



Reversing Rabbit Decline

One of the biggest challenges for nature conservation in Spain and Portugal

Dan Ward, 2005



Acknowledgements

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Executive Summary

1. Reversing rabbit decline is one of the **biggest challenges** for nature conservation in Spain and Portugal, given that: rabbits have declined massively in recent decades, that; this decline has had devastating consequences for the native ecosystem – including endangered predators – and that; effective recovery techniques have yet to be devised.
2. Wild rabbits originated in the Iberian Peninsula where they were once abundant throughout most of Spain and Portugal, at densities of up to 40 individuals per hectare. Two sub-species exist. *Oryctolagus cuniculus algirus* is confined mainly to the south and west of the Peninsula and *Oryctolagus cuniculus cuniculus* to the north and east.
3. Wild rabbits have been introduced from the Iberian Peninsula into many other parts of the world, e.g. Australia, where they have been successful and have caused significant damage to agriculture and native ecosystems. However, the conservation and recovery of rabbits in Spain and Portugal is just as important as their eradication elsewhere.
4. Rabbits are an essential **keystone element** of the Mediterranean ecosystem in Spain and Portugal – sometimes called the “rabbit ecosystem” – and are also important for extensive hunting by humans. At least 39 predator species prey on rabbits, including the critically endangered Iberian Lynx and Iberian Imperial Eagle, the decline of which has been partly due to rabbit decline. Rabbits are also “landscape modellers” with important impacts on plant communities, and their burrows provide habitat for many invertebrates.
5. Rabbits have declined massively in recent decades in Spain and Portugal, and it is estimated that there are now **as few as 5%** of the number of rabbits that existed 50 years ago. Moreover, rabbit decline has been uneven with many areas suffering rabbit extinctions and some areas still containing rabbits at relatively high density.
6. Rabbit decline has been caused by a number of diverse factors including: rabbit diseases (myxomatosis and Rabbit Haemorrhagic Disease); habitat loss and fragmentation due to intensive agriculture, exotic forestry, urbanisation, land abandonment, over-grazing by large game and forest fires; and, human-induced mortality due to rabbit control by farmers in agricultural areas and excessive hunting of rabbits by sport hunters.
7. Rabbit predators have not caused rabbit decline. However, after rabbits declined due to other factors, opportunistic predators may have contributed to the pressures frustrating rabbit recovery. This may have been exacerbated by recent increases in opportunistic predators such as foxes and Egyptian Mongoose, which is itself partly due to a decrease in top-predators (e.g. lynx, eagles), which naturally control opportunistic predators and reduce overall rabbit predation. Ironically, the reduction in top predators has been partly due to increased non-selective predator control by hunters frustrated by rabbit decline.
8. Surviving rabbit populations are isolated and unstable, and continue to be threatened by resurgent disease epidemics; the possible spread of a new genetically modified (GM) virus from Australia; inappropriate and excessive human-induced mortality by hunters and farmers; and, further loss of habitat to intensive agriculture, urbanisation, forest fires and desertification – especially given the likely impacts of global warming.
9. Rabbits are classified as Least Concern but classified by the Portuguese Institute for Nature Conservation as Near Threatened. Under IUCN criteria, due to recent declines, *O. c. algirus* should be globally re-classified, and *O. c. cuniculus* regionally re-classified.

10. The general objective of rabbit conservation is to achieve widespread and sustained rabbit recovery. This will be important for the species itself, and to support viable metapopulations of specialist predators (e.g. Iberian Lynx) and prevent further declines in many other predator species. Widespread and sustained rabbit recovery will also be important for rural sustainable development in the form of sustainable rabbit hunting. However, a full return to historical levels of rabbit abundance and distribution may not be possible due to persistent diseases and the impacts of, and conflicts with, agriculture.
11. Widespread and sustained rabbit recovery will require: planning and rabbit monitoring; habitat recovery and protection; a reduction in the impacts of rabbit diseases and human induced mortality; rabbit reintroductions and translocations, and (possibly); a reduction in the impacts of opportunistic rabbit predators in some areas. Many of these goals are related, and most (if not all) will be need to be achieved for successful rabbit recovery.
12. Overall, rabbit conservation has started late, only developing after decades of decline, and has had an overly narrow focus, being addressed indirectly and independently under the priorities of conserving endangered predators and managing game stocks. In addition, the subsequent progress in reversing rabbit decline has been very limited.
13. Although some rabbit monitoring has been undertaken, many areas and many recovery projects have lacked adequate monitoring, and the results of much monitoring that has been undertaken have either not been published or cannot be compared with each other because they were generated by incomparable methods. Similarly, neither Spain nor Portugal, nor any of the Spanish Autonomous Regions have approved rabbit recovery plans/strategies at present, and many areas have not even begun elaborating such plans.
14. Quite a lot of work and money has been spent on rabbit reintroductions, habitat improvement and the management of rabbit predators by hunters and conservationists. However, much of this work has either not yet been going long enough to demonstrate a positive impact or has been found to be inappropriate, ineffective or uncoordinated.
15. Some progress has been made in protecting and restoring habitat in some particular areas. However, little progress has been made in reducing the ongoing loss and fragmentation of habitat elsewhere. Similarly, some progress has been made in reducing hunting pressures in some areas, but in other areas the impact of human-induced mortality has not decreased, and has even increased, with rabbit decline. Finally, very little progress has been made in reducing the impacts of myxomatosis or RHD.
16. Particular barriers to progress in rabbit recovery that still need to be overcome include: contradictory policies and interests in agriculture, hunting, forestry and development; insufficient quality control of some management interventions; poor co-ordination between some individuals and organisations; a lack of understanding of how factors affecting rabbit decline interact; and, an inability to control the impacts of diseases.
17. Many things will thus need to change to improve rabbit monitoring and conservation in the future. These include: more funding, research and innovation; better co-ordination, information exchange and quality control; changes in policies and legislation; more political support; and, a higher profile for the importance and needs of rabbit recovery.
18. Specific initiatives that would assist these changes include: reclassifying rabbits in Spain and Portugal under IUCN criteria; a conference and web portal dedicated to rabbit conservation; a list to prioritise research areas; a new “rabbit alliance” to increase lobbying for rabbit recovery; and, an Iberian rabbit strategy and expert working group.

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Introduction

The decline in wild rabbits (*Oryctolagus cuniculus*) is one of the biggest challenges facing nature conservation in Spain and Portugal¹. As described in this report, the European Rabbit has declined massively in recent decades due to a complex mix of diseases, human-induced mortality, and habitat loss and fragmentation. Moreover, because the European Rabbit is an essential keystone² and game species in Spain and Portugal, this decline has had drastic consequences for both the rural economy and the Mediterranean ecosystem – including helping to bring the Iberian Lynx and the Iberian Imperial Eagle to the edge of extinction. In addition, the rabbit conservation effort has yet to demonstrate significant progress in reversing rabbit decline and many difficult obstacles have yet to be overcome.

In order to help to encourage and organise rabbit conservation in Spain and Portugal, this report aims to: raise the profile of the European Rabbit, its importance and decline in Spain and Portugal, at national and international levels; provide those interested in rabbit conservation with up-to-date information on the status, conservation and barriers to the conservation of rabbits in Spain and Portugal; provide recommendations for ways to improve rabbit conservation in the future, and; act as a “briefing document” for those attending a proposed International Rabbit Conference, planned to be held in Andalusia, Spain in 2006.

In particular this report addresses the four following questions:

- *Why is rabbit decline important, and what has it been caused by?*
- *What are the broad objectives and specific goals for rabbit recovery?*
- *Why has rabbit conservation not achieved more to date?*
- *What needs to change to achieve successful rabbit recovery in the future?*

This report does not represent new research, but is rather a compilation of existing information and expert opinions, organised into a number of chapters. Chapter 1 outlines the ecology, decline and importance of wild rabbits in Spain and Portugal, and chapter 2 describes the current status of, and threats to, existing rabbit populations. Chapter 3 outlines objectives for rabbit conservation in Spain and Portugal, and identifies specific goals that need to be achieved to reach these objectives. Chapter 4 assesses the degree to which these goals are being achieved, and identifies barriers that still exist to achieving them in the future. Finally, Chapter 5 discusses the requirements of, and recommends specific initiatives to help instigate, widespread and sustained rabbit recovery in Spain and Portugal in the future.

An appendix is also provided in this report, recording and analysing the diverse perspectives involved in rabbit conservation in Spain and Portugal, and the problem definitions and preferred solutions that they tend to be associated with. All of these diverse perspectives are important, and this report has attempted to integrate them all together to produce a coherent overview of the importance, decline and conservation of rabbits in Spain and Portugal.

