

REINTRODUCING LARGE CARNIVORES TO BRITAIN



GREY WOLF, EURASIAN LYNX AND EUROPEAN BROWN BEAR

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Reintroducing Large Carnivores to Britain: Grey Wolf, Eurasian Lynx and European Brown Bear

Introduction

The implications associated with reintroducing large carnivores into Britain are vast and complicated. Reintroduction is defined as an attempt to establish a species in an area that was once part of its historical range, but from which it has been extirpated or become extinct¹. The top predators that will be examined here in detail are the grey wolf *Canis lupus*, Eurasian lynx *Lynx lynx* and European brown bear *Ursus arctos*. Once native in Britain, these species became extinct primarily due to human activities. We therefore have an ethical and moral responsibility at least to consider reintroducing such animals, allowing them to re-take their designated place as top predators within our ecosystem.



Eurasian Lynx

The wolf, lynx and bear are all part of the Large Carnivore Initiative for Europe (LCIE). Its mission statement is 'to maintain and restore, in coexistence with people, viable populations of large carnivores as an integral part of ecosystems and landscapes across Europe'².

International treaties, such as the Bern Convention (1979) and the Rio Convention (1992), oblige the UK to encourage the restoration of populations of native species, while the EC Habitats Directive (1992) obliges the UK to consider the desirability of reintroducing former British natives such as the wolf, lynx and bear³.

These three species are keystone species; their impact on community structure is disproportionately large for their abundance. Removal or decline of such a species will have

a pronounced effect on ecosystem parameters⁴. Carnivores are indicators of ecosystem function and can serve as keystones in the top-down regulation of ecosystems⁵.

This means that top carnivores (occupying the highest trophic level) exert control on species at the next lower level (prey)



Grey wolf

and this continues down through the trophic levels. Top predators are believed to exert a regulatory role on ecosystems. Without their presence, the ecosystem becomes simplified and extinctions may occur.

Large carnivores (top predators) are capable (depending on the circumstances) of controlling not only the distribution but also the abundance of their prey. This can enhance the overall biodiversity and ecological integrity (native components are intact) of the environment.



European brown bear



The Grey Wolf

Scientific knowledge of the role of the wolf in ecosystems has increased greatly. In some areas there has been a marked change in public attitudes towards the wolf and this change in attitudes has influenced governments to revise and even eliminate archaic laws⁶. In Europe, wolves are still killed even when compensation is paid and when economic incentives are provided for better damage prevention⁷.

Factual and educational programmes are essential for wolf survival on reintroduction to Britain. Without the full support and participation of local people no significant conservation objective can be reached⁷. People's opinion of the wolf remains prejudiced, and this poses a serious problem for obtaining support for the reinstatement of the species into this country.



Grey wolf skull

The Eurasian Lynx

Reintroduction of the lynx to Britain is the most feasible of the three large carnivores, especially on an island nature reserve or enclosed 'eco-parks'⁸. Through natural re-colonisation and reintroductions, the lynx has started to make a comeback in Europe. The general public and media are less interested in the conservation and reintroduction of this elusive species than either the wolf or bear. There is at present sufficient forest cover and suitable prey populations to support a viable population of lynx in the Scottish highlands. We would not be able to return to Mesolithic population levels of nearly 7,000 lynx, but a reasonable population could be sustained with relatively few problems⁹.



Eurasian Lynx skull

Nearly hunted to extinction by fur trappers in the 20th Century, the lynx has now re-colonised parts of Europe.

The European Brown Bear

Spanning Europe, Asia and North America, the brown bear has the widest distribution of all bear species. The reintroduction of this species is seen to be unacceptable in the foreseeable future due to the potential threat to people. A more extensive dense forest cover over a much greater area is required for bear reintroductions. The UK has few extensive areas of semi-natural habitat suitable for large carnivores, and even the remotest areas support potentially conflicting economic activities, like extensive sheep rearing or deer stalking⁸.



European brown bear skull

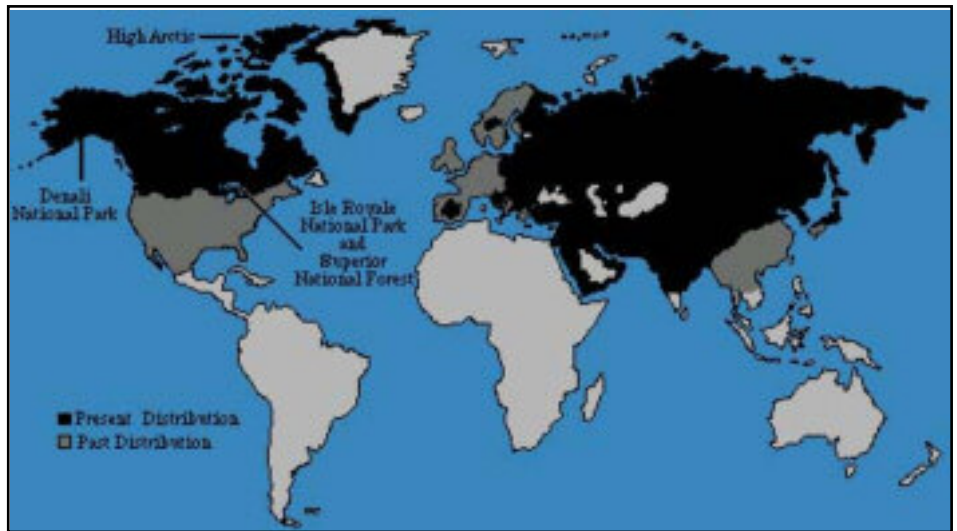
Although the same species, the North American brown bear is referred to as the grizzly bear. In some countries bears are managed as a game species, whereas in other countries they are legally protected (with the exception of a small amount of permits for the annual harvest).



History in Britain

The Wolf

The wolf was the last of the large carnivores to become extinct in Britain, disappearing in the 17th century. Hunting by humans was the primary cause; either due to the perceived threat to livestock or for sport. Wolves have also been hunted and trapped in countries such as Alaska and Canada for their fur. The wolf now ranges across parts of the United States, including Alaska, Idaho, Michigan, Minnesota, Montana, Wisconsin and Wyoming as well as Canada, Russia and a few eastern European countries.



Worldwide wolf distribution



Fossilised wolf jaw

Although extinct in Britain, the wolf is recovering naturally in Europe, where it is believed its population may have reached

numbers of up to 18,000. It was once present on every continent of the Northern hemisphere, where it played a critical role in maintaining the ecosystems to which it belongs.

Wolves were part of the natural wild fauna of Britain from inter-glacial times, approximately 50,000 years ago. As the glaciers of the last Ice Age retreated, about 10,000-12,000 years ago, wolves again re-colonised the British Isles. Mesolithic population estimates for the wolf stand at 7,000 individuals. The wolf was common throughout Britain in Saxon times where it thrived during wars. It disappeared from southern Britain about 800 years ago, although it was locally common at the time of the Battle of Hastings, where it scavenged the dead. A fossilised wolf jaw was discovered in Kent which was dated to 1300AD, a time in which the wolf was supposedly extinct from the area. The last British wolf is reputed to have been killed in Scotland in 1743, but the species disappeared from England by 1680.

People's negative view of wolves is often due to myths and superstitions that have been passed down through generations. Very few validated encounters of wolves attacking humans have ever been documented. When humans were hunter-gatherers the wolf was seen as a resourceful, powerful fellow-hunter. When we began tending livestock, the wolf remained a hunter, but then became a competitor. This is when the demise of the wolf began.

