

Genetic Diversity and Conservation (AQA AS)

European bison, *Bison bonasus*



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Genetic Diversity and Conservation

Teacher's Notes

This unit illustrates the principals behind conservation of species and biodiversity with a series of visits to programmes which are being carried out in the locality. Lozere has a wealth of rare species conservation programmes, partly because of the links with the Parc National des Cevennes but also because of its freely available open spaces. In Lozere, there are reserves for the wolf, *Canis lupus* and European bison, *Bison bonasus*; active species re-introduction programmes for European beaver, *Castor fiber*, capercaillie, *Tetrao tetrix*, griffon vulture, *Gyps fulvus*, and black vulture, *Aegypius monarchus*; and the captive breeding centre for Przewalski horses, *Equus przewalski poliakov*.

Particularly worthwhile is a visit to the European bison visitor centre, in the north of Lozere. A guided tour around the reserve in a horse-drawn carriage, and a visit to the excellent museum detailing the history of the decline of the bison in Europe and the successful reintroduction programme costs 9.50 EUR for students. Visits to the vulture and Przewalski horses programmes could be combined with a limestone grassland study as both are situated on the Causse Mejan. They could also be successfully combined with half a day white water rafting. The capercaillie re-introduction case-studies can be taught during an evening, and combine well with the populations unit.

Key Syllabus Areas

Unit 2, The variety of Living Organisms

3.2.3 Similarities and differences in DNA result in genetic diversity. The influence of the following diversity:

- The founder effect;
- Genetic bottle-necks.

Bibliography and Useful Web Sites

www.treemail.nl/takh/ Foundation for the Preservation and Protection of the Przewalski Horse;

www.ansi.okstate.edu/breeds/horses/PRZEW/

www.bisoneurope.com Bison reserve on the Margeride, Lozere

Introduction

Population decline of the majority of threatened species is anthropogenic, ie. it has been caused by people. Population decline can be brought about directly, through the exploitation of a species, either for meat, fur, or a natural product such as musk or bone for use in traditional medicine. Alternatively, population decline can be caused indirectly, as a result of actual habitat destruction or disturbance through noise, pollution or raised light levels. Unfortunately, some species have gone so far towards the point of extinction that their natural, spontaneous recovery back to self-sustaining numbers is negligible. This may be because their numbers have dropped to such an extent that stochastic factors – those which are due to chance - play an increasingly important in determining breeding success. For example, environmental pressure such as a severe winter may be enough to remove the last of the breeding females from a population of a species which hibernates, or a poor fruiting year may remove the winter feeding reserves of a bird species.

The International Union for the Conservation of Nature (IUCN), founded in 1948, brings together states, government agencies and a diverse range of non-governmental organisations (NGO's) in a unique world partnership – over 800 members in all, spread across 125 countries. As a union, the IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of the world's natural resources is equitable and ecologically sustainable. The union has helped many member states to prepare National Conservation Strategies for species and habitats. Amongst many aspects of its programme, the IUCN co-ordinates the Red Data List – the definitive list of the population status of plants and animals around the world, and co-ordinates “Species Recovery Programmes” for Red Data Species flagged up as being under severe threat. These programmes co-ordinate the efforts of NGO's and statutory bodies to facilitate the recovery of threatened species. The IUCN has Species Recovery Programmes for the Przewalski horse and European bison.

The Parc National des Cevennes (PNC) has established its own species recovery programme for the European beaver, *Castor fiber*, capercaillie, *Tetrao tetrix*, griffon vulture, *Gyps fulvus*, and black vulture, *Aegypius monarchus*. These programmes came about as the suitability of the PNC for these species was realised. All have a historical presence in the area, and have been lost either through hunting or misinformed persecution, as in the case of the vultures. The PNC has already successfully re-established red and roe deer into the park. Roe deer were eliminated in the 15th century, red deer (and capercaillie) in the 18th century. Other animals are returning to the park spontaneously, including Tengmalm's owl and otter, attracted by the reserve which has become a wildlife refuge.

