Biodiversity Under Threat

(A2 Geography for Edexcel)

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Teacher's Notes

This full day study will introduce students to the nature and study of biodiversity around the Eagles Nest field centre on Mont Lozere; why the area has a high biodiversity, what threatens biodiversity, and how these threats are being managed in the National Park.

Key Specification Areas

- What is the nature and value of biodiversity?
- What factors and processes threaten biodiversity?
- Can the threats to biodiversity be successfully managed?

Bibliography

Burton, S & Jeanes, A. (1997) 'Central Southern France' Hodder and Stoughton.
Waugh, D. (1990) 'Geography - An Integrated Approach' Nelson.

Introduction and background

Biodiversity, or biological diversity, is all life on earth; the number, variety and variability of all living organisms (Groombridge, 1992). Biodiversity can be considered at different levels. The diversity of species (animals which reproduce and produce fertile offspring), and the variety of genes within a breeding population (the genetic biodiversity, which may be high or low) are key to considering biodiversity. Biodiversity may also be considered at the habitat level, with different habitats containing typical organisms, and some habitats being more biodiverse than others. Tropical rainforests are typically described as having a high biodiversity when compared with tundra, BUT the species which are represented in these habitats are exclusive to those habitats and so neither habitat can be considered of greater importance to biodiversity! (Unless we are obsessed with only numbers of species).

Approximately 1.6 million species have currently been identified globally:

- 287,655 plants including:
  - 15,000 mosses
  - 13,025 ferns
  - 980 gymnosperms
  - 199,350 dicotyledons
  - 59,300 monocotyledons
  - 74,000-120,000 fungi
  - 10,000 lichens

- 1,250,000 animals including:
  - 1,190,200 invertebrates
  - 950,000 insects
  - 70,000 molluscs
  - 40,000 crustaceans
  - 130,200 others;

- 58,808 vertebrates
- 29,300 fish
- 5,743 amphibians
- 8,240 reptiles
- 10,234 birds
- 5,416 mammals

One early estimate by Terry Erwin (an entomologist with the Smithsonian Institute) put global species richness at 30 million, following extrapolations from the numbers of beetles found in a species of tropical tree. In one species of tree, Erwin identified 1200 species of beetle, of which he estimated 163 were found only in that tree. Based on the 50,000 species of tropical tree, this would suggest that there are almost 10 million species of beetle alone, just in the tropics!

The Mediterranean basin is identified as a global **biodiversity hotspot** – that is, it is a biologically diverse and ecologically distinct region under threat of destruction. Biodiversity hotspots are identified on the basis of the number of species present, the level of endemism (ie. biological distinctiveness), and the extent to which the species are threatened. Other global biodiversity hotspots include the Himilaya, the horn of Africa, New Zealand and the Caucasus mountains.

The Mediterranean basin biodiversity hotspot:

The flora of the Mediterranean Basin is dramatic. Its 22,500 endemic vascular plant species are more than four times the number found in all the rest of Europe; the hotspot also supports many endemic reptile species. As Europe's vacation destination, populations of threatened species are increasingly fragmented and isolated to make way for resort development and infrastructure. The Mediterranean monk-seal, the barbary macaque and the Iberian lynx, which is Critically Endangered, are among the region's imperiled species.

Key facts about the Mediterranean basin biodiversity hotspot:

Area 2, 085, 292 km^2
Remaining original vegetation 98, 009 km^2
Endemic plant species 11,700
Endemic threatened birds 9
Endemic threatened mammals 11
Endemic threatened amphibians 14
Extinct animals (since 1500) 4
Human population density (people per km2) 111
Area protected 90,242 km^2
Area with higher level of protection 28,751 km^2

The largest of the world's five Mediterranean-climate regions, the Mediterranean Basin stretches west to east from Portugal to Jordan and north to south from northern Italy to Morocco. Surrounding the Mediterranean Sea, the hotspot's 2,085,292 km² also include parts of Spain, France, the Balkan states, Greece, Turkey, Syria, Lebanon, Israel, Egypt, Libya, Tunisia and Algeria, as well as around five thousand islands scattered around the Mediterranean Sea. West of the mainland, the hotspot includes the Macaronesian Islands of the Canaries, Madeira, the Selvages (Selvagens), the Azores, and Cape Verde.