Legal Status

The wolf's conservation status places it on:

- IUCN Red List of Endangered Species, under the category of least concern (prior to 1996, wolves were found under the category of vulnerable)
- Appendix I and II of the Convention on International Trade in Endangered Species (CITES)
- Appendix II of the Bern Convention, Council of Europe
- Appendix II of the Habitats Directive, European Union
- The European Parliament Resolution on Wolf Conservation



The Eurasian lynx

The Eurasian lynx has been missing from Britain for the past 1,800 years. The most recent fossil was dated to approximately 300AD, although it is believed they could have survived longer due to their elusive nature. Mesolithic population estimates for the lynx stand at 7,000 individuals. The last glaciation, which reached its maximum extent about 20,000 years ago, means we have a clear starting point for any historical appreciation of our present fauna¹⁰. Great Britain became separated from Western Europe around 8,000 years ago, when the melting of the ice caps caused worldwide sea levels to rise. This effectively ended colonisation by terrestrial mammals, and therefore allows a definition of the native fauna – those that got here before that date by their own migrations¹⁰. From fossil



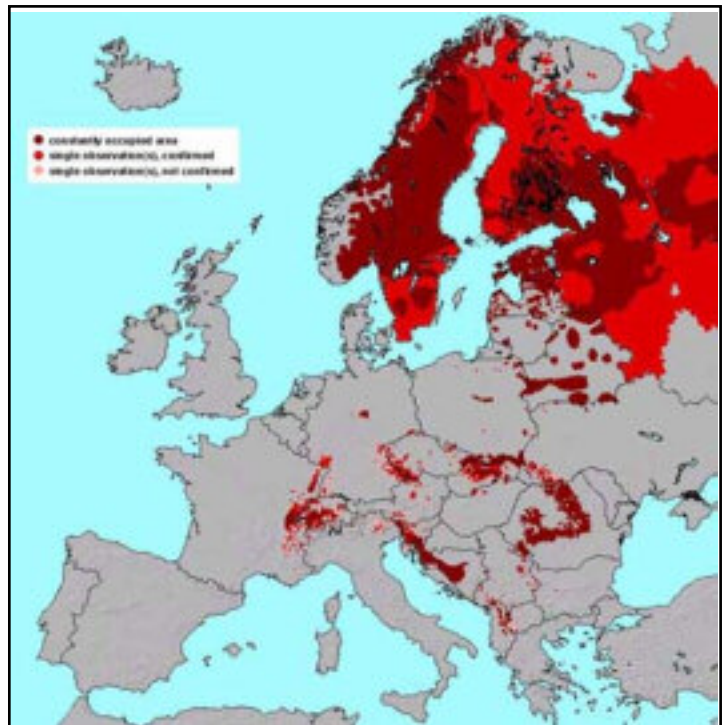
Lynx pelt

evidence it can be concluded that the lynx once roamed Britain from the south coast to the north coast³.

It is believed by some that the Eurasian lynx died out from natural causes such as an increasingly colder climate. Many believe that this acted as a secondary factor to humans. Severe deforestation for farming removed

dense cover required by the lynx and reduced the number of woodland deer. The lynx then turned to killing livestock, the farmers of which killed the lynx in order to protect their animals. Due to intensive hunting for their fur and their considered threat to other wildlife populations, the lynx has been eradicated from much of its former range in Europe¹¹.

The lynx was once widespread with its vast geographic region extending from Scandinavia, eastward across parts of northern Russia, to the Pacific coast of Asia. Its range has shrunk dramatically, particularly in Europe where populations in Norway, Sweden, Poland,



Eurasian lynx distribution

Slovakia, Romania and the Czech Republic have rebounded from near extinction¹¹. There are believed to be approximately 50,000 Eurasian lynx of which about 3,000 are in Europe. The largest population of the Eurasian lynx is in Russia, where there are an estimated 36,000-40,000 individuals¹¹.

Legal Status

The lynx's conservation status places it on:

- IUCN Red List of Endangered Species, under the category of near threatened
- Appendix II of the Convention on International Trade in Endangered Species (CITES)
- Appendix III of the Bern Convention, Council of Europe
- Appendix II and IV of the Habitats Directive, European Union



The European Brown Bear

Brown bears became extinct in parts of Britain in the 8th century, surviving in Scotland until the 10th century. The major causes of decline were destruction of suitable forest, hunting and persecution. Mesolithic population estimates for the brown bear stand at approximately 13,000 individuals, numbering over twice that of either the lynx or the wolf.

Over the past 300-400 years, bear numbers have declined dramatically throughout Europe, primarily due to human actions. It is estimated that the total global population of the brown bear (including the North American grizzly bear) numbers somewhere between 125,000 and 150,000 animals. Their preferred habitat includes mountain forests, open meadows and large river valleys, but in some areas they inhabit seashores, arctic tundra and dry deserts¹². Until the late 16th century, European brown bears existed as one large population. After this they became significantly affected by increasing human populations¹³.

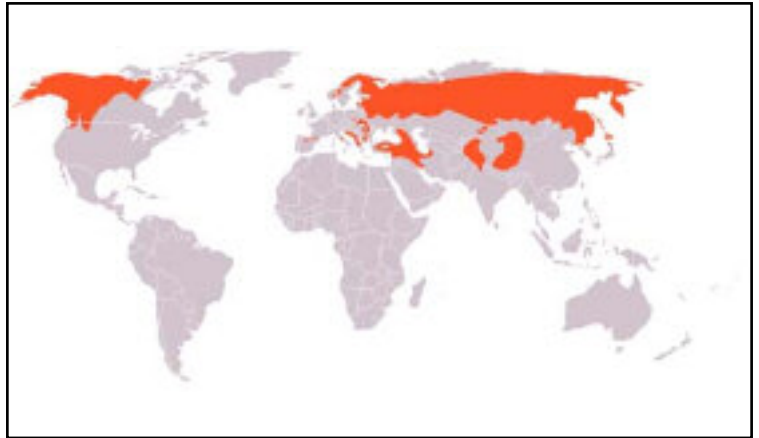
The most widely distributed bear species, the brown bear is found from western Europe to the Far East and Japan, parts of North America including Canada and Alaska, as well as isolated pockets in eastern Europe. European brown bears are currently found in ten populations which vary greatly in size; the North-eastern population of 37,000 bears is the largest; Trentino in the southern Alps (Italy) has the smallest population consisting of just 8 bears.

Threats throughout Europe include; hunting (both controlled and illegal), poisoning, deforestation, agricultural settlement, habitat loss, logging, poaching and human interference. There are still concerns about the



Brown bear gall bladder

illegal trade in bear populations, especially for gall bladders and bear paws.



Brown bear worldwide distribution

Habitat fragmentation is becoming an increased problem due to the construction of roads, opening up areas previously unreachable by poachers and hunters. Bear farming occurs in some countries, where bile is continuously extracted via a tube into the bile duct. Entertaining bears taught to dance are still used in some eastern European countries such as Bulgaria. Although some populations appear to be stable or even increasing, intensive conservation measures including translocations will be required in parts to save remnant populations¹⁴. Due to the small population size of many isolated remnant populations they are extremely vulnerable to random demographic fluctuations.