Specific Information

European bison.

This case study provides an example of how ex-situ conservation can be used to prevent species extinction. The bison at the reserve in the Margueride are bred to maintain a genetic reserve, with extra animals being sent to other collections, and possibly in the future for eventual release into the natural forest environment of the bison in Eastern Europe. European bison are classified by the IUCN as 'endangered'. It is the largest mammal on the continent, large bull bison standing over 6 feet tall and over 9 feet in length, weighing over 2,000 lbs. An adult bison can run at 60km/h, and will jump up to 2m high.

European bison are adapted to the forest environment, being slimmer and taller than their north American cousins. They also have smaller heads, and flatter backs, more suitable for pushing through thick forest cover. The European bison once roamed the great boreal forests that spread from the British Isles, through most of Europe and into Siberia. The population of bison in Europe had been contracting since the end of the last ice age, 12,000 years ago. The bison is a boreal species, adapted to life on the glacial fringe that extended across Europe at this time. As the climate gradually warmed, the range of this species contracted. Climate change, hunting, deforestation and habitat destruction, with a gradual change of its native habitat of coniferous woodland to agricultural land brought about the gradual decline of this species. By 1812, records indicated that only 3-500 remained in the wild. The last European bison surviving in the wild was shot in the Bialowieza forests of Poland in 1919. The only animals that remained were in zoos and private collections in Europe and around the world.

In 1923, at an International Congress for the protection of nature in Paris, a Polish Zoologist, Yan Sztolcman, proposed that research began with the aim of reintroducing the European bison into the wild. By 1923, only 54 European bison remained in the world. In 1932, a registry of European bison was drawn up, which indicated that only 40 European bison of pure blood remained (the remainder were American buffalo hybrids).

In 1929, a small herd of European bison was reconstructed in Poland, using only three females – named Biscaya, Biserta and Plish – who were brought in from zoos in Sweden and Germany. The Second World War slowed the project but eventually, in 1952, two animals were finally released into the wild, in the Bialowieza forest. The first birth in the wild was in 1957, and following subsequent releases which enriched the gene pool of the wild population, by 1959, 28 animals were living in freedom in these forests. By 1999, 3-4,000 animals lived in the wild. By contrast, there are 500, 000 American buffalo in the wild.

The European bison provides an excellent case study of the problems of small founder populations. The species now has serious genetic abnormalities as a result of the use of only three females to give rise to the present population. Five percent of the 250 bison in Belarus are affected by balanoposthitis, a disease which attacks the male genitals. Inbreeding frequently results in genital or sperm abnormalities – in zoo bred big cats, sperm abnormalities have led to the keeping of big cats being phased out in many of the worlds larger zoos.

Stud books are used to maximise out-breeding, and reduce the potential for inbreeding depression within the captive populations on reserves, with the 14 reserves in Europe exchanging males to maximise the genetic diversity of the populations. At Ste. Eulalie, the dominant male is due for exchange with the founder herd in Poland in the next couple of years.

Bison face further problems in their native Poland – there are currently plans to build a major road linking Warsaw and Helsinki, through the reserves at Biebrza and Narew National Parks, Knyszynska Forest Landscape Park and Augustowska Forest – the future for this species is far from assured. These sites are all legally protected and contain four sites protected specifically for birds, in the pan-European Natura 2000 network. Other species including elk, lynx and wolves are also likely to be impacted with the highway cutting through major migratory routes.

The Reserve.