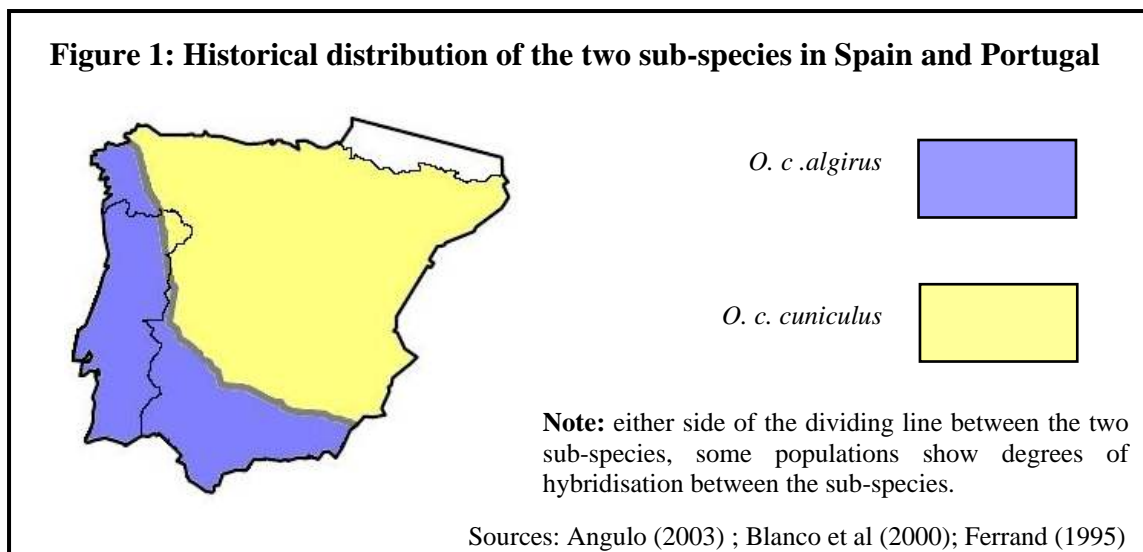
1. Ecology, Importance and Decline of rabbits

This chapter describes the ecology, importance and decline of wild rabbits in Spain and Portugal, to give the species the profile it deserves and to provide a background for an analysis and discussion of rabbit conservation to be found later in the report.

1.1. Ecology

The European Rabbit (*Oryctolagus cuniculus*) originated in Spain and Portugal where the species evolved in isolation, particularly during extensive ice ages when the Iberian Peninsula was isolated by ice sheets covering northern Europe³. The oldest known fossil rabbit found in Spain and Portugal is 2.5 million years old⁴. Historically, the species was abundant throughout most of Spain and Portugal, with the notable exception of the mountainous region of Asturias in northern Spain where the species has always been scarce⁵.

The European Rabbit is the only member of the genus *Oryctolagus*, which is one of twelve genera in the order Lagomorpha, which includes the pikas, hares and rabbits. The European Rabbit exists as two genetically distinct⁶ sub-species *Oryctolagus cuniculus algirus* and *Oryctolagus cuniculus cuniculus*, each with its own historical distribution, as shown below. These two distinct sub-species probably arose from two separate geographical groups of rabbits, isolated from each other for long periods when the climate was colder⁷. However, the current distribution of the sub-species overlap and some natural hybridisation occurs.



O. c. cuniculus has been introduced to many other parts of the world outside the Iberian Peninsula including the United Kingdom, Germany, Australia, New Zealand, parts of the Americas and many small islands⁸. *O. c. cuniculus* is also the origin of all domesticated rabbits⁹. Both sub-species are brown/grey in colour and approximately 34-35 cm long when adult. *O. c. cuniculus* is heavier at 1.50 – 2.00 kg, and *O. c. algirus* weighs 0.90 – 1.34 kg¹⁰.

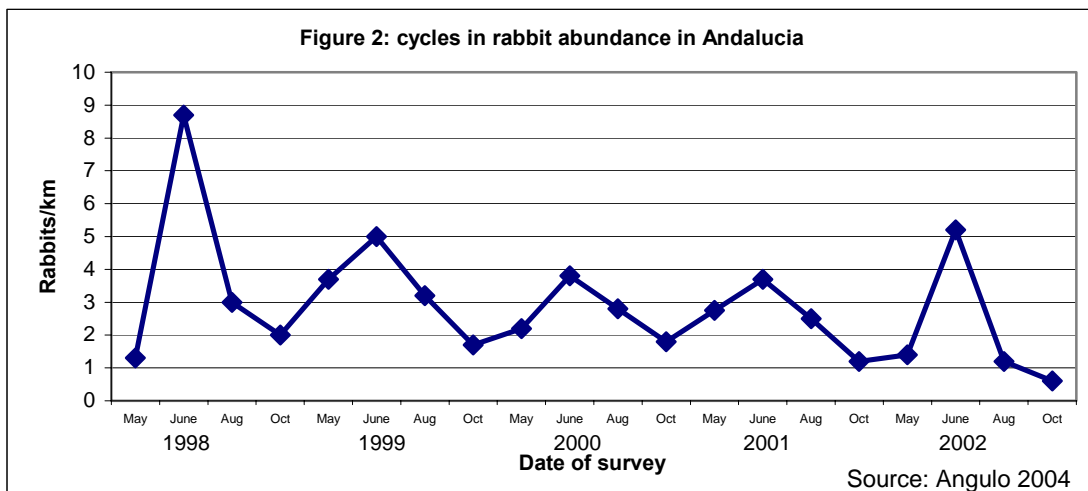
European Rabbits are herbivores with a system of double digestion and can feed on a wide variety of vegetation, adjusting their diet to suit the available vegetation. Species of grasses (*Graminae*) are the preferred food source¹¹. Competing herbivores, such as domestic cattle, have been shown to have a negative impact on rabbit survivorship and density¹². A mixed habitat is preferred, with at least 40% cover to provide protection from predators, and areas of grass or cereals for food¹³. For this reason traditional, low intensity farming (in contrast to modern intensive farming) probably benefited rabbits by opening up previously closed areas of forest and increasing the available food supply¹⁴. Rabbits prefer soft soils for warren

construction¹⁵ and live in territories with a typical home range of 1 to 2 hectares. The species seldom lives above 1500m¹⁶, and generally prefers a warm, dry climate¹⁷. However, at the micro level water sources are important and river banks are a particularly preferred habitat¹⁸.

European Rabbits are rare amongst lagomorphs (rabbits, hares and pikas) and other mammals in being able to reproduce throughout the year. However, reproduction is strongly affected by climate and available food such that in Spain and Portugal the typical breeding season is November to June. Gestation lasts on average 31 days and a female can raise 3-6 young at a time. Baby rabbits have no fur at birth and are blind. The fur begins to grow after approximately one week, and when they are about 13 days old, they can open their eyes.

The period of maternal dependence lasts just 20-30 days¹⁹, after which time young are expelled from the maternal territory. Dispersal distances are low and a maximum dispersal distance of 2 km has been recorded²⁰. Young reach sexual maturity at between four (*O. c. algirus*) and nine (*O. c. cuniculus*) months. However, up to 75% of young inexperienced rabbits are killed by predators before they reach maturity²¹. Predation rates decrease once individuals reach maturity and have their own territory. Overall, high losses to predators are compensated for by a very high birth rate: females can enter heat even when raising young, and up to 12 litters are possible, though 2-4 litters per year is more typical.

Given high reproduction and mortality rates, and a discrete climate-related breeding season, rabbit populations in Spain and Portugal have natural cycles in abundance, as shown below:

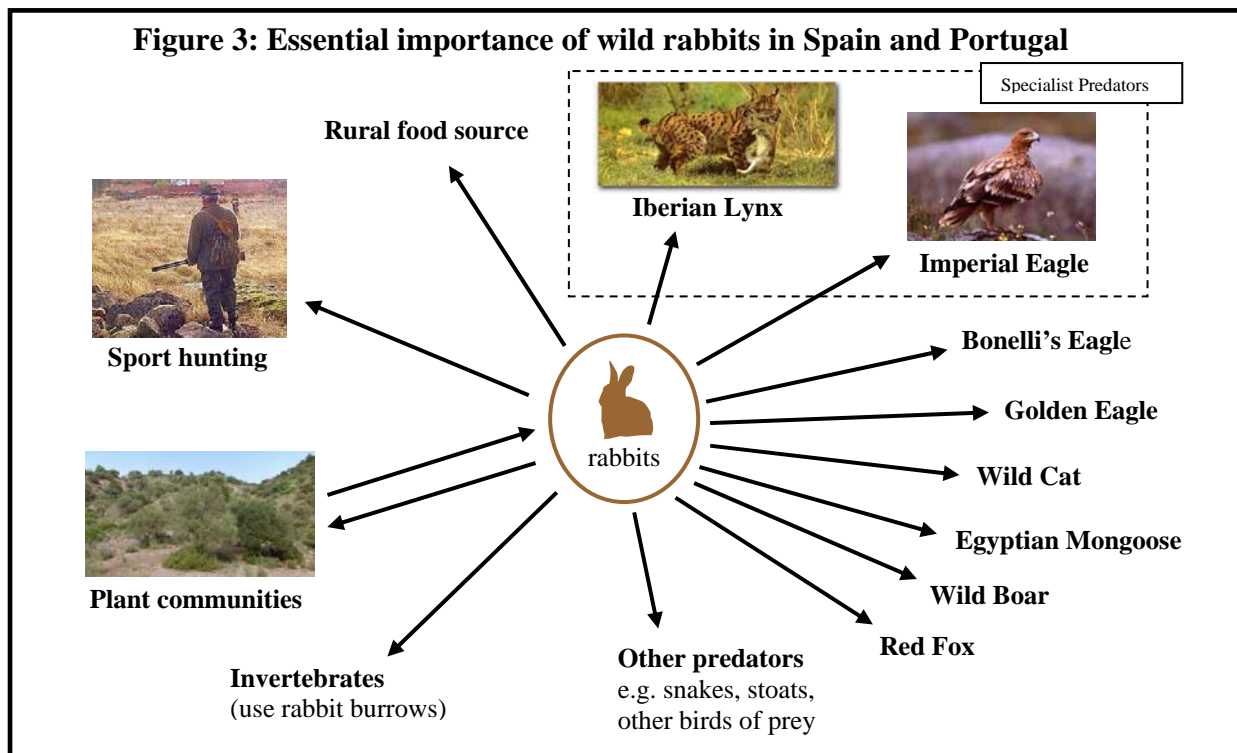


European Rabbits can live up to 10 years, though the average natural life expectancy in the wild is much lower due to predation. Rabbits typically live in colonies, the size of which depends upon habitat type, and tend to forage in groups to increase the likelihood of detecting, and to dilute the impact of, predators²². Rabbits in Spain and Portugal are crepuscular, being most active in twilight hours at dawn and dusk²³. Rabbits avoid high temperatures and predators by living in burrows (in areas of soft soil) or in the shelter of dense scrub or fallen timber, (where rocky soils prevent burrow construction). Rabbits living entirely above ground have been found to suffer from higher rates of predation than those living in burrows, and in general rabbits are more abundant in areas of softer soils where they can burrow.