Legal Status

The brown bear's conservation status places it on:

- Appendix II of the Convention on International Trade in Endangered Species (CITES)
- Appendix II of the Bern Convention, Council of Europe
- IUCN Red List of Endangered Species, under the category of least concern
- Appendix II (except Swedish and Finnish populations) and IV of the Habitats Directive, European Union



Ecology and Behaviour

Wolf ecology

The grey wolf was once the most widely distributed of all land mammals. Although only found in northern latitudes, wolves can live in a variety of habitats, as long as prey density is high enough to sustain a viable population. Wolves are opportunistic predators, feeding primarily on large ungulates such as deer, elk and wild boar. They appear to select for wild ungulates as long as more than one species is available, although they may take domestic livestock if wild prey is scarce⁸. Wolves are also seen as competitors for game in most European countries. Competition for similar food resources is seen from bears, tigers, cougars and dogs where present. It appears that wolves learn to prey upon the more easily obtainable species in their area; if deer and moose are available, higher proportions of deer will be taken¹⁵. On average a single wolf requires between 15-20 adult sized deer per year, although this does vary considerably.



Pack of wolves eating deer

The wolf is the largest member of the dog family, with the ability to hunt and kill animals of a larger size than itself. The wolf's physical traits and adaptations

reflect its predatory instincts. Wolves have long legs in comparison to other members of the dog family, designed not only for speed but also to overcome the hardships associated with deep snow¹⁵. Their dentition and jaws are likewise adapted to their carnivorous diet. Massive jaws are secured by strong masseter muscles and specialised carnassial teeth are used for cutting through tendons and flesh. The massive molars and powerful jaws are used to crush the bones of prey. The long skull contains a specialised olfactory area, which is most accurate at detecting an animal that is downwind of the wolf. The wolf's sense of smell is so well developed that it can smell its prey from more than 1.75 miles away.

Wolves live in packs, normally comprised of family members. Usually only the alpha male and the alpha female (dominant individuals) breed and the rest of the family help to look after the pups. Where there is high prey abundance, other females may breed, producing more than one litter per pack. A pack generally consists of the adult parents (alpha pair) and their offspring of the last 2-3 years. A typical grey wolf pack has 6-8 members but where food availability is high (in North America and Canada), numbers of up to 30 have been observed.

Wolves have amazing hearing and can detect other wolves howling from 6 miles away in forests and 10 miles away across open countryside. Wolves may howl to call the pack together, as a ritual or to find and identify each other and outsiders. The most dominant wolf starts the howl and the rest of the pack joins in according to their place in the hierarchy. The dominant wolf is also the last to stop howling.



Wolf howl

Wolves have numerous scent glands on their bodies to indicate their presence and identity to others. Urine and faeces are used as territory markers to deter wolves from other packs in the area.

Wolves can live for up to 13 years in the wild and up to 16 years in captivity. Their thick fur usually has a mottled grey colouration but some white, brown and black individuals have been seen. Wolves breed between February and April, depending upon their location, with a gestation period of approximately 63 days. Litter size is usually 4-6 pups, with only one litter per year. Pup survival is higher where prey density is at its greatest. Generally wolves disperse at 1-2 years old as they reach sexual maturity. They will usually disperse in order to find an individual of the opposite sex, to find a territory or start a new pack.

Some young wolves join packs that are already formed¹⁶.



Wolf Social Structure and Organisation

Wolves have a highly developed, unique social structure. They function as social predators and hunt in packs organized according to a strict, rank-oriented social hierarchy. Each pack has a leading, dominant pair and two dominance hierarchies; one male and one female. For each gender, every wolf has a rank or place in the order. They must submit to anyone higher than they are, but can dominate the wolves lower in rank. The alpha (dominant) male, submits to no one and all other males defer to him. The alpha female is the dominant female to whom all other females must submit. The alpha male usually assumes the overall top position, but in some cases the alpha female has been seen to take control of the entire pack.

The subservient members are usually direct descendants of the alpha parents. The beta male and beta female are next in rank after the alpha pair. Beta individuals are most likely to challenge the alpha pair to become the dominant individuals within the pack. Betas often assume the roles of assistants in the rearing of the alpha pair's young. In a large pack, there are two further groups below the top ranking animals; a group of subdominant (gamma) wolves below the beta wolves and a second group of juvenile (delta) wolves below the subdominants. At the bottom there is an omega individual, either male or female. Energy displacement by dominant individuals on subordinates is often observed under stable conditions.



Each wolf is always testing the wolf above it to see if it can hold onto its place and all higher wolves will make sure the lower wolves stay below them. Within the pack, wolves will constantly demonstrate their rank. When two wolves in the pack meet, the higher-ranking one will show confidence and if

required, may show aggression by raising its tail, putting its ears forward, lifting its lips in a snarl, and making itself look as big and threatening as possible. The wolves at the bottom of the pack try to make themselves appear as small as possible to avoid being noticed. They tuck their tails between their legs, hunch themselves and roll over to show they do not want to fight. Most of the communication among members of a wolf pack involves visual observation of body language.

A wolf's social status may be established early in life with the formation of an order of dominance among littermates¹⁵. An older pack has a more stable social structure as a large number of pups have matured under a particular alpha male, increasing his status and security within the pack. At some point the alpha male may step down from breeding, allowing a lower-ranking male to take his place and mate with the alpha female. The social stability of a pack may come into conflict when the alpha male dies and competition for this position occurs. Dominance privileges may occur in exceptional circumstances. On the birth of her young, a female normally subordinate to her mate may become dominant over him.

Within a pack, the dominant individual shows leadership in directing pack activities. For example, during a hunt, when the dominant male starts running, the others will follow. Packs of wolves are cooperative hunters, working together to bring down large prey in their range, whereas lone wolves hunt small prey. The alpha male is often the most aggressive and can also tell the pack when to 'give up' on an attack. The leader is often seen to act independently of the other members of the pack, with them dependent upon him. Behaviour of other pack members does have some influence over the alpha male's decisions. Social changes, such as the loss or addition of a pack member, have the greatest effect on social organisation.



Lynx ecology

The Eurasian lynx is the third largest predator in Europe, after the brown bear and the wolf. A member of the felid family, the Eurasian lynx is the largest of the four lynx species and the biggest cat in Europe. The lynx has a very characteristic appearance, with a short back, ear tufts and a stubby tail. Skeletal modifications, including the hindlimbs being longer than the forelimbs, appear to be adaptations for springing¹¹. Long, dense, thick fur provides insulation against the bitter winter cold. The summer coat is shorter, sparser and coarser, tending to be more reddish or brownish in colour, whereas the winter coat is greyish, displaying variations in tints. Pelt colour is highly variable within different parts of their distributional range. The underbelly always remains white. The pattern of spots varies, with four distinct colour patterns; small spots, large spots, unspotted and rosettes. A slight size dimorphism is seen between males and females, with the males usually being larger and heavier. Furthermore, individuals from northern and eastern regions are larger than lynx from more southern latitudes or the west.

Although primarily a forest dwelling species, some lynx live in treeless areas, as seen in central Asia. Their habitat use patterns are defined largely by the abundance and distribution of prey, principally arctic hares and several small species of ungulates¹¹. Lynx habitat use is greatly influenced by snow, which also influences prey movements when of a sufficient depth. Habitat use and population density of lynx may also be influenced by the presence of wolves. Lynx remains have been found in the stomachs of wolves and in some areas, a decline in wolf numbers has led to an increase in the presence of lynx. Lynx have excellent vision and hearing and are most active at dawn and dusk.

