter-disciplinary committee from the three Departements that have land within the Park. The committee has a membership of over 70 people and is formed from a variety of ministerial sources.

Cevennes National Park - Statistics.

- Total area 3,210 km^2. Core zone area 91,279 Ha (81% in Lozere, 19% in Gard) touching on 52 communes, where 117 hamlets contain the permanent population;
- The core zone contains land owned by the PNC (3%), sectionnaux (7%), domaniaux (30%) and privately (60%);
- 33,232 Ha open moorland and grassland 58,047 Ha forest in the core zone;
- Buffer zone area 229,726 Ha (54% in Lozere, 36% in Gad and 10% in Ardeche), touching 117 communes, about 4,000 hamlets and 41,000 inhabitants;
- Altitude ranges from 378m (Sainte-Croix-Vallee-Francaise) to 1,699m (Mont Lozere), on average it is 1,200m in the core zone and 650m in the buffer zone.

Landforms, geology and climate:

- The PNC is made up of 5 geographical regions, defined by the underlying rock-type:
- The Causses, a limestone plateau to the south east of Mont Lozere, divided by large river gorges, making up the Causse Mejan, Causse Sauveterre, Causse Noir and Causse Larzac – the average altitude of this area is 1000m. It is primarily used to raise the local sheep, the Raiole, for meat and milk;
- Mont Lozere, a granite massif rising to 1,699m. Used to raise the local cattle, the Aubrac, for meat, and as a major transhumance destination for sheep from the southern plains;
- Montagne du Bouges, a granite and schist massif to the south of Mont Lozere, rising to 1,421m. Used to raise sheep and cattle, and for timber production;
- Vallees du Gardons, a series of valleys cut into schist to the south of Mont Lozere. Used to raise Caprin goats, and sheep and for the production of chestnuts and honey;
- Mont Aigoul and Lingas, a granite and schist massif in the far south of the PNC, rising to 1,565m. Used for timber production (pine, spruce, beech, fir) and some transhumance in the past.
- There are ten major rivers, 3 enter the Mediterranean (the Ceze, Gardons and Herault) and the rest enter the Atlantic (Lot, Tarn, Minente, Tarnon, Dourbie, Trevezel, Jonte);
- The climate has three influences, oceanic, Mediterranean and continental. On Mont Lozere, winters are cold, bright and dry (90 days of frost/year), whilst summers are hot and dry. The main rainfall comes in the spring and autumn, which can also be very windy, influenced by the proximity of the mistral winds in the Rhone valley.

Aims

- To investigate the structure and nature of a temperate deciduous woodland ecosystem as the normal climatic climax vegetation on Mont Lozere, and to investigate the impact of human activity on ecosystems by studying a heather moorland plagioclimax ecosystem.
- To explore how human activity, biodiversity and sustainability are inter-related;
- To study the management of fragile environments, and how conservation and exploitation of ecosystems can co-exist.

Equipment:

Map and compass
Clinometer
2 ranging poles
Soil pH test kit and trowel
Infiltration can, mallet and water
Soil thermometer
Soil skewer
Soil auger and spade
Soil texture chart
Tape measure
50cm x 50cm gridded frame quadrat
Meter ruler
Plant identification charts
Random numbers table
Alcohol air thermometer
Whirling hygrometer and conversion chart
Hand-held anemometer
Light meter (environmental comparitor)
Recording sheets
Lux meters
Digital camera

Sites:

1) Temperate deciduous woodland KEY SPECIES – beech, rowan, silver birch.

These are beech woods with very ground layer due to the dense leaf canopy characteristic of the species. Most beech woods in the area were planted and have been managed in the past for fuel wood. The trees were often coppiced for firewood and the mature trees used for furniture. The woods also provide shelter for cattle during the harsher spring and autumn months. The beechnuts were of importance as part of the locals' staple diet (usually ground into flour) and to animals such as pigs, let loose into the woods to forage.

The site is quite a large wood on a steep, boulder-strewn slope. Many of the trees appear to be of a similar age, implying planting at some point – however, there are many mature specimens in the wood. Cattle still roam freely in the wood at certain times of year. The bedrock is granite.