Reserves for the ex-situ conservation of this species were gradually created around Europe, in suitable areas which had a cold continental climate in winter. There are now 14 reserves around Europe, where the bison live in semi-liberty, in the Ukraine, Poland, Lithuania, Russia, Belarus, and in France – at the Reserve de Ste. Eulalie, in Lozere, established in 1990. It is 200Ha in size, sub-divided into four sectors around which the animals are rotated during the year, depending on the availability of forage. The two main parts of the reserve are 75 Ha, and the bison are rotated between these summer and winter to allow the forage to recover. 40 Ha is reserved for younger animals, which are old enough to leave their mothers, but not yet old enough to breed. 10 Ha of the reserve are put aside to display the American buffalo, so that visitors can see the contrast between the forest-dwelling bison and the prairie-dwelling buffalo. During the winter they are

provided with supplementary feed, and a vet is on site. A reserve of this size can support a theoretical maximum of 42 bison.

Nine bison (3 males and 6 females) were transported from the forest of Bialowieza (2500km away!) and released into the reserve on 9th January 1990. A further arrival of bison occurred in 1991, bringing the total to 20: 15 females and 5 males. The reserve was then opened to the public in August 1992. One male dominates the herd, and males fight each season, the dominant male winning the right to mate with the females in the herd. The dominant male at the moment is called "Kleptoman".

Females are pregnant for 9 months, and feed their calf for 11 to 12 months. They will only have one calf (rarely twins) every two years. Young weigh 25 to 30kg at birth, and are branded early on (KA if born on this reserve, PO if born in Poland). Males live to 15 years, and can breed from 3 years old. Females live to 18 years, and can breed from 5 years old.

During a typical year, a proportion of the bison are tested for TB (not all animals are tested each year as blood testing requires animals to be anaesthetised which is stressful for the animals). All bison are fed a prophylaxis each year to treat worm parasites. Reserve staff examine bison droppings every three to four months to check for the presence of worms, and examine the diet of the bison.

The reserve received up to 500 visitors each day in the summer, and is a privately owned park. The questions provided in this pack will encourage students to direct their note-taking and make the most of their visit to the reserve.

[Przewalski Horse.](#)

The Przewalski horse (or 'Takh' in Mongolian) is the last remaining wild species of horse. All other horses are either domesticated or descended from horses which were once domesticated. They are distinct from the modern horse, having 66 chromosomes as opposed to 64. Whilst crosses between Przewalski horses produce a fertile hybrid, they have 65 chromosomes. Blood testing has also revealed markers which are unique to the Przewalski horse.

Przewalski horses were once common across Asia and Europe, illustrated in cave paintings in France dating from the last ice age. They are named after a Russian explorer, Colonel Przewalski, who 'discovered' them in Mongolia in 1881. Przewalski horses were last seen in the wild in 1968, in the Tachyn Schar Nuruu area in the south west of Mongolia on the border with China. It is certain at present that they are extinct in the wild.

In the early 1900's, 53 Przewalski horses were captured from the wild and dispersed between zoos and private parks. The present captive population is based on no more than 13 original ancestors. At the moment, more than 1,200 Przewalski horses live in captivity or semi-freedom – this has been the case for 11 to 13 generations, without the introduction of new genes from wild stock. This represents a severe genetic bottleneck and presents a huge potential for inbreeding depression. Concern for the future of the horse led to the production of one of the world's first International Stud Books which charts the genetic history of each individual animal and ensures that when animals are captive-bred, it is with animals with which they are as

far genetically removed as possible. This has led to the exchange of breeding stock across international borders.

The aim of the TAKH Association is the captive breeding and eventual release of Przewalski horses into the wild. The facility at Le Vilaret is a real success story. There are now nearly 80 Przewalski horses living in semi-freedom on the Causse Mejan. They live there all year round. The conditions are thought to be similar to the Mongolian Steppe, if anything, slightly less extreme. Temperatures on the Causse range from 35°C in the summer to -20°C (with wind chill!) in the winter. Temperatures in their original habitat can range from +40°C to -35°C. The breeding and bachelor herds graze across an extensive area of limestone grassland, and receive supplementary feed in the winter.