Lynx are solitary individuals, except for females with the young of that year. Both males and females occupy their own home ranges. More than one female territory can overlap a single male's territory. Males set up their territories to gain access to females, whereas females set up their territories according to resources in the area, primarily habitat and prey availability.

During the mating season, a male and female may be observed together, hunting as a pair for only a few days.



Lynx hunting in the wild

Territory boundaries are scent marked using urine, faeces and gland secretions. Overlap of adjacent female territories is small. Although males tend to avoid each other, overlap of their home ranges appears to be greater. During the mating season, males can travel long distances in search of a suitable female. Territory size can range from 25-2,000 km².

Lynx, like other felids, are stalk and ambush predators. They will take a variety of prey, dependent upon seasonal availability. Their diet consists principally of herbivorous mammals such as beavers, hares, rabbits, small ungulates and wild boar. They do take other small carnivores (they have been seen to kill and eat martens *Martes sp*, red foxes *Vulpes vulpes*, dogs, wildcats *Felis sylvestris* and badgers *Meles meles*¹¹), carrion and birds such as passerines, partridges and pheasants. If necessary lynx can bring down large ungulates, but they have a preference for the smallest ungulate species within a community, usually the roe deer *Capreolus capreolus*. Lynx now successfully prey on domesticated reindeer *Rangifer tarandus* in some countries such as Norway.



Lynx feeding



Lynx mate between February and April and, with a gestation period of approximately 10 weeks, they normally give birth between May and June. When the gestation period is coming to an end, the female selects a suitable den site in which to give birth to her kittens. Litter size varies, anywhere from 1-5, although 2 or 3 is the average. During oestrous (usually 3 days), the male accompanies the female,

during which time they mate on several occasions. Females reach sexual maturity before males; females can produce offspring at two years of age whereas



Lynx kitten

males are not sexually mature until they are three. Lynx can remain sexually active for many years, possibly until 14 years old for females and 16 years old for males. At least half the young die before reaching adulthood. In the wild, lynx can live for up to 17 years although the average is a mere four or five years. In captivity they may live up to 25 years.

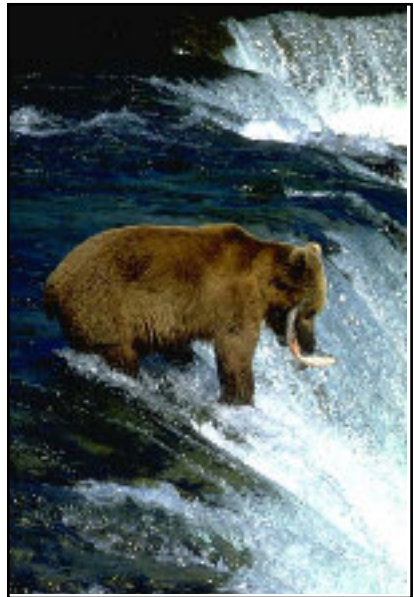
Bear ecology

Brown bears have a large head with a short nose, heavy stout body, strong muscular legs, small rounded ears, short tail and small eyes. Both the heel and sole of their feet touch the ground, as in humans, and the claws are long and strong. Although of a large stature, they can attain speeds up to 35 miles per hour over a short distance. Typically their fur has a brown colouration but cream to almost black animals do occur. Wild brown bears may live up to 35 years; 20-30 years is the average. They have poorly developed eyesight and hearing, but their olfactory sense is extremely well developed. Males are generally larger than females; size, and weight are dependent upon food availability, climatic conditions and habitat use.

The feeding ecology of the brown bear is very different from that of the wolf or lynx and also more complex. Both the lynx and the wolf are carnivores; they have specially adapted

carnassial teeth to aid their carnivorous diet. Bears are classified as carnivores but they are feeding generalists and have an omnivorous diet. Brown bears seek foods that will provide them with the highest nutritional value.

Northern American grizzly bears are more carnivorous than the European brown bear. Approximately 75% of a brown bear's diet consists of plant and vegetable matter. Evolving to cope with this omnivorous diet,



Brown bear feeding on salmon

brown bears have lost their carnassial teeth and replaced them with crushing molars with large grinding areas, an adaptation for a plant diet. Their large incisors still remain for tearing through flesh. Accompanying changes in their digestive tract have occurred. Diet varies from region to region and there is no set diet which all brown bears would adhere to. Bears tend to opt for the most readily digestible available plant foods, rarely eating older grasses, leaves and sedges¹³.

The bear's vegetable diet consists of berries, flowers, grasses, sedges, roots, herbs and tubers and hard masts such as acorns, chestnuts and hazelnuts. Due to its high digestibility and high nutritional value, meat, obtained either as prey, as carcasses or as baits, seems to be selected when available¹⁷. Bears will also take fish (primarily salmon), ants and others insects, honey, moose and elk calves, and a variety of small mammals. Livestock will be taken if necessary; however this is predominantly when other food sources are scarce. Meat is a more important foodstuff prior to winter dormancy. With their muscular shoulder hump and large claws, bears are better adapted to digging up small mammals, insects and roots.



A bear's home range varies greatly in different areas and depends predominantly on the distribution of high energy food sources. The male's home range is much larger than the female's and will overlap the territory boundaries of two or more females. Juvenile females on dispersal usually acquire territories encompassing part of their mother's home range. Bears are solitary (except for a mother with her cubs) but not territorial and therefore overlap between adjacent territories is not uncommon. Brown bears can be aggressive and maul one another; this is triggered by hierarchical behaviour. Dominant males obtain greater access to females and in doing so increase their reproductive success.



Mother with her two cubs

This process has evolved so offspring are born when conditions are optimal for their survival. The number of cubs born ranges anywhere from one to four animals, with two or three being the average. Young bears reach independence at approximately two and a half years old, although females do not reach reproductive age until they are five. Many young are killed by adult males before they reach adulthood. Bears have a low reproductive rate and are vulnerable to human-related mortality.



Brown bears can run fast over short distances, as seen here chasing salmon

Bears mate from June to July (sometimes earlier in late May), giving birth the following year between January and February. They are a polygamous species and both males and females may mate with several different individuals during the breeding season. Brown bears undergo a process called delayed implantation, where development of the embryo is arrested, remaining in the blastocyst stage for six months.

Do bears hibernate?

There is some controversy surrounding whether brown bears hibernate or undergo winter torpor (or dormancy). At present, there seems to be no clear answer to this. Brown bears inhabit a wide range of habitats across the northern hemisphere. It could be the case that individuals in the north of their range, where the temperature is somewhat colder, hibernate, and those further south undergo winter torpor. Ward and Kynaston (1995) believe that the brown bear enters a period of dormancy throughout the winter when there is little food available. Macdonald (2001) and Kemp et al (1999) both describe a state of hibernation, whereas Mitchell-Jones et al (1999) believes that brown bears do not have a period of true hibernation. The term hibernation is not really accurate because true hibernation involves considerable reductions in metabolic processes, heart rate and temperature¹³. Changes in heart rate and body temperature are observed in bears, but these are not as significant as in true hibernators. Brown bears do not enter deep torpor and can be easily aroused from their sleep¹².