2) Heather moorland KEY SPECIES – common heather, bilberry, cowberry, matt and fescue grasses.

The heather moorland ecosystem is adjacent to a peat bog site, making a contrast between the two very convenient. On either side of the peat bog hollow, the ground is raised up and produces a well-drained heathland community. The site is at 1530m, and very exposed. Winters are extreme and there may be snow cover for four months. Summers are hot and dry. In previous years, there has been intense grazing pressure over the whole of the Mont Lozere massif. Transhumant farmers from as far afield as Ales and Langogne brought their sheep and cattle onto Mont Lozere to graze during the summer months, to escape the heat of the plains. Deforestation of the uplands to generate pastures, followed by intense grazing pressure created a plagioclimax ecosystem, where succession has been stopped from taking it's normal course.

Method and organisation of study:

(1) ABIOTIC FACTORS AFFECTING THE ECOSYSTEM:

Microclimate investigation:

The vegetation in an ecosystem will modify and be modified by microclimate. Standardisation between groups is essential as data will be shared. At each site, set up the microclimate equipment as follows:

- ✓ Drive a ranging pole into the ground and attach an alcohol air thermometer using an elastic band, at 1.50m above the ground. Turn the thermometer out of direct sunlight;
- ✓ Put a soil thermometer in the ground to a depth of 5cm.

After five minutes equilibration time, at 15 minute intervals, record the microclimate at the station. Groups should take these readings at the same time. Read the air and soil temperatures. Measure light using the light environmental comparitor – held facing and at the same level as the air thermometer. Measure wind speed (m/s), air temperature (^{o}C) and wind chill (^{o}C) using the wind watch, held facing into the wind. Measure air humidity using a whirling hygrometer. Record all these factors clearly on recording sheet 1.

Gradient / relief investigation:

Place students 10m apart and use ranging poles (or students of the same height) to line up clinometer. Take reading (sample every 10 m if desired and take average). The angle of slope affects drainage and soil depth. Steeper slopes increase the rate of through flow and surface runoff leading to an increased likelihood of

mass movement and soil erosion. Soils on steep ground tend to be thin and relatively dry. Record the gradient of the site on recording sheet 1.

Aspect and altitude investigation:

Using a compass or a map, each group of students should establish the aspect of the site. South-facing slopes tend to be comparatively more productive than north facing slopes due to higher temperature and more direct incident radiation. Establish the altitude by finding the nearest spot height or contour marker on the map to the study site. Record the aspect and altitude of the site on recording sheet 1.

Soil investigation:

Using an auger, each group should extract a soil sample from the A-horizon at a representative site in the ecosystem, and establish soil pH and soil texture. They should measure the thickness of the organic horizon and the total soil depth. Infiltration rate can be used as an indirect measure of soil moisture. Hammer an infiltration can into the soil to a depth of 5cm. Fill the can to the top with water and record how far the water level drops every minute for a five-minute period. Record all these factors on recording sheet 1.

(2) STUDYING THE PLANT COMMUNITY

(USEFUL NOTES ON VEGETATION SAMPLING FOR FIELDWORK INVESTIGATIONS!)

Qualitative techniques:

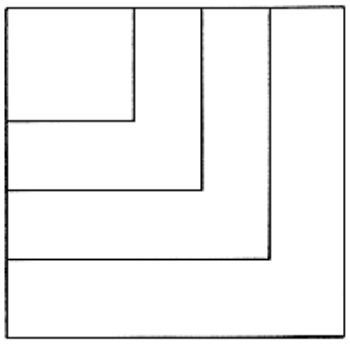
The simplest method of vegetation sampling involves recording presence or absence of a species at the site (usually done by a 'walk about' for a set time limit, e.g. 5 minutes). This technique is used by English Nature when assessing sites, and is called a ‘Phase One’ survey. This main disadvantage of this technique is that it gives no idea of the abundance of different species, only the species composition of a site.

Quantitative techniques:

Quantitative sampling involves the use of quadrats – either open or gridded frame quadrats, or point frame quadrats, depending on whether the data collection technique is to be subjective or objective. Sampling a representative proportion of the site gives an indication of what is present across the whole site. Students could carry out these exercises as pilot studies:

(i) Selecting appropriate open frame quadrat size using a nesting quadrat exercise.