A visit to the reserve will enable students to see Przewalski horses (hopefully close up, but they are a wild animal and are able to range over a large area, so there is always the chance that they could be some distance away) and to learn more about the TAKH programme at Le Vilaret. There may be a warden on site for the student to meet. If they are not available, Discover staff will give a talk about the work of the Association. The ultimate aim of the Przewalski foundation is the reintroduction of the horse into the wild – two combined breeding groups have been returned to Mongolia to date.

[Black and Griffon Vultures.](#)

The first evidence for vultures in this area dates to 70,000 years BC – vulture bones have been found in caves in the Tarn / Jonte Gorges and dated to this time. Vultures became extinct in the area which is now the Parc National des Cevennes by 1945. This was as a result of persecution by humans, who mistakenly believed that vultures killed livestock. The vultures were shot and poisoned indirectly when they consumed the bodies of animals which man had poisoned intentionally, such as foxes and wolves. There was also a reduction in the amount of carrion available to the vultures when early health legislation specified that the carcasses of dead livestock be buried rather than left for the vultures to remove. The carrion food chain of the Tarn Gorge and Causses was broken down – only the raven, red and black kite remained.

The re-introduction programme for griffon vultures, *Gyps fulvus*, began in 1970 when the first aviary was built. For ten years, this aviary was home to dozens of birds awaiting their return to freedom. An initial attempt in July 1971, to release four young vultures imported from Spain was unsuccessful. The birds all either died or disappeared. It was subsequently decided that time was needed to form a balanced population of captive vultures including a sufficient number of reproductive adults attached to the site. This period, during which the birds received daily care, lasted for ten years!

On December 15th, 1981, five pairs of griffon vultures were released. Six of the birds succeeded in forming a flock, two disappeared and one flew into an electric cable. One proved too tame for survival in the wild and had to be recaptured. This trial flock was increased by the addition of birds released periodically until 1986. A lengthy period of watching and waiting then ensued as formation of the colony was facilitated and understanding of how it functions grew. This is the only vulture colony in the world to have undergone such extensive study. There are now up to 250 griffon vultures at this site.

In 1992, the black vulture, *Aegypius monachus*, was also re-introduced into the area. The black vulture is now very rare in Europe – there are now thirty black vultures at this site, completing the carrion food chain. The only European carrion feeder which is still absent from the area is the lammergeier, or bearded vulture, *Gypaetus barbatus*.

The 'Belvédère des Vautours' has a display area, detailing the history of vultures in the area and the story of their reintroduction; an observation deck equipped with telescopes from which students can view the vulture colony and at the right time of year, chicks; a live video observatory with cameras trained on nests on the cliffs; shop. A visit to the 'Belvédère des Vautours' costs students approximately £2.00. It may also be possible to receive a talk from one of the wardens at the site, for a small additional cost.

[The European Beaver.](#)

After the end of the last ice age, the European beaver, *Castor fiber*, was found across Europe, including many parts of the UK. By the start of the 20th century it was on the brink of extinction in France. The beaver has long been exploited by humans for its fur and for a secretion, castoreum, which is produced by the beaver by a gland as a result of eating willow bark. People have historically used this as a traditional cure for many ailments – castoreum contains salicylic acid, which is one of the active ingredients in aspirin. Eventually, the beaver was protected in France in 1909. The beaver has always been present in low numbers in the Gardons river basin in the Cevennes, which flows south into the Mediterranean. Presence in the locality encouraged the PNC to re-introduce the beaver into the Tarn, which flows into the Atlantic. Six breeding pairs were introduced into the Tarn between Florac and Le Rosier, in 1980. Now, all of the potential sites for this species have been occupied by breeding pairs and their offspring.

The beaver feed on fish commonly found in the Mediterranean basin - barbel and dace - and in the Gorge du Tarn, they also feed on freshwater crayfish. Evidence of the activity of beavers can be seen along the stretch of the Tarn between Les Vignes and Le Rosier – and is best seen from a boat! Characteristically felled trees up to 1m in diameter, which have fallen into the river, can be seen, along with teeth marks from where the beaver have nibbled off bark for food. Evidence of small beaver dams can also be seen. As beavers are nocturnal, it is extremely unlikely that students would be able to see one during a visit. It is the long term aim of the programme that individuals from the Tarn and Garons river basins will move freely and disperse across the water shed at the Col de Jalcreste. This will maximise the genetic robustness of the beaver in this area of France, permitting gene flow between what are at present two separate populations.