Mother and cub feeding



Ecological Niche

Ecological niche is defined as the place or function of a given organism within its ecosystem. Different organisms may compete for the same niche. The wolf's niche is as a predator of the northern hemisphere that preys upon large mammals. Found within the same ecological niche as wolves are the felids such



Lynx and wolf kills aid other species within the ecosystem such as ravens have a preference for large herbivores, whereas lynx as solitary individuals prefer smaller prey species.



Wolves are pack hunters

as the lynx, mountain lions in North America and tigers and leopards in Asia¹⁵. Humans would also be found within this ecological niche.

When more than one species occupies the same ecological niche, they compete directly for access to territories, resources and nesting sites. Usually one of the species has an advantage over the other in utilizing the niche, often leading to a decline or in some cases the extinction of the second species from the ecosystem.



Mountain lions occupy the same ecological niche as wolves and lynx

Although wolves and lynx are found within the same ecological niche, as pack hunters wolves

Bears do not occupy the same ecological niche as either the lynx or wolf. In fact they seem to occupy an ecological niche all to themselves, primarily due to their omnivorous diet. The animal which has a diet most similar to that of the brown bear would be the badger, a substantially smaller species of an altogether different family.

Up to 80% of a brown bear's diet consists of plant and vegetable matter and only 20% consists of meat. They therefore overlap the ecological niches of two different groups of animals. The carnivorous part of their diet overlaps that of the canids and felids; they can take small ungulates and livestock. The herbivorous part of their diet overlaps that of the ungulates and large herbivores (such as the wild boar). Due to their generalist feeding behaviour and large stature, they remain a top predator within their ecosystem.



Vegetation predominates in the brown bears diet

Reintroductions

Wolf

Impacts on large herbivores

There are numerous arguments for and against the reintroduction of large carnivores such as the wolf back into Britain. Attitudes to reintroductions of carnivores tend to be favourable among the general public, but negative amongst those seen to be adversely affected¹⁸. There have been no reintroductions of large carnivores in Britain to date.

Response to proposed reintroductions of small carnivores (such as the pine marten) and



Grey wolf *Canis lupus*

herbivores (such as the beaver) have been met with more support. There is a large discrepancy between support from individuals that live within the proposed reintroduction site and those that live elsewhere. It is inevitable that if wolves are released into the wild, farmers at some point will

lose a proportion of their livestock to wolves. But is this any different than losses attributed to red foxes? Although support among the general public and conservationists remains high, large carnivore reintroduction has met with strong opposition from livestock farmers as well as individuals with game rearing or deer stalking interests.

There has been much discussion on reintroducing the grey wolf to the Scottish highlands, where it survived the longest in Britain. The main advantage would be the control of red deer *Cervus elaphus* and roe deer *Capreolus capreolus* populations. Humans kill 75,000 red and roe deer annually in Britain, whereas wolves only kill around 20 deer a year each⁶.

Deer can cause substantial damage to woodland and agricultural land due to browsing, grazing and trampling, thus preventing regeneration and disrupting the animals dependent upon these plants. Deer can completely strip the bark from tree trunks and branches, which will inevitably cause the tree to die. Radford (1999) puts this into context 'You can go to many parts of Scotland and into what should be native pine wood and you can't see a tree that is under



Red deer *Cervus elaphus*

200 years old. The problem is that with somewhere between 5 and 20 deer per square kilometre, you get no natural tree regeneration. They eat the young trees as soon as they appear¹⁹.

At present deer numbers are controlled by annual culling by humans. It is impossible to allow deer populations to grow exponentially



Scottish highlands, the proposed reintroduction area

without serious implications for natural habitats. There is not enough woodland in Britain to support ever increasing deer populations.



This situation would not be sustainable as there are not enough resources to satisfy such a large number of individuals. Wolves could manage deer populations by regulating numbers and therefore grazing patterns, allowing a revival of flora and fauna in the area.

If wolves were reintroduced, farmers would not have to pay people to come onto their land to cull deer which are damaging it. Human trophy hunting involves taking the fittest specimens from a deer population. Wolves do not take individuals in this manner. Instead their instinct is to weed out the old, lame, young and sick individuals leading to smaller, fitter deer populations.

The Island of Rhum off the West coast of Scotland has been suggested as a suitable site for a pilot reintroduction scheme. Wolves have never been inhabitants of the island. Suitability stems from the overabundance of deer and no local human inhabitants, other than Nature Conservancy Council staff. A similar reintroduction occurred in 1960 onto



Red deer on the Isle of Rhum

Coronation Island in Alaska, which is of similar size and prey density. The small island size and few hiding places for deer eventually led to the demise of the wolves there. Deer populations declined significantly leaving the wolves with an insufficient diet.

Attacks on humans and livestock

Wolf attacks on humans are extremely rare; the majority of attacks occur in rabid individuals. Although wolves do not act as reservoirs for rabies, they can catch it from other species. Rabies is not present in Britain and all reintroduced individuals would have to undergo

a disease screening protocol prior to release. Linnell et al identified four factors that are associated with wolf attacks on humans; rabies, habituation (wolves that had lost their fear of humans), provocation and highly modified environments²⁰. There has been no scientific evidence for attacks by healthy wolves in North America and reports of attacks in Eurasia have been greatly exaggerated¹⁵. There is no basis for belief that healthy, wild wolves in North America are of danger to human beings. For the most part, wolves seem to be shy of humans and avoid them at all costs.

Wolves, like all other wildlife, have the right to exist in a wild state in viable populations, co-existing with humans as part of natural ecosystems⁶. There are numerous ethical arguments surrounding the reintroduction of the wolf to Britain. Wolf ecotourism and jobs provided from this may aid in providing compensatory schemes for farmers who lose livestock to wolves. A vast amount of money would be paid to see animals such as the wolf in their natural environment.

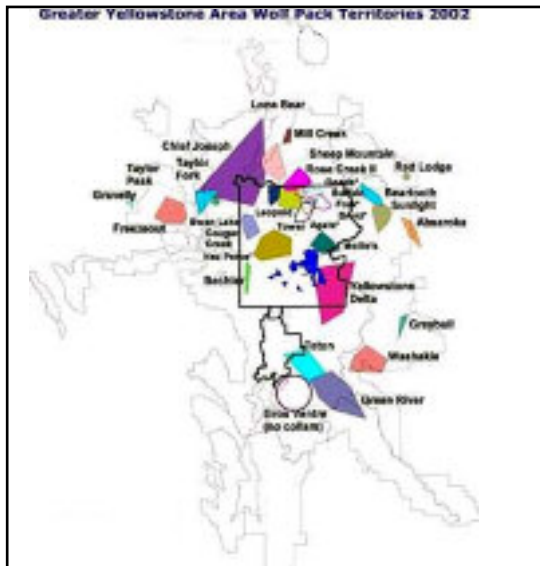
At present in Britain there is no state compensation for damage caused by wildlife and it is likely that any such scheme would have to be funded by the voluntary sector¹⁸. The damage to livestock has the potential to be high, due to the free ranging unsupervised stock which is found throughout the Scottish Highlands, coupled with wolf dispersal distances of up to several hundred kilometres. Wolves will take domestic livestock if wild prey is scarce, primarily sheep and goats. Although wolf predation on livestock within specific regions is low, impacts on individual farmers can be high. A return to more traditional livestock management practices, for example attending herds and guarding at night, could be considered to avoid sheep losses.