The basin's location at the intersection of two major landmasses, Eurasia and Africa, has contributed to its high diversity and spectacular scenery. The region boasts mountains as high as 4,500 meters, peninsulas, and one of the largest archipelagos in the world. The climate of the Mediterranean Basin is dominated by cool, wet winters and hot, dry summers, and rainfall ranges from as little as 100 millimeters to as much as 3,000 millimeters.

Although much of the hotspot was once covered in evergreen oak forests, deciduous and conifer forests, eight thousand years of human settlement and habitat modification have distinctly altered the characteristic vegetation. Today, the most widespread vegetation type is hard-leafed or sclerophyllus shrublands called maquis or matorral, which include representatives from the plant genera *Juniperus, Myrtus, Olea, Phillyrea, Pistacia*, and *Quercus*. This vegetation is similar in appearance to the chaparral vegetation of California and the matorral of Chile. Some important components of Mediterranean vegetation (species of the genera *Arbutus, Calluna, Ceratonia, Chamaerops*, and *Larus*) are relicts from the ancient forests that dominated the Basin two million years ago. Frequent burning of maquis results in depauperate vegetation dominated by Kermes oak (*Quercus coccifera*), *Cistus* spp. or *Sarcopoterium spinosum*, all of which regenerate rapidly after fire by sprouting or mass germination. Shrublands, including maquis and the aromatic, soft-leaved and drought phrygana of *Rosmarinus*, *Salvia*, and *Thymus*, persist in the semi-arid, lowland, and coastal regions of the Basin

Protecting Biodiversity and Managing Threats to Biodiversity.

The Cevennes National Park was established in 1970, partly in recognition of it's high level of biodiversity. It now welcomes over 800,000 visitors each year. The Park boundaries are outlined below – in France, National Parks are sub-divided into core and periforal zone, facilitating the prioritisation of different management approaches in the zones. For example, conservation and protection of rare species and habitats is prioritised in the core zone, and sustainable development for tourism in the periforal zone. Since 1984, the whole of the Park has also been designated a UNESCO Man and the Biosphere reserve. The total area of the Park is 3,210 km^2. The core zone area 91,279 Ha. The core zone contains land owned by the PNC (3%), sectionnaux (7%), domaniaux (30%) and privately (60%).

The altitude of the Park ranges from 378m (Sainte-Croix-Vallee-Francaise) to 1,699m (Mont Lozere). This altitudinal range influences the climate – we have areas experiencing oceanic, Mediterranean and continental climate conditions. On Mont Lozere, winters are cold, bright and dry (100+ 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.

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

The PNC has five different geological areas which contributes to the Parks' high biodiversity:

1) 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;

2) Mont Lozere, a granite massif rising to 1,699m. Used to raise the local beef cattle, the Aubrac, and as a major transhumance destination for sheep from the southern plains;

3) Montagne du Bouges, a granite and schist massif to the south of Mont Lozere, rising to 1,421m.

4) 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;

5) Mont Aigoul and Lingas, a granite and schist massif in the far south of the PNC, rising to 1,565m. Used for timber (pine, spruce, beech, fir) and some transhumance in the past.

The PNC is home to 89 mammal species, 208 bird species, 17 reptile species, 18 amphibian species and 24 species of fish. The PNC has reintroduced roe and red deer, mouflon, beaver, black and griffon vultures and capercaille. Many species have returned to their original habitats since the formation of the PNC, including black woodpeckers, Tengmalm's Owl, otters and herons. The PNC is notable for its insect biodiversity – over 2000 species. This is due to traditional farming methods;

Because of the range of rock types and altitudes found in the PNC, the vegetation is very varied. In the sub-alpine conditions on the top of Mont Lozere are found a range of rare alpine species and broom. In the Mediterranean conditions found in some of the southern valleys grow fig and holme oak. The Causses support a huge diversity of alkalis-loving plants and the peat bogs support carnivorous plants including sundew. Of the 400 species of plant protected under French law, 35 can be found in the PNC, which has over 2,250 species in total. 48 species found in the Park are endemic, found nowhere else in the world.

Mont Lozere is an extreme habitat! The climate swings dramatically between an alpine in the winter and a Mediterranean 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 produces nutrient poor, thin, acidic soils, with many large boulders, due to the slow rate of weathering.

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.

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.

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 investigate how commercial forestry has a negative impact on local biodiversity through disruption of ecosystems processes and introduction of non-native species.

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.

3) Conifer plantation KEY SPECIES – sitka and Norway spruce, mosses, lichens.