The choice of quadrat size is affected by the diversity of the ecosystem, and by the size of the organisms under investigation. Using two metre rulers, make a right angle somewhere representative in the study site. With the piece of string and soil skewer, make progressively bigger ‘quadrats’ eg. 10cm x 10cm, 20cm x 20cm, 30cm x 30cm to 2m x 2m and count the number of species in each. Plot the results – quadrat size on the x axis and species number on the y-axis.



Nestd Quadrats

(ii) How quadrats should be placed in the study area(s).

Systematic sampling:

If the ecosystems are adjacent to one another, and students are investigating an environmental transition (in this case in soil factors including moisture and acidity) such as between the peat bog and heather moorland,

it is best to use a systematic sampling technique. When examining environmental transitions, use a transect. This may be a belt transect (using quadrats) or line transect (sampling at discrete points along a line), and may be continuous or discontinuous, leaving a consistent gap between each sample point. If investigating vegetation along a transect, it is worthwhile investigating how the abiotic environment also changes along this transect, and influences or is influenced by the biotic community. Recording sheet 4.

Random sampling:

If the ecosystems are discrete sites, students should use a random technique. Quadrats are placed in a 10m x 10m grid according to a random number table. This will avoid bias in the sampling that may otherwise see some areas being more heavily sampled than others. Students place quadrats at random and after assessing the vegetation cover, calculate a running mean for the number of species in each successive quadrat. They will be able to collect a representative sample of the site:

Quadrat number	Number of different species	Running mean (number of species / number of quadrats)
1	10	10
2	20	15
3	9	13
4	17	14
5	12	13.6
6	10	13
7	21	14.1
8	15	14.3
9	13	14.2
10	14	14.2

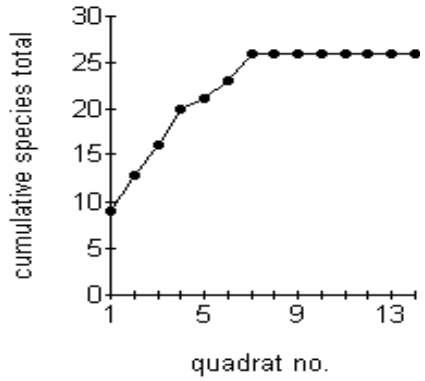


Figure 2
Graph indicating the running mean of the number of species in each successive quadrat

Carry on doing quadrats until the running mean figure remains within 0.1 for three successive quadrats – this will ensure a data set which is representative of the area and in which all the plants are represented in the sample. Recording sheet 3a, b or c.

(iii) How to record vegetation cover in each quadrat:

Students need to consider the advantages and disadvantages of objective or subjective sampling techniques. If data is to be shared, it is normally better to use an objective technique.

Objective sampling methods:

Presence / absence – indicate with a tick or cross if a species is present in the quadrat;

Counting;

Biomass;

% Frequency – Use a point frame quadrat or a gridded frame quadrat and record the number of 'hits' – use this to calculate the % frequency.

Subjective sampling methods:

Percentage cover – estimate using open frame quadrats;

Abundance scale, eg. DAFOR scale, where plants score D if dominant, A if abundant, F if frequent, O if occasional and R if rare.

Remember that whatever sampling technique is used, students must search their quadrats thoroughly. Species overlap one another and with percentage cover techniques, the cover will add up to more than 100% as species layer over the top and grow through one another. This is particularly relevant in sampling woodlands – remember the canopy cover.

Recording Sheet 1. EAGLES NEST

Microclimate and Physical variables.

Site……**Temperate deciduous woodland**…….

Time	Air temp. (^{o}C)	Soil temp. (^{o}C)	Air humidity (%)	Wind speed (m/s)	Wind direction (^{o})	Light (lux)	Light (0-10)

Gradient (^{o})	Aspect (^{o})	Altitude (m)

Site……**Heather moorland**…….