Case Study: Yellowstone National Park, USA

The reintroduction of wolves to Yellowstone National Park has been hailed as the most successful recovery effort in the history of the US Endangered Species Act²¹. By



1926 there were no longer any grey wolf packs left in Yellowstone National Park. Releases have taken place here since 1995, when its large size and abundant prey meant the park was recognised as an area where recovery of wolf populations had a good chance of succeeding. By the end of 2005, 13 packs occupied Yellowstone National Park.



Yellowstone wolf pack territories 2002

Soft and hard releases have both involved the translocation of wild caught individuals. The soft releases involved a delayed release from a temporary enclosure, using acclimation pens and temporary husbandry. To date, hard releases have been more prevalent in North America. Both release types established breeding wolf populations, although this was quicker in soft releases as they had bred in captivity. Soft releases showed no advantage over hard releases²². Population size was highest in 2003 with 174 individuals, decreasing to 118 individuals in 2005, mainly due to high pup mortality.

Although elk (wapiti) *Cervus elaphus*, numbers have reduced since reintroductions began, few devastating impacts have occurred. Wolf-related benefits have been seen at Yellowstone National Park, including wolf feeding providing essential scraps for scavenging animals. Areas which had been overgrazed prior to the wolf being reinstated are now growing more vigorously and the natural integrity of the ecosystem seems to be balancing. A total of 316 kills were detected by wolves in 2005; 77% were elk. This identifies a change in prey selection over the previous 8 years.

The Yellowstone to Yukon conservation initiative (Y2Y) is a proposal to create wildlife corridors up the north-west coast (of North America) to allow Yellowstone wolves to follow traditional seasonal prey migrations northwards²³. Seventeen critical cores and corridors (CCCs) have been identified that are crucial to the survival of key wildlife species throughout the region. The Yellowstone to Yukon region stretches 3200km from central Wyoming to the Peel River in northern Yukon. It ranges from 200km wide to 800 km wide in the north where it bulges out to encompass portions of the Yukon and north-west territories. The CCCs have been chosen either because they are: unprotected source areas needing protection as core areas; core protected areas embedded in a landscape needing more holistic management; linkages important to maintaining connectivity between core areas; or linkages that have been severed and require restoration²³.



Map of Y2Y initiative



Lynx

Impacts on large herbivores

In the northern Alps, where lynx density is estimated at 1.2 per km², each lynx annually consumes approximately sixty roe deer or chamois *Rupicapra rupicapra*, amounting to 3 to 9 percent of the ungulate population¹¹. As lynx are primarily a forest dwelling species, close proximity to forest cover seems to increase the risk of predation. Reintroduced lynx show the highest rate of predation on game.

Avian prey was reported to occur more in the lynx diet than in the diet of either the wolf or the brown bear. In Sweden, the capercaillie *Tetrao urogallus* was found in the lynx diet. This species is in decline in Britain. Many



Capercaillie *Tetrao urogallus*

people are naturally concerned about reintroducing a predator which could lead to the extinction of a threatened

species. The reintroduction of large predators has been questioned for this very reason, 'Lynx also take black grouse and capercaillie, two of our native species that are under threat and which I believe are far more desirable than an additional predator'²⁴. However, lynx tend to supplement their diet with capercaillie and it is not a main prey species.

Ungulate numbers in Scotland are thought to be sufficiently high so as to not be affected by lynx predation. Unlike the wolf, the lynx is not reported to make mass kills, and a study has shown that the impact of lynx is comparable to that of the red fox. Competitive exclusion could occur with wildcats *Felis silvestris*, but these do have a preference for smaller prey species.

The roe deer is the single most important prey species for the lynx. In Europe, hunters claim that the lynx are reducing their favoured prey species: roe deer and chamois. In parts of Europe where roe deer numbers are lower than in Scotland, lynx do exert control over roe deer

populations³. The deer population in the highlands is desperately in need of control; there are 350,000 roe deer in Scotland alone. In Finland, lynx hunt introduced white-tailed deer *Odocoileus virginianus*, and prey on semi-domesticated reindeer throughout Scandinavia. When the lynx was first



Roe deer
Capreolus capreolus

reintroduced to Europe, it initially brought about severe decreases in the roe deer and chamois populations. After several years, the remaining individuals built up strong anti-predator defences, distributing themselves more evenly throughout the landscape and slowly increased in numbers. Like the wolf, the lynx often provides food for other species in a way that humans and opportunistic predators tend not to do³.



Roe deer killed by lynx

Attacks on humans and livestock

Today, in most areas where several large carnivores coexist with humans, the lynx is seen as a minor problem compared to the other predators²⁵. Lynx present no danger to people and there have been no reports of attacks by lynx in Europe. Even females pushed away from their litters do not defend their cubs. A few injuries have been recorded from accidents involving injured, captured or rabid individuals⁸. Although rabies is occasionally reported in lynx, they are not an effective vector for the disease. However, lynx will attack dogs approaching their kittens, even if the dog is accompanied by people².



Livestock predation has been reported for lynx, but they seem to prefer wild prey as long as it is available⁸. Some traditional land users may still have a negative attitude towards the lynx. This has its roots in two main conflicts: hunters blame the lynx for reducing game abundance and availability, and livestock breeders fear attacks on their herds²⁵. Livestock predation by lynx is low compared to other large predators so it is therefore not regarded as a major problem. No livestock victims were found in remains of over 600 lynx kills in the Swiss Jura between 1988 and 1998²⁶. In the 1995-96 grazing season 6864 reindeer were compensated as lynx kills in Norway and Sweden, and in 1998, 9382 sheep kills were compensated²⁷.

Lynx, like other felids, do occasionally kill more than they could possibly eat. These surplus kills often occur when prey is naïve and vulnerable, following the reintroduction of a top predator which was previously not present in the ecosystem. Surplus kills are more frequent in the early stages of re-colonisation. The prey will over time evolve and adapt to the presence of a predator, and in this case survival of the fittest is prevalent. In central and eastern Europe, damage to livestock is almost unheard of and livestock attacks by the lynx tend to be fewer than for the wolf.

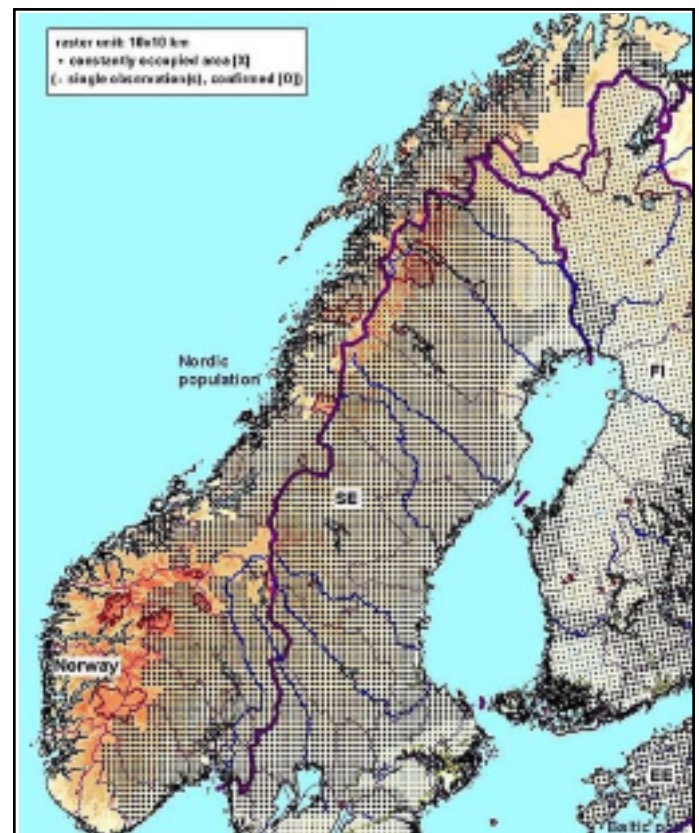
Case Study: European Reintroductions

A series of lynx reintroductions have occurred across Europe since the early 1970s in Switzerland, France, Germany, Italy, Poland, Austria and the Czech Republic. Romania's Carpathian Mountains in Transylvania are home to 2,000 lynx, as well as 5,000 bears and 3,000 wolves. This area has the largest population of bears, wolves and lynx of any European country outside Russia. The two other most important lynx populations are found in the Swiss Jura and Poland's Bialowieza Forest, where a great deal of research has occurred. Ancient woodland in the Bialowieza National Park is the closest surviving example of the kind of environment existing in Britain in the middle Stone Age²⁸.