The Cevennes was originally covered with native oak, beech and mountain pine. Deforestation was well advanced by Roman times, but depopulation at about 500 AD led again to increased natural woodland cover. However when the population and sheep numbers increased again there was increased grazing pressure and severe soil erosion, being at its worst towards the end of the nineteenth century. Afforestation started to take place with the help of compulsory land purchase. About two-thirds of the core area of the Parc National des Cevennes (PNC) is owned by the Office National De Fôret (OFN). The main species planted are a variety of conifers, oak and beech, planted in mixed age stands to reduce fire and disease risk. The wood from the conifers is taken to saw mills to produce building material and Lozere now has a policy of increasing use of wood for sustainable heating, with fuel pellets produced from wood chip and sawdust.

There is little ground cover in the coniferous forest, due to lack of sunlight reaching the floor and due to the deep acidic layer of slowly-decomposing needles. However, most of the older trees are covered in lichen, which indicates high air quality.

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:

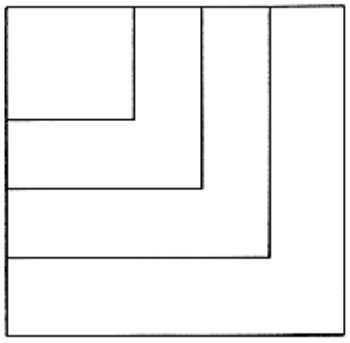
The simplest method of vegetation sampling involves recording presence or absence of a species at the site (usually done by a 'walk about' for a set time limit, e.g. 5 minutes). This technique is used by English Nature when assessing sites, and is called a 'Phase One' survey. This main disadvantage of 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

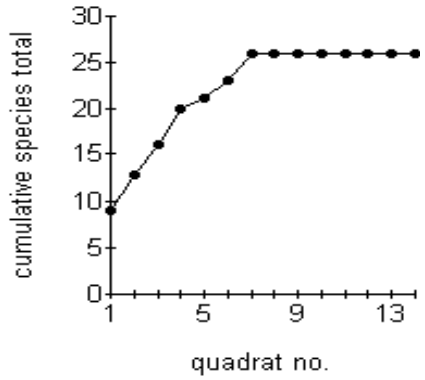


Figure 2
Graph indicating the running mean of the number of species in each successive quadrat

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

Factors and processes threatening biodiversity, and biodiversity management.

Ecosystem processes can be disrupted by changes to the ecosystem such as deforestation and re-afforestation with introduced species. The Cevennes National Park is the only French National Park on the mainland which has a significant amount of commercial forestry. More than 1,500km^2 cover the PNC, approximately half of which is coniferous forestry. Of this, one third is planted, non-native species (Austrian, black and maritime pine, Douglas fir). 63% of the core zone of the Park, 58,047 Ha is covered with forest. What happens to biodiversity when native deciduous woodland is replaced by non-native, conifer species?

Arguments for Commercial Forestry	***Arguments against commercial forestry***
France is a net importer of timber and wood products. The import bill for timber exceeds that for fuel, cars and food. Forestry provides employment, particularly in rural areas, where it is a larger employer than agriculture. The Cevennes would have been virtually covered in woodland prior to human settlement. Pine would have been present at altitude – afforestation redresses the balance of nature. Forestry provides unique habitats for flora and fauna. Over 30 species of birds nest exclusively in coniferous woodland, including threatened species such as goshawk. Recreation and tourism are encouraged in areas of commercial forestry. The PNC contains extensive waymarked walks. People on horseback and mountain bikes use Forest access roads. Car rallies are held in the Park and hunting is permitted. People gather mushrooms and bilberries in the forest. Careful landscaping of forestry plantations can enhance the beauty of an area. Landscape features can be highlighted by the use of different trees. Domestic timber production reduces the pressure on tropical rainforests. Woodland stabilises soil on steep mountainsides, reducing the risk of soil erosion and flooding.	Planting non-native species creates ecosystems with lower biodiversity than ecosystems containing native species. Only a restricted number of species may survive in the micro-habitats created. Invertebrates are particularly affected. A change of ecosystem, eg. reverting open heath to coniferous woodland, changes the whole community structure. Birds of open heaths have declined in the Cevennes due to afforestation. These are often replaced by species of lesser conservation value. The needles of conifers are tough, acidic and toxic. They take a long time to decompose, rendering conifer forest soil acidic and low in nutrients. Artificial fertilisers have to be used when trees are planted. Acidic run off, artificial fertilisers and pesticides used in managed forests can enter watercourses and harm aquatic life low down in the food chain. This affects fish, otters and beaver. Homogenous stands of monoculture conifers, planted in lines with harsh edges are unnatural and unattractive. Within the forest, views are restricted and the habitat is dark and lifeless. Access to commercial forestry is restricted to rights of way. Walking through the plantations themselves is difficult off major tracks. Hunters and mushroom collectors find access in conifer woodland difficult.