Maximum rabbit abundance has been recorded as high as 40 individuals per hectare in the highest quality habitat²⁴, though in recent decades densities have decreased drastically as described in section 1.3. Due to its historical abundance and key role in the Mediterranean ecosystem, the European Rabbit is a very important native species to Spain and Portugal, deserving of urgent conservation attention and effort, as described below.

1.2. Importance

The European Rabbit is an essential **keystone species**²⁵ (“a species whose loss from an ecosystem would cause a greater than average change in other species populations or ecosystem processes”²⁶) in Spain and Portugal, with important influences upon plant communities, and a large part of the diet of at least 39 predator species including Red Fox, Egyptian Mongoose, Wild Cat²⁷, Bonelli’s Eagle²⁸, Iberian Lynx, Imperial Eagle, Golden Eagle, Wild Boar, stoats and many other species, as shown below. In addition, rabbits help to model the landscape and their burrows provide habitat for many invertebrate species²⁹. It has been suggested that the Mediterranean ecosystem in Spain and Portugal should be renamed the “rabbit ecosystem” to reflect the historical abundance and essential role of rabbits³⁰, and it is likely that the name “Spain” derived from the Phoenician for “the land of the rabbits”³¹.



The relative ease of capture and historical abundance of the European Rabbit make it a popular prey species and specialist predators such as the Iberian Lynx and Iberian Imperial Eagle eat little else. The Iberian Lynx diet consists of 80-100% rabbits³² and a female with cubs will catch up to 4 rabbits a day. Similarly, the diet of the Iberian Imperial Eagle consists of 40% - 80% rabbits, increasing to almost 100% when raising chicks³³. The ancestral species of both the Iberian Lynx and Iberian Imperial Eagle probably originated in central Asia, but both species arrived in the Iberian Peninsula to shelter during intense ice ages that engulfed much of Europe approximately 1 million years ago. They then evolved to be dependent upon rabbits, possibly due to an absence of their ancestral prey such as ground squirrels³⁴.

The decline of the European Rabbit (as described in the next section) has been one of the three main causes of the decline and near extinction of the Iberian Lynx and Iberian Imperial Eagle – two of the most endangered predators in the world – the other two causes being habitat loss and high non-natural mortality. The decline of rabbits has also contributed to the decline of other predators such as the Wild Cat and Bonelli’s Eagle. It should be noted that rabbit decline has had both direct and indirect impacts on rabbit predators. Firstly, rabbit decline has meant that there is less food for specialised predators, reducing their survival and

reproductive rates. Secondly, rabbit decline has encouraged frustrated human hunters to increase the inappropriate use of non-selective predator control methods³⁵, which has killed and contributed to the decline of many rabbit predators and vultures (see section 4.9). Thirdly, some opportunistic rabbit predators (e.g. foxes and mongoose) may have increased as a result of rabbit decline and predator control (partly driven by rabbit decline) decreasing top predators (e.g. lynx/eagles) that kill and exclude opportunistic predators from their territories (see section 1.3.5). Thus urgent and sustained rabbit recovery is needed to allow endangered specialist predators to survive, and to restore complex interactions in the predator community.

Due to its abundance and ease of capture, wild rabbits have long been an important rural food source for humans and a game species in Spain and Portugal. It is estimated that in Spain alone – where hunting areas cover 70% of the country – there are over 1.3 million hunters³⁶, most of which hunt rabbits, on over 30,000 hunting estates³⁷. Although, due to the decline in rabbits, rabbit hunting has been partly substituted in some areas by partridge and large game hunting (e.g. deer), rabbit hunting remains an important cultural and economic activity, with many land-owners and gamekeepers basing their livelihoods upon income from commercial rabbit hunting. For this reason many hunters and hunting associations have dedicated significant amounts of time and money to rabbit recovery efforts, as described in Chapter 4.

Even more importantly than its role as a keystone and small game species, however, the European Rabbit is an interesting native species in its own right and one which deserves conservation just as much as more emblematic and high profile species, particularly given the speed and extent of rabbit decline, as described in the next section.

1.3. Decline

Although rabbits were once abundant in “great numbers”³⁸ in Spain and Portugal they declined drastically during the 20th Century. In general it is estimated that the number of rabbits in the Iberian Peninsula is now as low as 5% what it was 50 years ago³⁹. Similarly it has been estimated that in the last 30 years alone rabbits have declined on average by 80% in Spain⁴⁰. Moreover, rabbit decline has been uneven, with some areas still containing rabbits at relatively high density but rabbit populations going extinct, or nearing extinction, in many areas, and many other areas containing rabbit populations at very low density.

There are three main causes of the drastic decline in rabbits in Spain and Portugal:

- Rabbit disease (myxomatosis and rabbit haemorrhagic disease)
- Human-induced mortality (e.g. excessive hunting and rabbit control)
- Habitat loss and fragmentation (e.g. due to agriculture, forestry, development and fires)

Each of these causes is described in detail below.

1.3.1. Myxomatosis

Rabbit decline was already on-going in the first half of the 20th Century⁴¹, due to human induced mortality and habitat loss and fragmentation (see sections 1.3.2 and 1.3.3). However, the entry of myxomatosis into rabbit populations in Spain and Portugal in the 1950s greatly accelerated this decline. Myxomatosis was first introduced into Europe in France in 1952 by a farmer keen to rid rabbits from his land⁴². The disease originated in South America where it is endemic in the native Cottontail Rabbit, on which it has a lesser effect than on European Rabbits. Myxomatosis was first detected in Spain in 1953. Subsequently over 90% of rabbits in Spain and Portugal were killed by the disease⁴³. Studies have shown that the disease killed as many as 99% of all rabbits when it spread into the United Kingdom⁴⁴ and Australia⁴⁵.

Myxomatosis is a viral disease transmitted mainly by fleas and mosquitoes, although transmission by direct contact is also possible. It can kill wild rabbits directly, or indirectly by increasing susceptibility to predation, and is most prevalent in spring and summer, when fleas and mosquitoes are more common. Common symptoms are lumps and swellings around the genitals and head (see figure 4) possibly progressing to acute conjunctivitis, blindness, loss of appetite and fever. Secondary bacterial infections occur in most cases which cause pneumonia and inflammation of the lumps. In typical cases where the rabbit has no resistance, death takes an average of 13 days⁴⁶. The disease has a greater impact on younger rabbits than on adults.



Figure 4: rabbit with myxomatosis

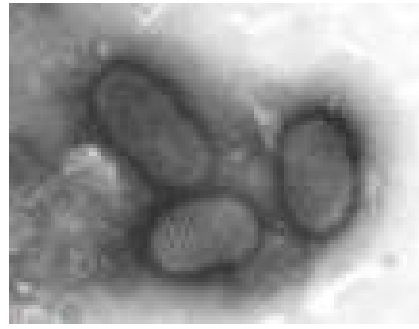


Figure 5: myxoma virus

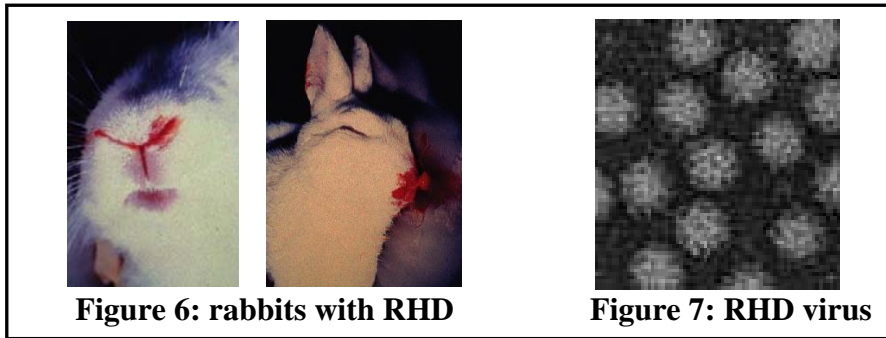
Following the initial outbreak, death rates from myxomatosis started to decline and by the 1980s the species was showing signs of recovery⁴⁷. However, even in the 1990s, as many as 35% of all juvenile rabbits in Spain and Portugal were being killed by the virus, either directly or as a result of the disease making them more susceptible to predation⁴⁸. Moreover, just as populations in Spain and Portugal may have been recovering from myxomatosis, another devastating rabbit disease arrived (Rabbit Haemorrhagic Disease), reducing populations once again and possibly preventing rabbits recovering from either disease, as described below.