The lynx has never been extinct in Norway or other parts of Scandinavia. Finland and

Sweden manage lynx populations appropriately and set small hunting quotas based on the presence of nuisance individuals.

In Norway the situation for the lynx is critical but hunting quotas continue to increase on a yearly basis in an unsustainable manner. No long term fieldwork has been carried out on the lynx populations, so numbers are based on broad estimates. Farmers dominate the local hunting committees and with their perceived view of the lynx as a problem for livestock, a halt to the increasing quotas does not seem plausible in the near future. In 2003 the World Wildlife Fund expressed concern that Norway seemed to be pursuing a policy which could end in extinction, with the population declining by almost half in the preceding six years²⁹. Norway seems to be locked into a disastrous and, within the current global conservation culture, highly questionable policy of decimating all its rare large carnivores, seeing them all as threats to the agricultural policy that subsidises livestock without imposing any requirements for good husbandry³⁰.



Lynx distribution in Norway 2001 - although numbers are declining fast, distribution seems relatively unaffected so far



Brown bear

Impacts on large herbivores

The brown bear's impact on large herbivores is not as significant as either that of the wolf or lynx. This is primarily due to its mainly herbivorous diet.

There have been very few studies throughout Europe that show wild mammal predation as an important part of the brown bear's diet. Attacks on wild ungulates are considered tolerable in Europe and should therefore not have an impact on bears suitability for reintroduction to the



Brown bear eating grass

Scottish Highlands. The problem is mainly confined to predation on moose in the boreal forest habitats of the Scandinavian and Northeastern populations¹⁴. Other problems associated with the brown bear include damage to orchards, crops and beehives.



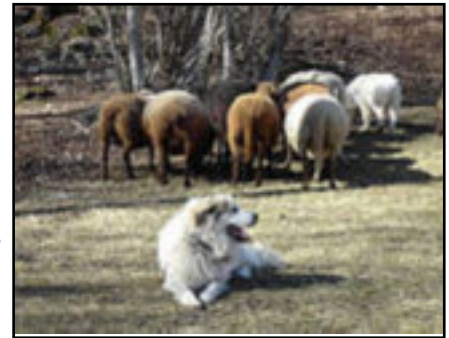
Bear damage to an apiary in Spain

Attacks on humans and livestock

Bear attacks on livestock vary considerably depending on the husbandry techniques involved. Norway has a large number of free ranging sheep which are left unattended for months at a time and therefore suffers the largest depredation in Europe and between 3,000 and 4,000 sheep are killed each year by 15-30 bears¹⁴. Unlike Sweden, Norway is not managing its bears sustainably. Norway has

between 26 and 55 bears but culls them at an unsustainable rate of between 10 and 20 percent per year³⁰. Sweden at present has a secure bear population of approximately 1,000 animals and culls fewer than 4% a year.

Extensive sheep-herding would reduce the attacks on livestock, removing the necessity to cull such large numbers. Livestock predation not only involves sheep but also semi-domesticated reindeer, goats, horses and cattle. Electric fencing has also been



A dog guards livestock in Switzerland

successful in some countries in deterring bears from livestock areas. In Austria, approximately ten sheep are killed by bears each year, although this is with a population of only ten bears³¹. In Bulgaria, of 1,200 livestock reported killed by bears between 1975 and 1983, more than 80% were sheep³². In the Abruzzo, bears are occasionally reported to kill sheep and calves but are said to kill only one or a few animals in an attack³³.

Bears do pose a danger to humans, and there are a number of bear attacks in North America every year, some of which have been fatal. When food reserves run low, the chance of humans coming into direct contact with bears increases. A hungry bear is said to be a dangerous bear, especially prior to hibernation. A human-fed bear is more dangerous still, as it regards the human as a provider of food and will attack if its quota is not provided²⁴. Crop failures and reduced food availability draw bears out of the forest into human environments, and this is when conflict predominates.

Attacks in Europe have been reported for both healthy and rabid bears. There seems to be little information on brown bear attacks in Europe and the majority of information comes



from North American grizzly bears. Due to the dense human population in Europe, the brown bear is believed to be a shyer and therefore a less aggressive animal than that in North America. In Europe, 175 encounters between people and bears have been recorded. Aggressive behaviour was reported in 49 of these and in 15 cases people were attacked or injured, resulting in three deaths⁸. Although incidents occurring in Europe are fewer and less well documented, there are over four times as many brown bears in North America as in Europe. Attacks on humans do not appear to be a result of predatory behaviour, but rather a result of the bear defending itself, cubs or a carcass against humans¹⁴.



North American grizzly bear

Although incidents occurring in Europe are fewer and less well documented, there are over four times as many brown bears in North America as in Europe. Attacks on humans do not appear to be a result of predatory behaviour, but rather a result of the bear defending itself, cubs or a carcass against humans¹⁴.

Case Study

Early European efforts at reintroduction were unsuccessful in the large part, primarily due to the use of captive bred animals. It is now widely understood that carnivorous animals raised in captivity have an extremely poor chance of surviving if reintroduced. Their chance of survival can be increased slightly by incorporating soft releases; however this is not



Bialowieza National Park

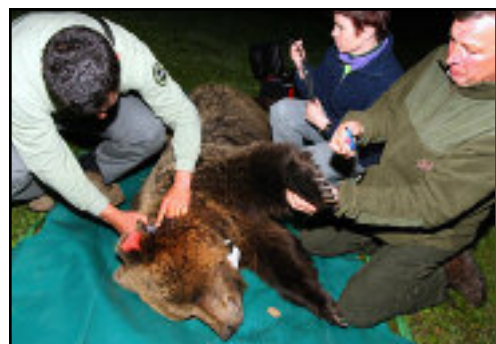
significant enough to justify the continuation of such a method. Seven hand raised cubs reintroduced to Bialowieza National Park in Poland from neighbouring Belarus were killed by poachers not long after release¹. All other reintroductions of captive bred individuals either resulted in the animals being returned to captivity or death.

There have been three successful translocations within Europe involving brown bears. All of them have involved animals originating in Slovenia where the population is sustainably high. Two separate techniques have been used; the summer-release technique and the winter-release technique, the latter of which has been more successful. The



Brown bears are common in Slovenia

first occurred from 1989 to 1993 where 2 females and one male were translocated to Austria and hard released. The bears were radio-tracked and both females gave birth to cubs. In 1996 two females were reintroduced to the Central Pyrenees in France and a year later in 1997 a male was introduced¹. Both females produced offspring in 1997. In the Italian Alps, 2 males were released in 1999 and an additional 3 females were released in 2000. A further 2 females were released in 2002 to supplement the population. All three reintroductions were successful in establishing breeding populations. It is clear that reintroduction success for bears is greater for subadults than adults and is correlated with translocation distance (affecting their homing behaviour)¹.