Time	Air temp. (^{o}C)	Soil temp. (^{o}C)	Air humidity (%)	Wind speed (m/s)	Wind direction (^{o})	Light (lux)	Light (0-10)

Gradient (^{o})	Aspect (^{o})	Altitude (m)

Soil variables:

Soil variable	Temperate Deciduous Woodland						Heather moorland					
pH												
Texture												
Infiltration rate (cm/min)	T1	T2	T3	T4	T5	Av.	T1	T2	T3	T4	T5	Av.
Depth of O horizon (cm)												
Total soil depth (cm)												

Recording Sheet 2. EAGLES NEST

Vegetation - % frequency.

Site ……Temperate deciduous woodland……

Species	Quadrat number:										Mean % frequency
	1	2	3	4	5	6	7	8	9	10	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

Site ……Heather moorland……

Species	Quadrat number:										Mean % frequency
	1	2	3	4	5	6	7	8	9	10	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

Summary Sheet: EAGLES NEST
Ecosystems. Investigating change and challenge.

Abiotic factors

Microclimate	Woodland	Moorland	**Soil**	Woodland	Moorland
Air temperature (^{o}C)			Soil pH in A horizon		
Soil temperature (^{o}C)			Soil texture in A horizon		
Air Humidity (%)			Infiltration rate (mean cm / min.)		
Wind speed (m/s)			Depth of O horizon (cm)		
Wind direction (NSEW)			Total soil depth (cm)		
Light (lux)					
Light (0 – 10)					

Site factors:					
Altitude (m)			Aspect (^{o})		
Relief (gradient ^{o})			Microrelief		

Biotic factors

WOODLAND		**MOORLAND**	
Species	Mean % frequency	Species	Mean % frequency

Brief explanation of field techniques used to measure vegetation cover:

Brief explanation of evidence of human impact in woodland

Brief explanation of evidence of human impact on moorland

Ecosystem Challenge: Exploring Conservation and Exploitation in the Cevennes National Park.

The Cévennes region was designated as a French National Park on 2nd September 1970 and Mont Lozère became part of the "core zone" within the Park's overall structure plan. The Park needs to be conserved for future generations, whilst allowing for small developments that do not harm the character of the Park. The physical attractiveness of the area, its ecological diversity and its peculiar mystique have drawn a wide range of visitors, creating problems for this particular Central Zone. The National Park is exploited by many sectors:

- Commercial forestry (the Cevennes is the only National Park in France where large scale forestry takes place;
- Mineral exploitation (uranium, lead, zinc);
- Tourism (eg. Skiing, hiking long distance national trails;)
- Fishing (in rivers and fish farming)
- Agriculture.

How does the National Park management plan reconcile the conservation of rare species and threatened ecosystems within the National Park with the needs of other stakeholders?

The effects of the skiing industry on Mont Lozere can be investigated throughout the year. Heavy ski-traffic after good winter snow conditions leaves its mark on the landscape for many years. Skiing on Mont Lozere is at best unpredictable as illustrated by the table below:

Ski season	**Total days ski runs operational**
1998 / 1999	85
1999 / 2000	5
2000 / 2001	7
2001 / 2002	9
2002 / 2003	91
2003 / 2004	9
2004 / 2005	6
2005 / 2006	9
2006 / 2007	10
2007 / 2008	7

This study has been designed to help students investigate the environmental and economic impact of the skiing industry on Mont Lozère and its inhabitants. Students carry out an environmental impact assessment (EIA) on existing ski runs to determine the current level of environmental damage, and use the data to inform a decision-making exercise based on the proposed expansion of the current facilities.

Since the 1960's, local and regional authorities have encouraged the development of downhill skiing in the Massif Central in an attempt to bring some of the economic benefits associated with this huge growth industry, to the area. Unfortunately, due to the rather unreliable snow conditions in the southern part of the Massif Central, not all the ski developments have become commercially successful. There are also many environmental issues associated with alpine skiing, such as gullying, deforestation and the positioning of unsightly ski tows in the core zone of the Cevennes National Park.

This unit uses the "Ski Chalet du Mont Lozère" as a case study. Transects are used to assess the damage caused by skiing to the physical environment. The visual impact of the ski chalet and the resort infrastructure are assessed, and the attitudes of a cross section of people are included, for example those employed in the industry, tourists, and local people, to assess the impact of the skiing industry on the local economy.