Aims

- To investigate the effects of afforestation on a scenic upland site in the style of an environmental impact assessment;
- To prepare and EIA report, which addresses the possible impact of afforestation on the Roc de Montal on biodiversity and landscape.

Introduce this part of the day as a scenario:
"An environmental Consultancy have been approached by the Parc National des Cevennes, to carry out an EIA on the Roc de Montal, in lieu of a planning application by a Timber Company - 'Trees are Us' - who are bidding to afforest the site. They have also been invited to tender their own afforestation plan, which is sympathetic to the aims of the National Park - Conservation of the natural ecosystems within the National Park and the maintenance of traditional lifestyles in the area."
And either:
To construct an appropriate afforestation plan for the site, taking consideration of timber production and revenue, recreation provision, biodiversity, preservation of landscape value and maintaining the traditional uses of woodland in France;

Hypotheses

- Afforestation of the Roc de Montal would modify the abiotic and edaphic environment at the site, reducing its biodiversity;
- Afforestation would adversely affect the landscape value of the Roc de Montal;

Data collection sites

The Roc de Montal is a group of granite tors within walking distance of the Eagle's Nest. Students visit the Roc de Montal to assess the landscape value of the site and its environs, and sample an area of intensive spruce forestry, passed through en route to the Roc de Montal. The return route passes through an area of ancient beech woodland to the east of the summit, which can be visited to draw out the contrast between deciduous and coniferous woodland ecosystems.

Methods and organisation of study

The EIA will determine the potential effects of afforestation on the Roc de Montal. It is therefore necessary to establish what would be lost from the site should the scheme go ahead. The abiotic and edaphic conditions giving rise to the biotic community on the ridge is assessed, and the biotic community surveyed. The potential impact of afforesting the site is determined by comparing these results with an afforested site.

- Repeat the data collection exercise from the morning in the spruce woodland.
- Carry out the landscape evaluation.
- Complete the Environmental Impact Assessment summary for the potential impacts of afforestation on biodiversity and related factors.
- Plan an afforestation scheme which will support and enhance local biodiversity at the proposed site, whilst supporting the local economy through timber production for fuel wood.

Environmental Impact Assessment.
Summary of the potential impacts of afforestation on biodiversity and related factors:

Biodiversity of trees and other plant species	Biodiversity of mammal and bird species
Biodiversity of invertebrate species	Impact on food chains and food webs
Impact on Microclimate	Impact on soil and nutrient cycling
Impact on local landscape	Impact on local economy

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Landscape Evaluation 1.

There are many ways of assessing landscapes. The checklist below is based on that used by the Countryside Commission when evaluating landscapes. To complete the table, circle the words you feel are most appropriate when describing the landscape features you are looking at.

Aesthetic Qualities:

Size:	Tiny	Small	Large	Vast
Area:	Tight	Enclosed	Open	Exposed
Diversity:	Uniform	Simple	Diverse	Complex
Form:	Steep	Sloping	Rolling	Flat
Colour:	Monochrome	Dull	Colourful	Gaudy
Movement:	Still	Calm	Active	Busy
Pattern:	Random	Irregular	Organised	Formal

Impressions:

Beauty:	Ugly	Plain	Attractive	Stunning
Security:	Comfortable	Safe	Unsettling	Threatening
Management:	Artificial	Managed	Natural	Wild
Familiarity:	Everyday	Familiar	Unusual	Strange
Effect of people:	Untouched	Harmonious	Unbalanced	Destructive

Now answer these questions:

How do you feel about this area? Use this space to record six words not listed, which describe your feelings about this area. …… ……
…….. …….. …… ……

How suitable is this area for informal recreation? How do you think local may use this area already? How do you think visitors to this area may use it already? How could the provision of recreation in this area be improved? Record your ideas in the space below:

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Landscape Evaluation 2.