[Capercaillie.](#)

The capercaillie, *Tetrao tetrix* is a boreal species that had as its former distribution the whole of the European land mass, from Scotland, through Europe and into Siberia. It is still found in large numbers in Scandinavia and Eastern Europe, and it is still found at altitude in parts of its former range. It is an enigmatic and attractive bird species, the largest member of the grouse family, and a species which the PNC have been interested in reintroducing for many years. This species provides an excellent case study of a species whose conservation in-situ has been supported by ex-situ techniques (captive-breeding).

The capercaille became extinct in the area that is now the Parc National des Cevennes during the 18th century. The major cause for its extinction in the area was the gradual change in land use from forests to pasture and cultivated fields – another name for the capercaille is the wood grouse, forests being the preferred habitat. The forest structure required by capercaille is very different to the tight, constricted forestry provided by commercial forests grown for timber production. Capercaille require mature, open pine forests, with clearings in which bilberry and heater grow, and old pines in which to safely roost at night. It is a large bird with a wing-span of up to 125cm.

The chicks of the capercaille are predated by the fox and pine martens, which, along with wild boar, take eggs from the nest. Adult birds are predated by goshawk, and pine marten, who will only eat the head of the adult bird. It is thought that a population explosion of these predators was also a likely cause for the reduction in capercaille numbers in the area, particularly since the reduction of lynx and wolves, which would have maintained the populations of the smaller carnivores at a more acceptable level.

The capercaille is the largest of the European grouse species, and is restricted to coniferous forests, where there is a significant proportion of pine with elements of deciduous trees and bogs, which support berry-bearing shrubs such as cowberry, bilberry and juniper. The capercaille feeds largely on pine needles, buds and aspen leaves from November to March, supplemented with berries during the late summer and autumn. The chicks feed on insect grubs in the spring to provide essential protein.

The Capercaille males exhibit lekking behaviour – they come together in all- male groups during the winter, and females visit the lek to choose a mate.



Some control measures have taken place, specifically targeting numbers of red fox in the release areas, but this species re-introduction programme has been fraught with difficulties and has only been of limited success. Adult birds were brought into the Cevennes National Park from Austria and Italy. The adult birds were kept in aviaries and used to produce over 600 chicks. Of these, some were reared by their parents, whilst others were reared artificially, being kept warm under artificial lighting, and fed a supplemented diet enriched with vitamins and minerals. The success of the chicks reared more naturally by their parents was more marked.

The chicks were reared and released over a 15 year period between 1978 and 1993. 80 to 90% died before reproducing – due to predation, flying into electric fences and power-lines and dispersing out of the protected area of the national park. Between 50 and 60 birds remained after the completion of the programme. There are at present thought to be approximately 30 adult birds in the park – 20 were counted during the summer of 2003. The reintroduced population is thought to be decreasing by 9% each year.

The major reason for the lack of success of this programme is thought to have been the large distance over which the birds disperse after release. The core protected-area of the PNC is only 90,000Ha and there are no barriers for the birds flying out of the area. When spread over a wide area, they are less able to find

partners for breeding. Many birds are killed flying into wire fences and electric power-lines. Capercaillie are also particularly susceptible to disturbance, particularly during the lekking season (in winter) and when rearing their young. An increase in the amount of tourism, albeit 'green tourism', with people walking (especially with dogs which are not under control) and mountain biking through the areas where the birds have been reintroduced, is also implicated in the lack of success in this programme.