1.3.2. Rabbit Haemorrhagic Disease

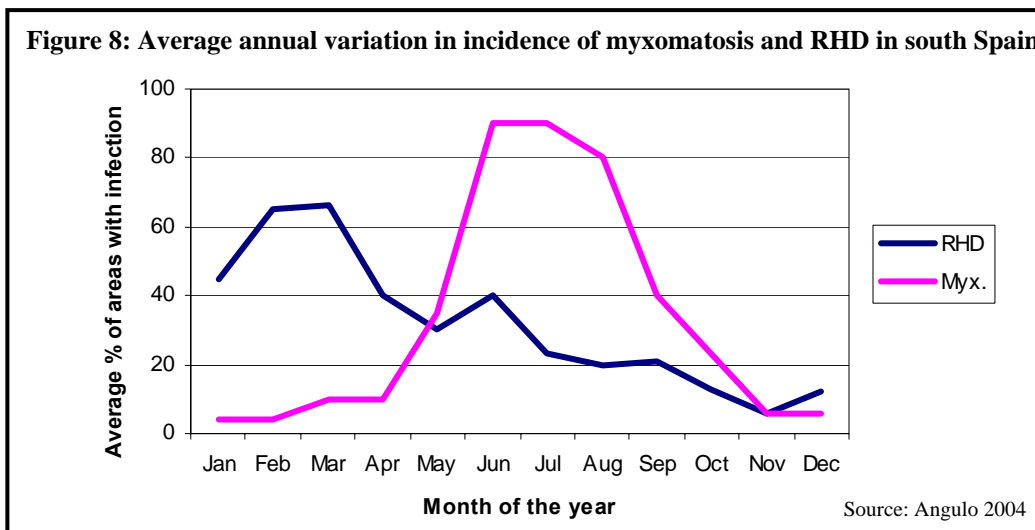
Rabbit Haemorrhagic Disease (RHD) was first described in China in 1984⁴⁹. However, it was discovered in a batch of rabbits imported to China from Europe and it is now suspected that the disease originated from Europe⁵⁰. RHD was first detected in Europe in 1987 and spread to Spain and Portugal by 1989. The initial effect of the disease was devastating and 55%-75% of rabbits in Spain and Portugal were killed⁵¹. 90% of some rabbit populations were killed when the disease was introduced into Australia in the mid-1990s⁵². In both the Iberian Peninsula and Australia the effect of RHD seems to have been highest in the driest areas⁵³.

RHD is a viral disease mainly spread by direct contact between individuals, rather than via insect vectors. However, some insects have been found to carry the virus, particularly in Australia, and the virus can survive in the environment for several weeks, particularly when temperatures are lower⁵⁴. By contrast, although human-related transmission was probably also important during the spread of the initial disease outbreak⁵⁵, human-related transmission is probably no longer playing a significant role in the spread of RHD⁵⁶. RHD is most prevalent in winter and spring, and kills adult rabbits but not young under eight weeks. The cause of the lesser impact of RHD on young rabbits is poorly understood. However, it is known that rabbits born to immune mothers are temporarily protected by maternal antibodies, and that if infected with RHD at this time young rabbits will gain life-long immunity to the disease⁵⁷.

After infection, RHD has a short incubation period of 24-48 hours and rabbits usually die within 6-24 hours of the onset of fever⁵⁸. RHD causes haemorrhaging of the lung and lesions in the liver⁵⁹, and symptoms include bleeding from the nose and mouth, as shown below.



Both myxomatosis and RHD are endemic in European Rabbits in Spain and Portugal. It is possible that the existence of one disease is preventing recovery from the other, by killing individuals who have immunity to the other disease. Both diseases cycle through the year with distinct seasonal variations, as shown for south Spain below; the winter peak in RHD is driven by climate and the arrival of new sub-adults in the population and the summer peak in myxomatosis is driven by the increase in disease vectors in the summer. However, in a particular year it is not possible to accurately predict the extent of the impact of each disease, which varies year to year, possibly due to fluctuations in climate and weather, especially rainfall. In general, the diseases have a complimentary impact, with RHD affecting mostly adults, being transmitted mostly by direct contact and being most prevalent in winter and spring, and myxomatosis mostly affecting young, being transmitted by insects and occurring in spring/summer. However, no direct interaction has been detected between the two diseases.



1.3.3. Habitat loss and fragmentation

Habitat loss and fragmentation has been a major cause of rabbit decline, starting even before the arrival of diseases. European Rabbits require a scrub-forest habitat providing vegetation for shelter and open grass-land areas for food, both within a small area given the small home range (1-2 hectares) of adult rabbits. The human conversion of Mediterranean scrub-forest has thus had a negative impact upon the species, contributing to its decline⁶⁰. Overall it has been estimated that 1% of Mediterranean scrub-forest is lost each year to human development.

Early human influence on the Iberian landscape, in the form of low-intensity agro-forestry, may have actually benefited rabbits by providing an ideal habitat mosaic of shelter and food (as noted in previous sections). Thus, the loss of such land uses in recent decades, abandoned to allow a return to closed forest or changed to intensive agriculture has contributed to rabbit decline. Areas of closed forest provide less food for rabbits than mixed agro-forestry. Similarly, large monocultures of crops – rather than diverse small farming patches – fail to provide year-round food sources for rabbits and lack vegetation for protection from predators.

Huge areas of the Iberian Peninsula were converted to such intensive agriculture in the 20th Century; for example, in Portugal under the 1940s “wheat programme”⁶¹. Moreover, much intensive agriculture initially proved unsustainable due to a lack of sufficient soil fertility, rainfall and water for irrigation. Thus lands were abandoned and new areas of Mediterranean scrub forest consumed. Subsequent developments in irrigation and “greenhouse” technology have enabled more vast areas to be developed for intensive fruit and vegetable production. The intensification of livestock farming has also degraded rabbit habitat, (e.g.) given that high densities of cows and other domestic animals compete with rabbits for food. Similarly, recent raising of over-abundant big game (e.g. deer) on many commercial hunting estates has increased food competition with rabbits and degraded important rabbit habitat. Finally, many traditional farming practices have been abandoned, and a lot of land returned to closed forest.

Beyond the impact of big game and changes in agriculture, large areas of Spain and Portugal were converted to exotic pine and Eucalyptus plantations in the 20th Century. For example, in Spain the national government planted 1 million hectares of Eucalyptus between 1940 and 1960 alone⁶², and Eucalyptus plantations have consumed large amounts of habitat for rabbits and rabbit predators, particularly in southern Portugal. Eucalyptus dries out the soil reducing available food and water for rabbits, and provides little under-storey for protection from predators. Similarly, exotic pine plantations provide little shelter or food for the species.

In addition to intensive agriculture and forestry, much ideal rabbit habitat has been lost in recent decades to urbanisation and infrastructure development. In particular huge areas of rabbit habitat in river valleys have been flooded to create numerous large reservoirs⁶³. Finally, a lot of important rabbit habitat has been lost to large and damaging forest fires in Spain and Portugal. The incidence and impact of fires has increased with the planting of highly flammable Eucalyptus forests, increasing incidences of arson⁶⁴ and (recently) climate change.

1.3.4. Human-induced mortality

Humans have long killed significant numbers of rabbits in Spain and Portugal for food, for sport and to protect agriculture. Whilst traditional practices were probably sustainable, some more recent practices are not and have rather contributed to rabbit declines in the Iberian Peninsula, particularly in combination with the impacts of rabbit habitat loss and diseases.

It has been alleged that in some agricultural areas where rabbit populations declined due to diseases the final cause of local rabbit extinctions was from farmers destroying warrens and killing those few rabbits that were immune to, and had survived, diseases. Certainly, some farming practices in some areas (e.g. warren destruction, snares, poisonings) specifically aim to remove rabbits from local areas and official policies continue to allow farmers to kill rabbits, e.g. by the granting of “exceptional permits” for summer rabbit hunting on agricultural land when impacts of rabbits on crops have occurred in Spain. Some current practices and official policies on rabbit populations in agricultural areas have not changed significantly in recent decades and were originally devised to control rabbits when the abundance and impact of rabbits were much higher. Although some rabbit control is still needed in some areas, in many areas where rabbits have declined it is not justified. In addition, beyond direct, intentional mortality, many rabbits are also killed each year in agricultural areas by the extensive and excessive use of chemical pesticides and fertilisers.

Beyond being killed by farmers, many millions of rabbits have been killed each year by hunters. The number of hunters in Spain has increased significantly in recent decades and there are now over 1 million registered hunters, compared with less than 0.5 million in the

1960s⁶⁵. In addition, the effectiveness of rabbit hunters has increased with better weapons technology⁶⁶. Overall it is estimated from official bag count data that in the 1980s over 10 million rabbits were being hunted each year in Spain alone; this number has subsequently reduced significantly to around 3 million rabbits hunted per year - probably mostly due to a reduction in the numbers of rabbits available to be hunted⁶⁷. Although some hunters have benefited rabbits by preserving valuable habitat and (more recently) attempting rabbit recovery techniques (see chapter 4), other hunting practices have exacerbated rabbit decline.