Impact of the feature on the landscape:		Visual appeal of the feature:	
Stands out very strongly	score +2	Highly attractive	score +2
Stands out slightly	score +1	Attractive	score +1
No impression / not visible	score 0	Neutral	score 0
		Unpleasant	score –1
		Highly unpleasant	score -2

Landscape feature	Impact of feature (I)	Visual appeal of feature (V)	Total score for feature (I x V)
Geology			
Granite tor			
Scattered boulders			
Geographical features			
Ridge			
River valleys			
Distant hills			
Vegetation			
Open broom scrub			
Conifer plantation			
Bryophytes (moss and lichens)			
Beech woodland			
Scattered trees			
Meadow			
Hedgerows			
Agriculture			
Dry stone walls			
Scattered farm buildings			
Managed pasture			
Rough grazing			
Terraces			
Livestock			
Traditional cattle (Aubrac)			
Other cattle			
Sheep			
Wildlife			
Birds			
Invertebrates			
Mammals			
			Total =

(2) Preparing an Afforestation Scheme.

Students are provided with a range of resources, which will enable them to plan a design for afforesting the Roc de Montal. The design will be presented on a base map, the master is the last page in this pack. Expand it to A3 size on a photocopier, as students find this easier to work with. Discuss which tree species have been planted where, and why. Students should use a colour key indicating different species, and should annotate their map with a detailed justification of each species' position, considering:

- How **biodiversity** at the site can be maxinised whilst allowing for full timber priduction;
- Arrangements for harvesting the timber, routine and emergency access;
- How have water courses been protected;
- Any improvements for flora and fauna in the area – nest boxes, clearings, native species, species assemblages, etc;
- How has the afforestation design taken account of existing landscape features, such as the Roc de Montal, the river valley and distant views;
- What arrangements have been made to maintain and improve access to the site for farmers and the public;
- Recreational initiatives, eg. Mountain bike routes, picnic areas, car-parking facilities – could and should this area be turned into a major recreation site?

This takes about an hour and a half. Students should then calculate the value of their timber as indicated. Finally, the groups should present their plan to the rest of the class, justifying their design choices.

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Timber Species Fact Sheet. (Appendix 1)

This list details the more commonly used tree species for commercial forestry. Use it to work out which species would be best planted where on the Roc de Montal. Use the yield data to calculate the volume of timber (in m^3) produced after 50 years growth.

SCOTS PINE. Yield: $350m^3$ per Ha after 50 years.

From: Alpine (above 800m)

Prefers: Wide range of conditions. Easy to establish on broom scrub. Frost hardy. Needs plenty of light. Thrives on acidic, light, well-drained soil. Avoid water logged and alkaline soils.

Remarks: Growth is rather slow, but this is a hardy tree species, and considered a safe bet in most conditions. A tree with a high, open canopy, therefore encouraging understorey development.

Timber: General purpose. Easily treated for outdoor use – fencing, joinery, etc.

CORSICAN PINE. Yield: $450m^3$ per Ha after 50 years.

From: Corsica.

Prefers: Low elevations. Light, well drained soils, preferably acidic, but can tolerate base-rich soils better than Scots pine.

Remarks: Better yielding tree than Scots pine, but more difficult to establish.

Timber: As Scots pine, but not as strong – less suitable for building.

LARCH. Yield: $400m^3$ per Ha after 50 years.

From: Japan or Central Europe.

Prefers: Wide range of conditions. Suitable for grassy, broom-covered or heathery slopes. Quickly outgrows and suppresses surrounding vegetation, so a valuable pioneer species. Avoid dry sites where annual rainfall is >750mm. Avoid poorly drained and exposed situations – ideal for protected slopes.

Remarks: The only deciduous conifer – leaves turn brown and fall in Autumn – a useful species for improving ecological diversity in the understorey.

Timber: Strong and heavy. Fencing, gates, building, telegraph poles and chipboard.

DOUGLAS FIR. Yield: $650m^3$ per Ha after 50 years.

From: Western North America.

Prefers: Well-drained soil of good depth and moderate fertility. An excellent tree for valley slopes, but not for exposed conditions, heather-covered ground, or shallow or waterlogged soils.

Remarks: On suitable sites, grows rapidly and produces a high volume of timber. Good drainage is very important.

Timber: An excellent construction timber with a high strength to weight ratio. Suitable for fencing, joinery, poles, chipboard and pulpwood.

NORWAY SPRUCE. Yield: 500m^3 per Ha after 50 years.

From: Scandinavia.
Prefers: Moist soils and acidic peats. Succeeds on old woodland sites, and most soils of moderate fertility. Shade tolerant. Fails on heather sites, and does poorly on well-drained sites.
Remarks: Produces a high volume of timber on suitable soils.
Timber: Wide range of uses, including timber for building and Xmas trees.