Bear being checked before translocation



Natural Selection and Survival of the Fittest

Natural selection is the theory which states that those individuals best adapted to their environment tend to survive and produce offspring, passing on their genes to successive generations. Large predators tend to prey on sick, injured, diseased and old animals over healthy individuals. These animals would be expected to be less effective reproducers and they may also slow down the herd. Hence they are not as well adapted to their environment.



The fittest individuals in this elk herd will survive longer against predators

Genetic drift is the natural consequence of sexual reproduction and the random mixing of genes which this involves¹³. A small population has a greater chance of completely losing a gene. Inbreeding depression can also be a problem, reducing the overall genetic variability, and introducing harmful and potentially lethal genes into the population.

Predators such as wolves can aid in removing congenital abnormalities or proneness to disease from the population, preventing these traits from being passed down through successive generations (survival of the fittest). In effect, the predators are unconsciously helping the prey population to become better adapted at avoiding being hunted. The main disadvantage of this strong selective force is the removal of young members of the herd who are killed before they can pass on any advantageous traits. If culling of deer populations by humans were to occur, this process of natural selection in the prey population would not be so pronounced.

Humans tend towards trophy hunting and therefore do not choose individuals to hunt in the same way as would a wolf. Unless professional deer stalking for herd management is undertaken, natural selection does not occur in the same way as it would

were the deer being hunted by predators such as wolves.

In recent years there have been changes in political attitudes towards hunting, in particular fox hunting, which was banned in 2005. If culling of deer was outlawed, this would have disastrous effects, firstly on forests, and secondly on deer populations themselves. Deer numbers would increase dramatically until they had removed all the available resources in the area. At this point there would be a crash in their population size as food availability would be low and competition between individuals would be high. Predators are therefore an important part of the biological community.

In areas where wolves are present, especially in North America, communities remain in relative stability and equilibrium. In Britain, where the wolf has been extinct for a substantial amount of time, large herbivores have evolved and reached equilibrium in their absence. The wolf's impact if released can be predicted based on information available from positive studies in both Europe and North America. In Isle Royale National Park, Michigan, the wolf functions as a control on the numbers and quality of moose *Alces alces*, which feed on the vegetation. All three thrive in apparent stability³⁴. Isle Royale represents a simplified animal community for studying complex predator prey relationships. Dramatic fluctuations have been seen in both the predator and prey populations since the 1970s. However, these seem to follow the same general trend. An increase in wolf numbers takes advantage of the moose population, resulting in increased wolf fecundity and improved pup survival. Moose numbers decrease dramatically, allowing vegetation to recover and reducing the available food supply for the predators and hence the wolf population decreases. The moose population then starts to increase again due to predator decline, and with this comes an increase in the number of wolves.



Why is Captive Breeding not the answer?

The outcome of reintroductions tends to be very different for captive bred carnivores, compared to wild caught ones. This is due to the numerous limitations of reintroducing animals who have never had to fend for themselves. In the wild, parents would teach their offspring how to hunt their own food as well as how to build dens, select a suitable mate, avoid humans and compete with other top predators occupying the same ecological niche. They would learn that if food reserves are low in a particular area, they must move to a new area in order to survive. If captive bred carnivores were to be reintroduced to the Scottish highlands lacking these required skills, they would find it difficult to survive for prolonged periods of time.

If breeding populations are established in captivity, learned behaviour will not be passed down through subsequent generations as it would in wild animals. Captive bred carnivores will retain their natural instincts to hunt, but this is unlikely to be enough for animals who have been provided for by humans for much of their life. If populations are to survive after



Grey wolf, submitting to human keeper

reintroduction, it is essential to provide supplementary feeding, through the use of soft release cages for a period of time.

In the case of wolves, packs would need to learn how to hunt together. In captivity, each member of the pack is provided with the same amount of food. In the wild, the highest ranking members of the pack (alpha pair) feed on the kill first, followed by the lower ranking animals. These lower ranking animals need to learn how

to survive on a reduced amount of food. Live prey cannot be fed to animals in captivity and so their instinct to kill instead of play with their food is poorly developed. Furthermore, their lack of fear of humans can lead to major problems, involving conflicts between the two.



Captive bred wolves lack a fear of humans

Bears, wolves and lynx raised in captivity and then released into the wild tend not to exhibit natural behaviour with regard to prey selection and proximity to humans. This results in the animals causing more human/wildlife conflicts³⁵. Inevitably, it will be almost impossible to establish breeding populations in the wild from captive bred animals.

If reintroductions were to occur, it would be more successful if young, dispersing animals were caught and translocated from other regions in Eurasia where their numbers are sustainably high. The large home ranges and low population densities of large carnivores mean that the Scottish Highlands is the only UK region with the potential to support a viable population¹⁸. To maintain a wild population, the release site must be capable of maintaining more than the minimum viable population for the species. For all three species of large carnivore discussed here, a minimum of fifty animals would be required to prevent inbreeding depression, and more than 500 are required to maintain genetic variability¹⁸.

Evolution

Evolutionary theory predicts that in the absence of predators, prey species will lose their defensive behaviour⁴. This is especially prevalent in island populations. Deer and other prey species of wolves, lynx and brown bears have evolved over the past 300 years in Britain without the presence of a top predator. Have humans suitably filled this niche, preventing such animals from becoming accustomed to a predator free environment? How will deer fare with the reintroduction of wolves and the lynx in terms of their behaviour? Will it have any affect on their breeding success? Will translocated wolves from abroad adapt to a sudden change in prey species? Reintroduction of large carnivores comes with numerous questions and issues that must be addressed prior to release.

Conclusions

Paul Lister, a multimillionaire who owns 23,000 acres of land, hopes to reintroduce wolves, lynx and bears to his Scottish estate in the highlands. He believes that the predators can be satellite tracked, allowing farmers to be compensated if their livestock is attacked. In order to have enough space for wolves and bears, he would need to acquire a further 27,000 acres from the neighbouring estates³⁶.

The biggest foreign landowner in Scotland, the late Paul van Vlissingen, also wanted to reintroduce wolves and lynx to the Scottish countryside. A three year study of his 80,000 acre Letterewe estate showed that traditional culling was having little impact on deer numbers³⁷. These results demonstrated that deer were not being properly managed and that reintroduction of large carnivores would be

a more effective method of control. Both Paul Lister and Paul van Vlissingen believe that wolves and lynx would provide a basis for ecotourism in the region.

Large carnivore reintroductions are widely debatable, and those least likely to show a positive attitude are farmers, deer stalkers and inhabitants of rural areas. In a poll carried out in Switzerland, 82% of the people asked were in favour of lynx reintroduction, 64% for the wolf and 54% for the bear⁸. How would this compare in Britain, where suitable habitat is substantially lower? How can we expect other members of the EU to reintroduce or top-up populations of large carnivores if we ourselves make no such effort? Lynx reintroduction is the most plausible for the foreseeable future, but without the support of the public any such effort will never succeed.



Paul Lister's Alladale estate

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