General Information

Skiing is a popular winter activity in France. Winter sports form an important growth industry with the number of skiers in France currently rising by 10% each year. Many French children attend weekly and annual 'ski school' from the age of five – as part of their compulsory education. Many of the French are competent skiers and their numbers are supplemented by an influx of visitors from other European nations, particularly the UK. The best-known and most popular ski resorts in France lie to the east, where the high alpine slopes allow summer glacier skiing as well as a three-month winter season from February to April. Less known to foreigners and used by a comparatively small number of the local population are the ski resorts of the Southern Massif Central.

The real growth of snow resorts in the Massif Central dates only from the 1960's. From 1961 resorts were modernised and additional accommodation provided for skiers. Special trains would leave Paris on Friday nights in winter, allowing Parisians to enjoy a weekends skiing in the Massif Central, before returning to the capital in time for work on Monday. Another growth resort has been Super-Besse (near Clermont-Ferrand) where the installation of ski lifts and the building of hotels, chalets and holiday villages, provides accommodation for over 3,000 winter sports enthusiasts. The spa town of Mont Dore that lies nearby has been directly affected by these changes and has responded by diversifying its economic and retail base. Accommodation is now provided for a winter sports clientele and access to the local snowfields has been improved. Other ski resorts have developed on a less spectacular scale with a much more subdued multiplier-effect at work.

There are also alpine pistes on Mont Lozère. For administrative reasons the mountain is divided into the 'Nord' and 'Sud'. In 'Mont Lozère Nord' there are two major areas: Mont Lozère and Le Gaulet, catering for a variety of standards with a total of 56km of prepared runs. In 'Mont Lozère Sud' there are 7.5km of prepared piste at Col de Finiels with the base at Le Pont de Montvert. On nearby Mont Aigoul there is more extensive downhill skiing with a total of 126km of piste.

Winter sports on Mont Lozère play an important role in the local economy and, through the operation of the multiplier effect, have provided additional income for rural populations. This has helped to stem the tide of

desertion from these highland villages and provided an important stimulus for the revival of local craft industries and services. In Le Pont de Montvert, the arrival of skiers is viewed as an important source of income by shop, bar and hotel owners.

If snow conditions are good there can be 500 weekly visitors during the ski-season. Cross-country and downhill skiers usually stay for a day or a weekend at most, returning again when the conditions next allow. The number of winter visitors has gradually increased due to the popularity “active leisure”. Skiing has a recognisable impact on the landscape of Mont Lozère. During summer the extent of the pistes is evident and the slope damage from skiing and trampling produces 'scars' on Mont Lozère. Road side verges are damaged during snow ploughing and to an extent the preparation of pistes is reflected in the widespread growth of rosebay willowherb, a plant which seeks out soils which have been recently disturbed. In addition, the arrival of cars using snow chains, and walker’s wearing heavy footwear creates pressure at specific sites. Less noticeable are the cross-country ski tracks where the skiers appear to have less impact.

Aims

- To investigate the impact of skiing on the physical environment and visual landscape;
- To evaluate the economic and social impact of skiing on Mont Lozère;