SITKA SPRUCE. Yield: 600m^3 per Ha after 50 years.

From: Western North America.
Prefers: Damp sites and exposed high land. Stands exposure better than any other common conifer. Avoid all dry sites.
Remarks: Faster growing than Norway Spruce, and a very high volume producer.
Timber: Similar to Norway Spruce. An excellent pulpwood tree also.

OAK. Yield: 75m^3 per Ha after 50 years.

From: All across Europe.
Prefers: Well-aerated, deep, fertile soils. Avoid all shallow, poorly drained soils, and exposed sites.
Remarks: A valuable wood for furniture-making, but grows very slowly – of much greater ecological value – at least 10 000 species of invertebrate, bird, mammal, lichen, etc. are known to inhabit or rely on oak at some stage of their life cycle.
Timber: A valuable wood for furniture making.

BEECH. Yield: 90m^3 per Ha after 50 years.

From: All across Europe.
Prefers: Well drained soils. Many be slightly acidic or alkaline. Grows well on exposed slopes.
Remarks: Casts a very dense shade – despite being deciduous, very little understorey beneath beech woodlands. Of limited ecological value, therefore, other than in adding diversity to conifer plantations.
Timber: A very strong timber used in interior construction and furniture making.

BIRCH. Yield: 300m^3 per Ha after 50 years.

From: All across Europe.
Prefers: Most soils. Copes well with acidic, freely draining soils. Avoid very exposed sites – suitable for slopes. Good pioneer on heather/broom scrub.
Remarks: A useful tree for increasing ecological diversity on a conifer site.
Timber: A poor quality timber, suitable for chipboard and pulpwood only.

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Forestry Commission Guidelines for Forestry Design. (Appendix 2).

The success of your afforestation plan, in terms of its sensitivity to the needs and values of the National Park and other interest groups, depends on its visual, recreational and ecological impact on the landscape. These design principals and techniques will help you create an attractive and varied landscape.

ECOLOGY:

Native species should be favoured, and a mixture of hard and softwoods provides the highest biodiversity. Leave gaps and use deciduous species to encourage an under storey.

LANDSCAPE:

The shape of the forest is particularly important. Edges should be irregular, diagonal to the contour, and reflect the shape of the ground by rising uphill in hollows, and downhill on convex slopes. The following should be avoided:

Long, straight edges;

Right angles;

Parallel edges;

Symmetrical shapes;

Vertical boundaries (running straight uphill);

Horizontal boundaries (following contours).

The following are recommended:

Leave unplanted areas which would screen main landscape features;

Leave gaps between forest and watercourses – this avoids shading water plants and acidification by needle litter. Stream valleys should be planted with broadleaved species if possible, to benefit aquatic life and increase diversity;

Vary the width of unplanted verges beside linear features (tracks, paths, streams);

Include areas of larch, a deciduous conifer - they can be used to highlight landform;

Leave irregular gaps where possible;

An under storey of shrubs near edges provides valuable wildlife habitats, and improves visual diversity.

RECREATION:

With any recreational provision, it is important to minimise any negative visual effects from the scheme. You will need to consider whether your proposals are in sympathy with the natural environment which people come to the site to appreciate. Waymarked trails encourage people to enjoy the forest and the PNC and ONF use them around the PNC. Ideally, they should provide for a full range of physical ability. As much landscape variety as possible should be included. Avoid sites susceptible to erosion – avoid the track going directly down slopes. Inclusion of interpretative boards will help to inform visitors to your aims, encouraging them to treat the site with respect. Picnic areas, where used, should be located for their shelter, aspect (generally SSE-WSW), and view. They are usually close to a car park, but with sufficient ground or tree separation to give visual detachment and minimise traffic noise.

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Method for Estimating Timber Value at Felling. (Appendix 3).

Place over lay grid onto base map. Each square is 1Ha (100mx100m). Count the number of squares occupied by each species. If a square is less than half covered, ignore it. If a square is more than half covered, count it in the total.

Write down each species planted in the first column of the table, bottom right of the base map. Record the yield data for each species planted in the second column – this data is in the Timber Species Fact Sheet (appendix 1).

Fill in the total area occupied by each species in the third column.

Calculate the total yield for each species by multiplying together column one and two.

Calculate the total timber yield by adding up the values in column four. Record this on the table.

Students can now calculate the profitability of their scheme. The value of standing medium grade construction timber is 50 Euros per m^3, and the production costs 15 Euros per m^3.

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Afforestation of a scenic upland site.