Aims

- To introduce the principals underlying species conservation and the protection of rare species, and the principals of biological conservation and maintaining the diversity of living organisms within habitats (candidates should be able to describe an example);
- To illustrate the significance of the EU Habitats Directive concerning the conservation of natural habitats and of wild fauna and flora and of Natura 2000, through local examples of programmes being carried out in Lozere;
- To describe the harmful effects of inbreeding and explain the need to maintain a gene bank for possible future use, including conserving wild types and rare breeds as genetic resources;
- To discuss the economic and ethical reasons for maintaining biodiversity;
- To provide case study material of successful captive breeding and release programmes.

Method and Organisation of Study

Activity 1: A visit to the European bison reserve at Ste. Eulalie;

Activity 2: A visit to the 'Belvédère des Vautours', Les Rosiers.

Activity 3: A visit to the Przewalski Horse Breeding Facility, Le Vilaret.

Discussion Points

- How successful have the species re-introduction programmes been in the PNC?
- Can you suggest how any of these programmes can be made more successful – how would you manage the conflicting aims of the PNC in the case of capercaillie reintroductions?
- How does the use of a stud book help species to survive genetic bottle necks – where there are only a few surviving animals?
- How could species reintroduction programmes be used by the PNC to support their other aims (eg. Education);
- What are the links between species conservation and the principals of biological conservation and maintaining the diversity of living organisms within habitats? How does one support the other?
- What is a 'flag-ship species' – how can a high-profile threatened species be used as an umbrella to aid the conservation of the wider habitat?

Follow-up Activity.

Design a poster (to be exhibited in the PNC central information centre in Florac), describing the efforts of the PNC and its partners in supporting species conservation. Include:

- Details of the species conservation programmes active in the PNC today (either concentrate on one and cover it in great detail, or include a summary of all of the programmes);

- How species conservation fits into the overall aims of the PNC (see Appendix 1), particularly how some of these aims may support one another, and others may conflict (ie. Hunting, disturbance from walkers, etc.)
- Flag-ship species and habitat conservation.

Discussion Points

- Evaluate the advantages and disadvantages of the conservation techniques used for endangered species with and surrounding the Cevennes National Park.
- How successful has the ex-situ conservation of the European Bison at Ste Eulalie been? Is it a successful business or a successful captive breeding programme? Discuss your thoughts.
- How good is the education programme at the vulture reintroduction centre. How could it be improved?



Eagles Nest European Bison Reserve

Include as much detail as possible for each of these points – the information can be found out from the excellent displays, or by asking one of the guides.

When would bison have been at their most common?

When and why did bison become extinct in the wild?

- 1.
- 2.
- 3.
- 4.

What stopped the bison from becoming completely extinct in the wild?

Describe why the site of the reserve is good for bison (size, climate, food sources);

Describe the population structure of the bison on the reserve at the start of the project, and today.

Describe how the bison are looked after on the reserve during a typical year? (Give details of feeding, vet treatment, movement around reserve?)

7) What is inbreeding depression? How can it reduce species fitness? How is it kept to a minimum on the reserve (think about: the reproductive strategy of this species – how is parentage guaranteed? What happens to excess males? Use of stud books?)

8) What are the threats to bison in the wild today?

9) Is this an example of ex-situ or in-situ conservation? Justify your answer.



Eagles Nest Przewalski Horse Reserve

Include as much detail as possible for each of these points – the information can be found out from the excellent displays, or by asking one of the guides.

When would Przewalski horse have been at their most common?

Describe in detail the appearance of a Przewalski's horse. What makes them unique?

When and why did they become extinct in the wild?

What stopped the Przewalski horse from becoming completely extinct?

Describe why the site of the reserve is good for the horse (size, climate, food sources)

Describe the population structure of the horses on the reserve at the start of the project, and today.

Describe how the horses are looked after on the reserve during a typical year? (Give details of feeding, vet treatment, movement around reserve?)

7) What is inbreeding depression? How can it reduce species fitness? How is it kept to a minimum on the reserve (think about: the reproductive strategy of this species – how is parentage guaranteed? What happens to excess males? Use of stud books?)