In general, over-hunting of rabbits is common on many hunting estates⁶⁸. In addition, many hunting practices have been inappropriate, especially in combination with the impacts of rabbit diseases. Some hunters and hunting associations have reduced rather than increased controls on rabbit hunting in response to rabbit decline⁶⁹ and this has caused some rabbit populations to go extinct. Similarly, by hunting rabbit populations that have been reduced by disease, some hunters have probably frustrated rabbit recovery by killing individuals with disease immunity⁷⁰. Finally, as some rabbit populations have gone extinct, some hunters have focused more on those populations that have managed to survive at high density, increasing hunting pressure on remaining populations and causing some to decline significantly.

1.3.5 Rabbit Predators

Rabbit predators have not caused rabbit decline. Rabbits existed for millennia at high densities in Spain and Portugal alongside a large number of predator species⁷¹. Moreover, rabbits have evolved to be tolerant of high predation levels through anti-predator behaviour and high reproduction⁷². Thus, the widespread⁷³ use of predator control by hunters aiming to recover rabbits is often excessive, inappropriate and counter-productive⁷⁴ (see section 4.9).

Although rabbit predators have not caused rabbit decline, the recovery of some rabbit populations that have been decimated by diseases, habitat loss and human-induced mortality may be being partly prevented by common opportunistic rabbit predators – particularly Red Foxes, Egyptian Mongoose, Wild Boar and feral cats and dogs. This phenomena is known as the “predator pit”⁷⁵ and may explain why rabbits introduced into areas with fewer natural predators (e.g. Australia) have been able – unlike in Spain and Portugal – to recover from both myxomatosis and RHD. Reductions in vegetation cover by intensive agriculture and forestry have increased the vulnerability of rabbits to common predators by reducing available shelter. In addition, densities of Red Foxes may have increased in recent years in Spain and Portugal, as they are particularly adaptable to human presence and have benefited from the reduction in top predators such as the Iberian Lynx, which can kill foxes and reduce fox densities on their territories. Similarly, densities of Wild Boar, which also eat significant numbers of young rabbits⁷⁶, have increased in recent decades due to land use change and a lack of top predators⁷⁷. Ironically, the decrease in top predators, and thus the decrease in natural control of common rabbit predators, has been partly caused by frustrated rabbit hunters implementing inappropriate non-selective predator control⁷⁸ (see section 4.9).

1.4. Conclusions

The European Rabbit is an important native keystone species in Spain and Portugal, where it is one of the most important elements of the Mediterranean ecosystem but also where, unfortunately, it has declined drastically in recent decades due to two diseases (myxomatosis and RHD), habitat loss and human-induced mortality. The current status of rabbit populations in the Iberian Peninsula, and threats to their future survival, are described in the next chapter.

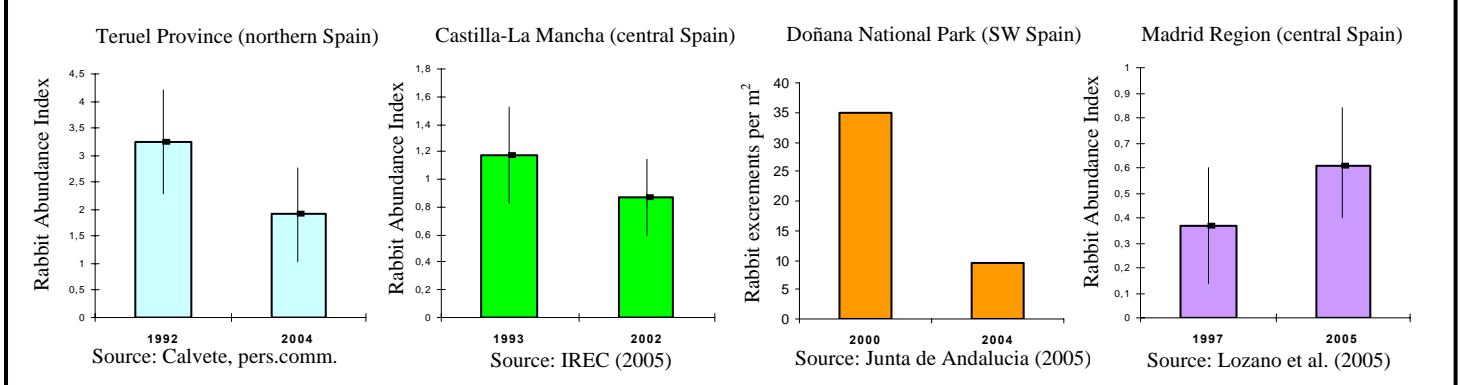
2. Status of and Threats to rabbit populations

The European Rabbit is an essential keystone species for the Mediterranean ecosystem in Spain and Portugal, where it has declined massively in recent years. This chapter describes the status of, and threats to, those rabbit populations that have managed to survive.

2.1. Status

European Rabbits are globally classified as Least Concern by the IUCN. However, the Portuguese Institute for Nature Conservation (ICN) has classified rabbits as Near Threatened in Portugal⁷⁹. In addition, it has been argued that European Rabbits should be re-classified from Least Concern to Near Threatened or even Vulnerable⁸⁰ in Spain. Under IUCN criteria a species or sub-species can be declared as regionally⁸¹ or globally Vulnerable if there is “an observed, estimated, inferred or suspected population size reduction of $\geq 30\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased”⁸². In addition, a species or sub-species can be declared as Near Threatened if it “is close to qualifying for or is likely to qualify for a threatened category in the near future”⁸³. The decline in rabbits in Portugal⁸⁴ and some regions of Spain have been observed and estimated as either close to or exceeding 30% in the last ten years (see figure 9), and the causes of rabbit decline have not ceased. Thus rabbits should not be widely classified as Least Concern, as is currently the case in Spain. The sub-species *O. c. algirus* should be globally re-classified, given that it has declined massively, and is confined to the Iberian Peninsula⁸⁵. In addition, *O. c. cuniculus* should be regionally (but not globally) re-classified, reflecting its decline in most but not all regions, and the fact that it has been spread beyond its natural range into other areas of the world where it is not native and poses a threat to native ecosystems. The benefits of, and barriers to, reclassification are discussed in section 5.9.

Figure 9: Recent changes in regional rabbit abundance



Rabbit decline has been massive and uneven, and is still ongoing. In many areas rabbits have gone extinct or survive at very low density. Where densities are low there has been little rabbit recovery, and rabbits have not recolonised areas where they have gone extinct. Some areas do still contain rabbits at relatively high density, and there is also a big variation at the regional level with a few regions (e.g. Region of Madrid⁸⁶) recording increases in rabbit densities in recent years, whereas rabbits have continued to decline in most other regions. For example, in Aragon since 1991 – i.e. even after the massive declines caused by the previous arrival of first myxomatosis and then RHD – rabbit numbers have declined by a further 40% in the last 14 years⁸⁷. Similarly, in Portugal rabbit densities declined by over 30% in the ten years up to 2002⁸⁸. Moreover, in the Biological Reserve of Doñana rabbit densities are now as low as 0.03 per ha⁸⁹. Iberian Lynx require 1 – 4 rabbits per ha for breeding, and as a result of the extreme scarcity of rabbits, lynx are no longer breeding within the reserve⁹⁰ and are being kept alive partly by supplementary food supplied in enclosures by conservation personnel⁹¹.

It has been argued that rabbit populations have declined most in the south and west of the Iberian Peninsula⁹². This could be due to warmer, drier climates, given that (e.g.) RHD has a bigger impact in such climates. However, it has also been suggested that this variance might be due to diseases having a greater impact on *O. c. algirus* than on *O. c. cuniculus*. In this regard, it has also been suggested that populations containing hybrids between the two subspecies show the least impact of, and greatest recovery from, rabbit diseases. Finally, it has also been suggested that rabbit hunting is most intense in the south of the Peninsula⁹³.

At the more micro-level, rabbit decline has also varied and a number of hypotheses have been proposed to explain this. Firstly, historical abundance seems to be important, with areas of historically higher density being less likely to suffer rabbit extinctions. Secondly, it seems that some granite areas have permitted rabbit recovery better than other areas, possibly because granite offers more places for rabbits to hide from predators. Thirdly, it has been suggested that there are important interactions between habitat type and disease impacts, given that (e.g.) rabbit populations in different habitats differ in their age structure (and thus RHD impact), contact rate between individuals and exposure to myxomatosis vectors (i.e. fleas and mosquitos). Fourthly and finally, it has been suggested that a non-pathogenic protective virus might exist, reducing the impacts of diseases in some areas and not others, thus explaining the variation in rabbit abundance⁹⁴; although such a virus has not yet been detected in the wild. Overall, there remains a great deal of uncertainty and disagreement amongst experts, and there are many cases of variance in rabbit density that are seemingly inexplicable. This is due in part to inadequate rabbit monitoring, disease surveillance and understanding as to how the different factors that have caused rabbit decline interact (see sections 4.3 and 5.2).