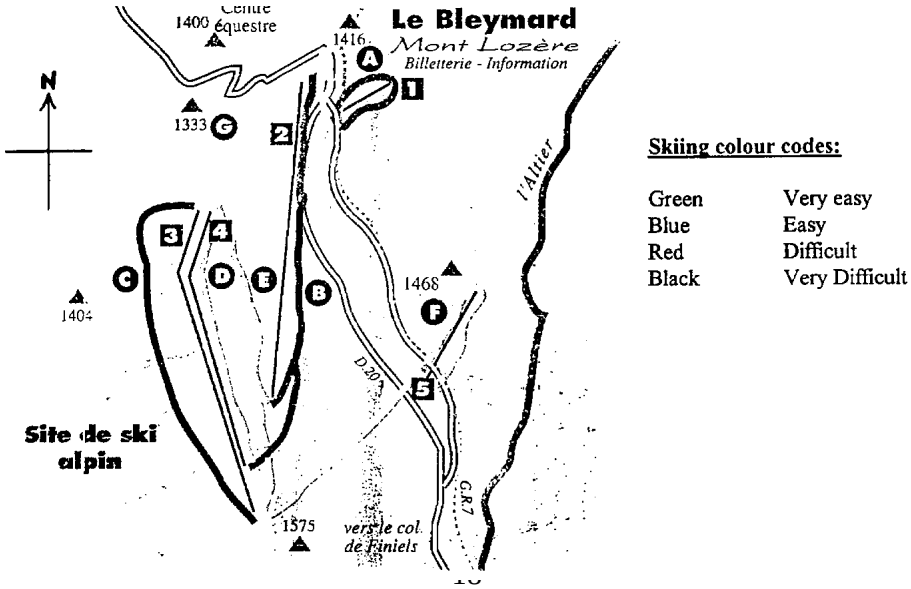
Hypothesis

- Soil temperature, pH, soil moisture, soil depth and infiltration rate on ski runs will be affected by skiing. This will in turn influence vegetation cover – there will be a reduction in overall vegetation height, species diversity and a change in species composition on the pistes compared to off piste;
- The skiing facilities have a significant visual impact on the landscape;
- The skiing industry is an important resource for the local population for employment and leisure.

Data Collection Site

The main green piste on Mont Lozere’s alpine slopes.

Map of Downhill and Cross Country Ski Runs on Mont Lozère:



Equipment

2 Ranging poles
Clinometer
Tape measure
Open frame quadrat
Compass
Small ruler (for plant height)
Skewer (for soil depth)
pH kit and trowel
Digital soil thermometer
Infiltration can and water
Map - Mont Lozère (scale = 1:25,000)
Plant identification sheets
Blank paper for field sketches
Recording sheet 1

Method

Transect survey.

Each group of students runs a 30m tape across the ski piste. Ensure that the transect lines run from an untrampled area, through the middle of the piste, back into an untrampled area again. These untrampled areas represent the control sites. Place the quadrat at 2m intervals along the transect line, and assess:

% cover of each species present;
% bare ground;
Height of the tallest vegetation;
Species diversity;
Soil depth – repeat x3 in each quadrat;
Soil temperature;
Infiltration rate (students could split this between the groups);
Soil pH.

Each group should then stretch the tape measure tightly across the piste and measure depth of erosion – seen by the depth below the taut tape measure – at 50cm intervals. Finally, measure the gradient of the slope using the clinometer and two ranging poles. Recording sheet 1.

Landscape evaluation.

Carry out the simple landscape evaluation assessing the visual impact of skiing on the Mont Lozere landscape.

Interviews with local restaurateur and ski-operator (if possible).

Interview the proprietor of one of the restaurants and the operator of the ski equipment building using the questionnaire in Appendices 2a and 2b.

RECORDING SHEET 1 – INTERRUPTED BELT TRANSECT ACROSS SKI PISTE

Species	% cover for each plant species – distance across transect										
	0m	2m	4m	6m	8m	10m	12m	14m	16m	18m	20m
Heather											
Fine leaved grass											
Sedges											
Spanish Broom											
Petty whin											
Alpine hawkweed											
Species diversity											
Max plant height (cm)											
Soil depth (cm)											
Soil temperature (^{o}C)											
Soil pH		x	x	x	x		x	x	x	x	
Infiltration rate (cm/min)		x	x	x	x		x	x	x	x	

DEPTH OF EROSION (CM) AT DISTANCE ALONG TRANSECT																	
0m		0.5m		1m		1.5m		2m		2.5m		3m		3.5m		4m		4.5m	
5m		5.5m		6m		6.5m		7m		7.5m		8m		8.5m		9m		9.5m	
10m		10.5 m		11m		11.5 m		12m		12.5 m		13m		13.5 m		14m		14.5 m	
15m		15.5 m		16m		16.5 m		17m		17.5 m		18m		18.5 m		19m		19.5 m	
20m																			

The Eagles Nest

Impact of Skiing - Landscape Evaluation

The Impact that skiing makes on the landscape can be assessed in a numerical or a descriptive way.