8) What are the threats to Przewalskis' horses in the wild today?

9) Is this an example of ex-situ or in-situ conservation? Justify your answer.



Eagles Nest Vulture Reintroduction Programme

Include as much detail as possible for each of these points – the information can be found out from the excellent displays, or by asking one of the guides.

When would vultures have been at their most common?

When and how did they become extinct in this area?

Approximate date _____

Reason 1

Reason 2

Reason 3

What species of vultures did the programme aim to reintroduce?

What is the role of vultures in the Tarn Gorge food web, and why is this so important?

What are the other species of carrion feeders in France?

Describe why this site is good for the reintroduction of vultures.

How did the reserve reintroduce the griffon vulture – give as much detail as you can (eg. when did the programme start, how did they raise the birds, how successful was the programme in the beginning?)

How are the vultures looked after now – what input do humans have?

Appendix 1. The Objectives of the PNC (2000 – 2006 Management Plan Document)

Objective 1.

- Conserve and develop the potential of habitats and natural environments – open spaces, forests, wetlands, water ways, rocks. Put into action:
 - A knowledge and understanding of the management of habitats and natural areas;
 - The protection of exceptional areas;
 - Protect water ways, water catchments and wetlands;
 - Inventory, protect and manage rock formations and mines of interest.

Objective 2.

- Protect animal and plant species of conservation and heritage value. Put into action:
- Surveys of animal and plant species including lesser known species;
- Preserve biodiversity and manage plant and animal habitats;
- Reassure people that there are no plans to reintroduce large predators (wolves and lynx);
- Fight against invasive plant species

Objective 3.

- Control game animals at levels compatible with the safeguarding of the environment, and control those activities that influence their numbers (ie. hunting). Put into action:
- Manage habitats so that they can support game animals at sustainable levels for hunting and the environment;
- Produce a development plan for game animals to keep them at sustainable levels;
- Experiment and research these levels so that hunting can be sustainable;
- Communicate with all the parties involved in hunting so that they can take on board the aims of the PNC.

Objective 4.

- Retain the life and character of the Cevennes landscape. Put into action:
- Know and understand the roots of the traits and characters of this remarkable countryside;
- Put into action the 'Countryside and Environment Plan' which will allow the management of existing heritage features and the re-establishment of lost features in the landscape.
- Retain the local architectural types found in distinct regions throughout the Cevennes by influencing the planning application process.
- Advise and educate the planning office about proposed building work and ensure that work meets the standards set down by the Park as seen in 'model' villages such as L' Hopital;

Objective 5.

- Combine the safeguarding of the area's cultural heritage with its future cultural development. Put into action:
- Carry out a complete archaeological inventory of sites in the area;
- Support the development of scientific processes and research and create experimental worksites;
- Create an intervention fund;
- Improve the quality of building work which is carried out;
- Encourage the restoration of associated commune features such as beals, mills, bread ovens.
- Create an oral history and memoir of lifestyles and practises linked to the local area.
- Support the development of the Occitan language.

Objective 6.

- Encourage visitors to the National Park and suggest the Visitor Centre and Ecomusees as a destination. Put into action:
 - Research the needs of the visiting public;
 - Reinforce partnerships between organisations in the Ecomusee scheme – ie. Hyelzas farm, Le Troubat, Mas Camargue, etc.
 - Develop the visitor Centres: revive the Ecomusee in Pont de Montvert, complete the Cevennes Ecomusee, develop the Ecomusee of the Causse and gorges, create a Mont Aigoul Ecomusee, promote eco-tours in the PNC, Improve training for personnel, reorganise the information centres, develop the identity of the park.

Objective 7.