Despite the complexities and uncertainties in rabbit decline, experts have concluded that rabbits have declined massively in recent decades, that average rabbit densities are as low as 5% of 1950 levels⁹⁵, and that this rabbit decline is ongoing in most areas. Furthermore, some populations that have managed to survive seem not to be stable and many continue to be threatened by a number of existing and new potential pressures, as described below.

2.2. Threats

RHD and myxomatosis remain endemic in rabbit populations in Spain and Portugal. Although it is expected that in the long-term rabbits will evolve immunity to both diseases and/or the diseases themselves will evolve to have a lower impact, the effect of both diseases could actually worsen in the short and medium term, particularly at the local level. This might occur (e.g.) due to changes driven by global warming towards a drier, warmer climate in Spain and Portugal exacerbating the impact of diseases. Any increase in the impact of rabbit diseases in the short or medium term would be particularly problematic for the Iberian Lynx and Iberian Imperial Eagle, as both these rabbit predator species are already close to extinction.

In addition to the continuing impact of existing diseases, and just as RHD and myxomatosis arrived without warning, it can not be ruled out that another devastating disease could be introduced into Iberian rabbit populations, particularly given the ever increasing rates of transport of people and animals in the 21st century making it very easy for diseases to move between countries and continents. Such a disease could be an as yet unknown natural disease occurring in other lagomorph populations in other parts of the world. Just as likely, however, is the arrival of a new man-made GM rabbit disease under development in Australia⁹⁶.

CRC Pest Animal Control have been developing a number of immunocontraceptive viruses for introduced pest species in Australia, including rabbits and mice⁹⁷. The rabbit virus is based upon a modified myxomatosis virus, and is designed to deliberately spread in wild rabbit

populations making female rabbits infertile. At present the company is concentrating more on fully developing mice viruses than rabbit viruses. However, it is likely that a new GM immunocontraceptive virus for rabbits will be fully developed in the near future in Australia, and could well be released given strong pressures from Australian conservationists and farmers for new rabbit control methods. Official risk assessments for GM viruses in Australia do not at present have to consider the possible effects of the virus spreading to other countries⁹⁸. Moreover, the unlicensed release of RHD into mainland Australia in 1995 – when it was still being tested on an off-shore island⁹⁹ – and the subsequent illegal introduction of RHD into New Zealand in 1997¹⁰⁰ shows that either accidental release or the illegal activity of individuals could cause a new GM virus to be released and spread, even if it is not granted an official licence. In addition, the history of natural disease spread, and the continuing desire from some European farmers for more rabbit control methods, could mean that once released into Australia a GM virus could rapidly spread to other continents, including Europe.

If a new GM immunocontraceptive virus reached Spain and Portugal, its impact would be devastating. In combination with the continuing impact of RHD, myxomatosis, habitat loss and human-induced mortality, the new GM disease could bring many (or even all) rabbit populations to extinction. This seems likely given that the GM immunocontraceptive virus would be specifically designed for this purpose in Australia where, due to far fewer natural predators, it is much harder to eradicate rabbit populations than in Spain or Portugal.

Beyond rabbit diseases, excessive hunting and inappropriate management continues to threaten many rabbit populations. For example, it has been alleged that some rabbit populations that have recently recovered from rabbit diseases have suffered massive resumptions in rabbit hunting and have declined again to low levels as a result. Secondly, the common practice of translocating rabbits between populations – particularly by the hunting community – can significantly affect donor populations, potentially pushing them from high to low density, especially given complex disease dynamics (see section 4.5). Thirdly, it has been officially stated that many rabbit populations that have been reduced by diseases can not support the current level of hunting pressure that they are being subjected to¹⁰¹, and the ongoing tendency by some hunters to over-hunt¹⁰² and even to employ no hunting restrictions when rabbits are scarce¹⁰³ continues to threaten some rabbit populations with extinction.

In addition to the continued threat from diseases and hunting, remaining rabbit populations continue to be threatened by habitat loss. Despite cultural trends towards sustainable development, it is likely that demands for urbanisation, intensive agriculture and water reservoirs will increase in the future in Spain and Portugal, encouraging further loss of Mediterranean scrub forest. Moreover, many more and perhaps even larger areas will be lost to forest fires in the future, particularly given the likely impact of climate change. Similarly, Spain is the country in Europe most threatened with desertification, also driven by climate change. Desert habitats can not support European Rabbits or the specialist predators that depend upon them. Finally, many surviving rabbit populations are small and isolated and thus more prone to extinction from random “stochastic” factors including skewed sex ratios and freak weather events; e.g. floods and droughts have affected some rabbit populations.

2.3. Conclusions

Given recent declines, *O. c. algirus* should be re-classified globally, and *O. c. cuniculus* regionally, by the IUCN. Many surviving populations are small and isolated and continue to be threatened by hunting, existing diseases, possible new (including GM) diseases, and habitat loss from fires, desertification and development. The objectives and actions required for wild rabbit recovery in Spain and Portugal in the future are described in the next chapter.

3. Conservation goals and objectives

The wild rabbit is a very important species in Spain and Portugal that has declined massively in recent decades, and remains suppressed and subject to possible further threats in the future. There is still a great deal of uncertainty and debate amongst experts as to how best to address and reverse rabbit decline (see appendix). Nevertheless, it is possible to outline the broad objectives and important specific goals for rabbit recovery, as described below.

3.1. Broad objectives

The ultimate objective of rabbit conservation in Spain and Portugal is the sustained and widespread recovery of the species across the Iberian Peninsula. A complete recovery to the numbers and distribution of the early 20th Century is unrealistic given conflicts with intensive agriculture and the likely long-term persistence of some rabbit diseases. Nevertheless, it is necessary to achieve widespread and sustained rabbit recovery (rather than local and/or temporary recovery) given the diverse importance of rabbits as a native keystone and game species in Spain and Portugal. Even with a narrow focus on the endangered Iberian Lynx and Iberian Imperial Eagle, widespread rabbit recovery is necessary given the large interconnected areas required to sustain viable meta-populations of these specialist predator species.

Sustained and widespread rabbit recovery will require a long-term reduction in the impact of rabbit diseases. This may occur naturally, as rabbits evolve immunity and/or diseases evolve to be less deadly. However, it may also require management interventions given that the complex mix of impacts (e.g. myxomatosis, RHD, predators, hunting etc.) seem to be frustrating the evolution of disease immunity in rabbits in Spain and Portugal. In addition, habitat protection and recovery, and a reduction in the impacts of human-induced mortality will also be required as in addition to disease impacts, rabbits are under pressure over large areas from existing hunting, development, agriculture and forestry practices.

Linking up isolated populations

In order to achieve a sustained and widespread recovery it will be necessary in the medium term to link up smaller isolated rabbit populations into more continuous, larger connected populations. This is because rabbit distributions have already become very fragmented, with large areas where rabbits have gone extinct, between isolated populations. In addition, the linking of isolated populations will also be necessary in the medium term to sustain rabbit populations (and populations of rabbit predators that depend on them), which might otherwise disappear due to stochastic factors inherent to small and isolated populations¹⁰⁴.

Linking up isolated populations may cause initial declines by introducing diseases into populations that are at present disease-free. However, larger linked-up populations are more able to recover from, and achieve a stable equilibrium with, diseases¹⁰⁵, which in the longer term is more important for rabbit recovery. Conversely, small isolated populations that may at present be disease-free are likely to become infected with diseases in the near future – e.g. via insect vectors or human-related transmission – and if they remain small and isolated they will be less likely to be able to recover from disease impacts and more likely to go extinct.

The expansion and linking up of isolated rabbit populations will require habitat recovery in the intervening areas, planning as to which areas to prioritise and translocations and/or reintroductions to help link up populations¹⁰⁶. A reduction in the impacts of diseases and hunting will also be necessary to allow populations to expand into new areas.

Stabilising and maintaining remnant rabbit populations

In order to have populations of rabbits (and rabbit predators) to link up into more continuous distributions in the future, it will be necessary to first stabilise and maintain remnant rabbit populations, and thus to reverse on-going declines and the transient nature of many rabbit populations. This will be particularly important in the short term for the endangered Iberian Lynx and Iberian Imperial Eagle, surviving populations of which may go extinct if the particular populations of rabbits on which they depend disappear.

Stabilising and maintaining existing rabbit populations will firstly require: more monitoring to determine abundances, and areas where rabbits do and do not survive, and; more planning to prioritise, organise and execute management interventions. In particular it will be necessary to identify and agree on those rabbit populations that should be the priority for initial conservation work, perhaps those populations surviving at the highest density – as they are the ones argued to be most likely to survive and to respond positively to management interventions¹⁰⁷ – and/or, those populations most important for endangered predators. Secondly, the management interventions themselves will need to include: habitat improvements to boost population growth rates; a reduction in the negative impacts of human induced mortality and diseases, and (possibly); the local short-term reduction in the impact of common predators on particular populations. Thirdly, it will be important to avoid new threats to surviving rabbit populations, for example by protecting areas of habitat and campaigning against the possible release of a new GM rabbit virus, under development in Australia.