1. Numerical System

Assess each individual component in the landscape:

Impact on the landscape (a)	Score	Visual Appeal (b)	Score
Stands out clearly	+2	Attractive	+2
Stands out	+1	Good	+1
Little impact or invisible	0	Poor	-1
		Unattractive	-2

Landscape Component	(a) Impact on landscape	(b) Visual Appeal	Final score (a x b)
Vegetation Woodland Moorland Fields			
Physical features Hills Valleys Cliffs			
Skiing features Roads Ski lifts and pistes Ski Station			
		TOTAL SCORE	

For this technique both objective and subjective measurements are used. The scores given by different people for the impact on the landscape of various components will probably be similar. However the visual appeal is much more of an opinion.

2. Descriptive System

Evaluate the landscape by drawing a circle around the word that you feel gives the best description.

SIZE:	tiny	small	large	vast
AREA	restrictive	enclosed	open	exposed
BEAUTY	ugly	plain	attractive	stunning
HUMAN IMPACT	spoilt	artificial	natural	wild

Data presentation and analysis

- On A3 graph paper, present the vegetation data as kite diagrams - line up all the remaining results with the vegetation data;
- Plot maximum plant height below the kites as single scale lines, above the line;
- Record the species diversity as a figure on the line beneath the maximum plant height;
- Calculate the mean soil moisture and soil depth in each quadrat;
- Present pH figures on the line below;
- Present depth of erosion data as a line graph below the line. Join to represent the soil surface;
- Plot soil depth as single scale lines below the soil surface line;
- Present infiltration data as bars – height of bar represents amount of water (cm) which infiltrates per minute.
- Collate and tabulate the interview results. Write a short passage outlining the economic and social impact of skiing on Mont Lozère.

Critical appraisal:

The methodology should be considered, paying attention to errors which may have occurred due to:

- Human error;
- Equipment error;
- Problems inherent in the techniques used.

Evaluation of data:

- What is the environmental impact of skiing on Mont Lozere? Does this vary according to the steepness of the piste? Is there any difference between the impact seen on cross-country tracks compared to that on the alpine pistes?
- How is the vegetation affected by the skiing – is there a change in species composition? Why do you think this is? What adaptations characterise plants tolerant of trampling?
- Is tourist provision at the ski resort adequate given the number of visitors to the site (500 per week during the winter season, when there is snow)? Do you think there is more business at other times of the year? Why else may people want to come to this area - is there evidence of recreational provision other than that associated with the skiing industry?

Point for Discussion:

- How have the National Park reconciled the seemingly opposing aims of conservation and sustainable exploitation of the ski piste areas of Mont Lozere? (Core vs buffer zone model of National Parks)
- Are any species or ecosystems particularly under threat? Justify your answer;
- Uranium was mined in the National Park during the 1980's. How can mineral extraction have a negative impact on environmental conservation (eg. Pollution of water courses, deforestation, etc.)

INTERVIEW:

Type of facility/operation/establishment. .....

1. How long have you run this establishment?

2. How many visitors do you receive during:

Summer?		Winter?	

3. Where do your visitors come from?

What is their average length of stay?

4. Do local people use your facilities off-season?

5. What attracted you to this area?

6. Would you like to see an expansion of the skiing facilities on Mont Lozère?

7. How strongly do you agree or disagree with the following statements:

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Skiers are noisy and disruptive					
Skiers are an important source of income					
Skiing facilities should not be expanded					
Skiing damages the environment					

Appendix 2b - Interview For Proprietor (Ski Facilities).

Type of facility/operation/establishment: .....

1. Depuis quand avez-vous ca commerce?

2. Combien des visiteurs avez-vous pendant:

été?		hiver?	

3. Les visiteurs viennent d'ou?

Combien durent les sejours?

4. Est-ce-que les residents locaux utilisent vos facilities?

5. Quelles sont les attractions pour vous ou cette region?

6. Pensez vous qu'il y a plus de facilities du ski sur le Mont Lozère?

7. Qu pensez - vous des questions suivant:

	Convainau	D'accord	Par sur	Contre	Totalement Contre
Skieurs sont beaucoup bruyant et derangent					
Skieurs sont tres importants pour argent					
Les facilities de ski doivent rester les memes					
Le ski est mauvais pour l'environment					