- To encourage eco-tourism and spread it across the PNC more evenly. Put into action:
- To better understand what people do when they come to the PNC, and their expectations;
- To promote a range of tourist services and products that meet the Parks aims, and work within the EU sustainable tourism charter;
- To redirect tourist developments and encourage them to be more evenly spread around the PNC;
- To develop Mas de la Barque, the Station du Ski on Mont Lozere and Mont Aigoul as tourist destinations;
- To produce and improve the sale of walking guides and illustrated maps of the region ('Carteguides') to include 50 sites plus associated walks;
- To improve the existing network of walking routes;
- To increase the number of caravan and mobile home camping sites;
- To increase the number of 'Gites Panda',
- To support and influence green-tourism enterprises, and offer training.

Objective 8.

- Encourage a permanent resident population, who live in touch with the environment and landscape. Put into action:
- The inhabitants are responsible for the quality of the landscape, so encourage the use of renewable energy sources, sensible removal of rubbish, etc;

- To generate a habitat management policy;
- To enable the permanent residents to be autonomous, acknowledge their expertise, and embrace traditional and modernity;
- Continue to assist local farmers financially through grants and with advice in developing farming practises, and their property.

Objective 9.

- Encourage farming, which respects the environment and is adapted to the different part of the PNC.
Put into action:
- Encourage natural farming practises which work in harmony with not fight against the natural constraints of the environment;
- Encourage compassionate farming, which offers jobs for young people, employs more people;
- Encourage dynamic farming in the sense of farm diversification;
- Encourage farming, which doesn't pollute the environment, use chemicals and supports the traditional animal and plant varieties in this area.

Objective 10.

- Plant and develop rich and diverse forestry. Put into action:
- Manage the forests on a local level – manage forests in partnership with the ONF;
- Plant and develop multi-use forests;
- Create a forest, which has better landscape quality, better ecological value and higher biodiversity.

Objective 11.

- Enhance the image of produce and labelled items originating in the PNC, and ensure that production will be ongoing. Put into action:
- Reconcile social and economic development with conservation of heritage resources;
- Introduce a characteristic 'PNC' or 'Cevenole' label which has "eco-certification";
- Ensure that production will be able to continue in the long term;
- Research possibilities for some new products made from chestnut wood.

Objective 12.

- Develop project partnerships with local communities and local people.

Appendix 2. Bison at Ste Eulalie, 08/03/07.

No.	No. of Pedigree	Name	Parents	Date of Birth	Sex
6	7123	Polina		17/05/90	F
10	7502	Karesa		1990	F
19	7504	Kamelia		1991	F
12	7505	Kaverne		1991	F
13	7506	Kandida		1991	F
17	7509	Kasandra		1991	F
21	7514	Kabernet		1991	M
28	7822	Clarence	06*05	30/05/93	F
30	8032	Clementine	10*02	9/06/94	F
34	8033	Clemantite	06*05	18/11/94	F
35	8522	Clochard	12*05	10/05/96	M
36	8828	Cleptomane	13*05	18/04/97	M
41	8834	Clarine	19*05	27/09/97	F
42	9117	Club	28*21	21/05/99	M
	9331	Clarine 2	17*03	17/04/00	F
	9334	Claque	Popis 3 * Clarence	19/04/00	F
	9332	Climat	06*02	21/04/00	M
43	9523	Clopin	10*14	9/05/01	M
	9731	Clapet	12*21	7/05/02	M
	9734	Clipper	17*21	19/05/02	M
	9735	Clotilde	6*21	25/05/02	F
	10033	Clavaire 2	34*21	23/05/03	F
	10034	Claudine	6*21	26/05/03	F
	10035	Classe	28*21	28/05/03	F
	10135	Clavecin	12*21	23/04/04	M
	10136	Clairon	17*21	25/04/04	M
		Cloe	13*21	21/04/05	F
		Clog	10*21	16/05/05	M
		Clement	6*21	20/05/05	M
		Clever	41*21	05/06/05	M
	10637	Clebard	17*36	22/04/06	M
	10674	Clelia	12*36	24/04/06	F
	10675	Clavier	6*36	25/07/06	M
	10676	Cliff	30*36	18/11/06	F

		Clio	41*36	11/01/07	F
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