3.2. Specific goals

In order that existing rabbit populations can be stabilised and maintained in the short term, and then expanded and linked up in the medium term, to permit widespread and sustained rabbit recovery in the long term, a number of specific goals need to be achieved:

- Implementing sustained, widespread and comparable monitoring of rabbit populations
- Planning management interventions and the prioritisation of geographical areas
- Reducing the impacts of, and avoiding new (including GM), rabbit diseases
- Reducing the negative impacts of human-induced mortality
- Protecting and restoring rabbit habitat in current and potential rabbit areas
- Translocating/reintroducing rabbits successfully into existing and new areas
- Reducing the short term impact of common rabbit predators, but only where justified

3.3. Conclusions

There is still a lot of debate and uncertainty amongst experts as to how best to address rabbit decline in Spain and Portugal, and more inclusive action planning is required. Nevertheless, it is possible to identify the broad objectives for rabbit conservation in the Iberian Peninsula, and specific goals that need to be achieved to reach these objectives, as described in this chapter. Each of these goals is necessary, given that many different factors have combined to produce rabbit decline and all need to be achieved to permit rabbit recovery. The progress that has been made to date in achieving these goals in the Iberian Peninsula, and the barriers that still exist to achieving them in the future, are described in the next chapter.

4. Progress and barriers to progress in conservation

Despite European Rabbits being an essential keystone (and game) species in Spain and Portugal, rabbit conservation efforts have not yet been able to reverse rabbit decline, and rabbit populations remain threatened as described in Chapter 2. This next chapter analyses the progress made towards the goals and objectives required for rabbit recovery (described in Chapter 3), and identifies barriers to achieving them in the future. In general, rabbit conservation has been characterised by a late start and a narrow focus, as described below.

4.1. Late start

Rabbit conservation efforts in Spain and Portugal only began 10-15 years ago, even though the species had been declining massively for decades due to disease, habitat loss and human-induced mortality. Moreover, most existing rabbit conservation projects and programmes are less than five years old, and a lot of important work has not even begun in many areas.

There are two main causes of this late start to rabbit conservation:

i) A late start to nature conservation in general in Spain and Portugal

The late start to rabbit conservation efforts, only beginning after decades of rabbit decline, is in part a function of the late start to nature conservation in general in Spain and Portugal – as has been found for the conservation of other Iberian species, such as the Iberian Lynx¹⁰⁸. The past oppressive regimes, international isolation and weaker economies due to the long Fascist dictatorships in Spain and Portugal meant that Iberian individuals and organisations were less interested in, informed about or able to instigate nature conservation than their contemporaries in other western nations. In addition, the development of scientific research in Spain and Portugal was slower in the past than it is now. It was only after the fall of the dictatorships, the rise of democracy, EU membership and accelerated economic growth that nature conservation in the Iberian Peninsula started to develop in the late 1980s and 1990s.

ii) Rabbit conservation not being a high priority conservation issue

Rabbit conservation has not been a high priority issue in Spain and Portugal, and this has meant that even after nature conservation started in the late 1980s, rabbit conservation has lagged behind and has only really started to develop in the last few years. The low profile given to rabbit conservation has been in part due to a failure to widely recognise the ecological importance of rabbits in Spain and Portugal. It has also been due to the international discourse on the species being dominated by the need to eradicate rabbits from areas where they have been introduced (e.g. Australia). In addition, it has been alleged that conflicting pressures from hunters and farmers – keen to avoid protection of rabbits and constraints on their own activities – have resisted moves to take rabbit conservation more seriously as a conservation issue¹⁰⁹.

Nature conservation in general, and rabbit conservation in particular, are now underway at least in some parts of Spain and Portugal. However, even once started, rabbit conservation in the Iberian Peninsula has suffered from an overly narrow focus, as described below.

4.2. Narrow focus

Most rabbit conservation efforts to date have been driven on the one hand by hunters keen to recover rabbit populations on hunting estates, and on the other hand by conservationists keen to recover a vital prey species for the Iberian Lynx, Imperial Eagle and other endangered predators. These pressures are important, and without them it is likely that rabbit conservation efforts would still not have developed today. However, an indirect focus on rabbit conservation under the priority of endangered predators or hunting has meant that:

- Rabbit conservation has been constrained to geographical areas particularly important for predators and/or hunters rather than the wider rabbit distribution.
- Rabbit conservation efforts have not adequately addressed some key issues, such as the need to reduce conflicts between rabbit populations and agriculture.
- Rabbit conservation efforts have been poorly co-ordinated with different geographical areas, and those interested in different predator species and hunting, developing rabbit conservation methods largely independently from each other.

Very recently, there has started to be some collaboration between the different geographical areas and diverse actors involved in rabbit conservation. In addition, there have been developments suggesting that rabbit conservation could soon be taken seriously as a conservation issue in its own right. However, there have been, and still remain, many barriers to achieving important specific goals in rabbit conservation, as described below.

4.3. Monitoring

Species monitoring is important to fully appreciate the extent, and to diagnose the causes, of species decline. In addition, widespread and sustained species monitoring is essential for devising and evaluating conservation strategies, and for assigning species the correct conservation status, including under IUCN Red List criteria. Unfortunately, however, the monitoring of rabbits in Spain and Portugal has had both a late start and a narrow focus, and subsequent progress has been slow and frustrated by a number of barriers, as described below.

Firstly, little monitoring data exists for rabbits before the 1990s. This means it is very difficult to accurately describe, or to diagnose the precise causes of, historical rabbit decline – although some researches have attempted to do so by analysing data from rabbit hunting bag counts, recorded since the 1970s¹¹⁰. Secondly, even during the 1990s, many geographical areas and rabbit recovery projects failed to implement rabbit monitoring¹¹¹ so that it is not even possible to accurately describe many recent trends in many rabbit populations, or to evaluate the success of older rabbit recovery projects. Thirdly, and partly as a consequence of the tendency to address rabbit conservation indirectly and independently in different geographical areas and for different ultimate aims, most rabbit monitoring that has been implemented in recent years has tended to use different, incomparable methods. This means that it is hard to compare results even from those recovery projects that have been monitored.

A census was conducted across some regions of Spain in 1993, repeated in 2003¹¹². Other recent surveys have been conducted in some Spanish regions and in Portugal, and these have been useful in showing that populations continue to decline in most areas (see section 2.1). In addition, some widespread maps of rabbit density have been produced by those co-ordinating the recovery strategy for the Iberian Lynx in Spain and Portugal. Maps produced for Iberian

Lynx conservation have used surveys of rabbit latrine density in 10 km x 10 km squares, and have been particularly useful in showing that remaining lynx populations are mainly confined to areas of relatively high rabbit abundance. However, these maps are of very low resolution and have – unsurprisingly – been confined to areas where lynx have been present recently.

Different incomparable methods used to monitor rabbits include: visual surveys of rabbit numbers, counting rabbit latrines, counting rabbit droppings, telemetry and hunting bag counts. In addition, some surveys that have used the same method, have used a different survey scale of resolution (e.g. 1 km, 5 km or 10 km squares) and thus their results are still incomparable. In late 2005 the Spanish Environment Ministry recommended standard protocols for rabbit monitoring¹¹³ to be followed by others working in rabbit conservation in Spain and Portugal. These protocols include, for example, in hunting estates, a record of rabbit bag counts per hunter per day, accompanied by a biannual night time visual drive through survey and biannual counts of rabbit droppings. The record of bag counts per hunter per day can be a simple effective way to provide data to estimate rabbit density and recent trends that can be compared year to year, and across estates, provided that any changes in hunting restrictions and effort are taken account of. Visual surveys and dropping counts, timed at the annual peak and trough in abundance, can also provide useful data in some locations, depending upon the amount of vegetation cover and habitat type.

It will be difficult, however, to implement, and to encourage most researchers to implement, these new recommended protocols in different areas, particularly where these methods contradict existing monitoring methods, and particularly given that rabbits alter their behaviour in different soil types. It has thus been suggested that regular censuses be co-ordinated at the Iberian level, using the same method and scale across the Peninsula, following more research and debate amongst experts to determine the best methods. Most importantly, such an Iberian rabbit census would need to be repeated every 2-3 years to provide accurate and up-to-date information on trends in rabbit abundance and regional variations, that can at present only be inferred from some local and regional surveys. However, such an important initiative would likely be obstructed at present by: inadequate co-ordination amongst rabbit experts, between Spanish Regional Governments and between Spain and Portugal; and by the low profile of, and funding for, rabbit conservation.

4.4. Planning

Adequate planning of nature conservation, in parallel and in response to species monitoring, is important to organise and mandate conservation actions, and to prioritise geographical areas. Without adequate planning nature conservation projects fail to address key issues, are unable to challenge powerful conflicting interests and in general are less likely to succeed. Unfortunately, the planning of rabbit conservation – like rabbit monitoring – has suffered from a late start and a narrow focus, and progress is being frustrated by a number of barriers.

Andalucia had a rabbit and partridge recovery plan running from 1997 to 2001¹¹⁴. However, at present none of the Spanish Autonomous Regions have approved rabbit recovery plans, and neither Spain nor Portugal has a rabbit recovery strategy, despite these being officially recommended¹¹⁵. The Spanish Environment Ministry has just begun to elaborate a rabbit recovery strategy, in late 2005, and Castilla-La Mancha is now working on a draft rabbit management plan. Similarly, Navarra has a useful draft rabbit recovery plan. However, it will probably be many years before these plans are finished and/or approved, and Portugal and most Autonomous Regions in Spain have not even started working on a rabbit recovery plan.

One of the few areas to have a rabbit recovery plan is Doñana National Park and Lugar Nuevo¹¹⁶, managed jointly at present by the Spanish Environment Ministry. These plans run from 2002 to 2005, and were created mainly due to the particularly high importance these areas have for the last remaining populations of Iberian Lynx and Iberian Imperial Eagle.

There are several reasons for weak progress in planning rabbit recovery. Firstly, planning of nature conservation in general in Spain and Portugal has been poor¹¹⁷ with planning for other species – including high profile species such as the Iberian Lynx – being inadequate¹¹⁸. Secondly, even within the weak tradition of Iberian nature conservation planning, planning of rabbit conservation has had a low priority given the low profile and lack of conservation classification of the species. Thirdly, elaborating rabbit conservation plans is obstructed by insufficient monitoring data and research to base plans upon. Fourthly and finally, even if rabbit recovery plans/strategies could be elaborated, they may not be politically approved due to a lack of political support, particularly to balance conflicting interests (e.g. agriculture and hunting), as has been the case with some elaborated but unapproved lynx recovery plans¹¹⁹.

Planning of rabbit conservation is important and these obstacles need to be overcome. However, even if sufficient rabbit recovery plans could be elaborated and approved, it has been suggested that they might not be properly implemented due to a lack of resources, skills and political support. These, and other obstacles, are apparent when analysing the limited progress that has been made with achieving other conservation goals, as described below.

4.5. Reducing disease impacts

Rabbit diseases (RHD and myxomatosis) have been one of the main causes of rabbit decline in Spain and Portugal, where they are endemic, and continue to threaten rabbit populations and prevent rabbit recovery. It is expected that in the long term the diseases may evolve to be less pathogenic and/or that rabbit populations may evolve significant immunity. However, myxomatosis continues to account for a large amount of rabbit mortality (i.e. 35%) 50 years after its introduction¹²⁰ and both diseases are expected to continue killing a high percentage of rabbits in the future, at least in the short/medium term. Thus reducing the impacts of myxomatosis and RHD will be an essential part of future successful wild rabbit recovery.

Attempts to reduce the impact of rabbit diseases to date have involved two main methods: vaccines and improvements in habitat quality. Separate vaccines have been developed against both rabbit diseases, administered by injections. The myxomatosis vaccine provides 60-70% immunity against the disease, but has side-effects including a mild form of the disease and increased susceptibility to predation. The RHD vaccine provides 80-90% immunity and has far fewer side-effects than the myxomatosis vaccine¹²¹. Both vaccines were specifically designed for, and have been particularly effective at conferring immunity on, domestic rabbits¹²². In addition, both vaccines have been used by hunters and conservationists implementing rabbit reintroductions (see section 4.8). However, neither vaccine confers complete immunity and both vaccines have negative side-effects¹²³. Moreover, because the effect of the vaccines is relatively short lived (<6 months) they are not able to confer life-long immunity on released rabbits. Similarly, because the vaccines are neither transmitted between adults nor from parents to off-spring, and because it is impossible to catch and vaccinate all rabbits, these current vaccines cannot reduce disease impacts in wild rabbit populations¹²⁴.

Trials have been made with automatic injection devices for administering the vaccines in artificial rabbit dens as a way of vaccinating wild rabbits¹²⁵. However, even with such methods it will not be practically possible to vaccinate a large enough proportion of wild

rabbits to control diseases, particularly in the long term. Similarly it has been suggested that vaccines be modified so that they can be administered orally, including via water supplies. However, even if it proves practically possible to administer vaccines in water supplies, this is likely to be resisted by concerns for impacts on human health and the wider environment. Moreover, administering existing vaccines more widely will increase the negative side effects of the vaccine whilst not increasing the length of the immunity period conferred.

Given the continued impact of RHD and myxomatosis, and the limitations of existing vaccines, quite a lot of work has been carried in recent years attempting to develop new genetically modified (GM) vaccines, supported financially by hunting associations. To date, the main output of this work has been the popularly-known LapinVac live GM vaccine¹²⁶. Laboratory tests and a controlled field experiment on a small island near Menorca have shown that this new vaccine can confer immunity against both myxomatosis and RHD¹²⁷. In addition, because LapinVac is a GM version of a live myxomatosis virus, specifically designed to spread amongst wild rabbits, LapinVac could potentially reduce and control disease impacts in wild rabbit populations. Unfortunately, however, there are a lot of problems concerning the possible future release and use of LapinVac.

Firstly, as a genetically-modified live virus, LapinVac creates big ethical and environmental concerns. The long-term effects of a new GM virus cannot be completely foreseen and could be negative on both human health and the environment given the propensity of viruses to evolve unpredictably. Secondly, given that LapinVac would spread uncontrollably once released, it would likely spread outside of Spain and Portugal including into areas where introduced rabbits cause significant agricultural and environmental damage, and where existing diseases act as significant rabbit control measures. If LapinVac spread into such areas (e.g. Australia) the resulting rise in rabbit populations could have extremely negative consequences for agriculture and native ecosystems. Thus Australian concerns about LapinVac are similar to Iberian concerns about an Australian GM virus¹²⁸ (see section 2.2). Thirdly, it has not yet been shown that LapinVac would effectively control RHD and myxomatosis in wild rabbit populations, and the only way to confirm these positive impacts would also risk the negative consequences outlined above. Fourthly and finally, it has been argued that LapinVac – like all rabbit vaccines – fails to address a fundamental issue in rabbit conservation; i.e. that rabbit diseases are here to stay and cannot in practice be eradicated, and thus that conservation management should thus focus on reducing the *impacts* of diseases rather than attempting to control the spread and incidence of the diseases themselves¹²⁹.

Given, in particular, the practical and inherent limitations of rabbit vaccines, some recent work has sought to encourage and develop techniques for improving rabbit habitat quality so as to off-set the impact of rabbit diseases. By increasing habitat quality, it should be possible to sufficiently increase rabbit reproduction and survival rates so that rabbit populations can recover even with the continued presence of both diseases¹³⁰. This work has particularly involved the cutting of small areas in native forests, to be sown with cereals or mown to encourage native grass species, both of which are excellent food sources for rabbits (see figure 10). Such work has been carried out in Spain and Portugal by a number of different governments, hunting associations and conservation organisations. In addition, studies and recommendations have been made concerning the shape, number and location of artificial mown planted patches, concluding that numerous, small, irregular and dispersed patches are best¹³¹. However, most habitat improvement work has not been going long enough (e.g. + 5 years) and/or has not been accompanied by sufficient rabbit monitoring to demonstrate a significant and sustained positive impact on rabbit populations. In addition, some rabbit experts have questioned the effectiveness of some of the methods used.

Figure 10: Rabbit habitat improvement work, cutting small areas in native forest



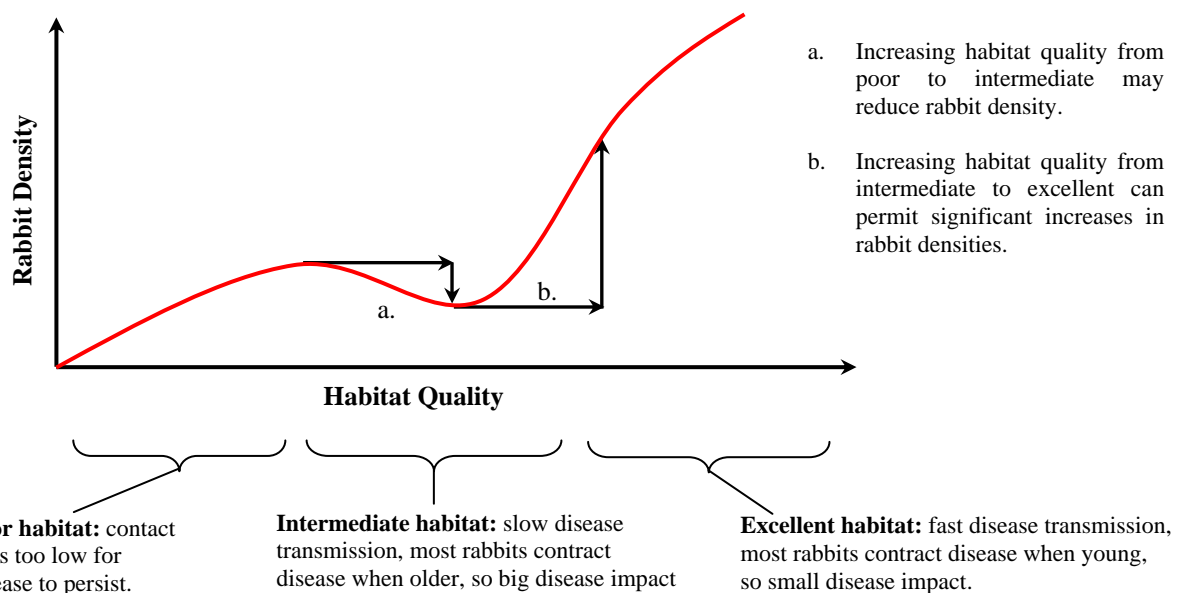
Photo: E. Gonçalves



Photo: U. Breitenmoser

Theoretical studies have shown that small increases in rabbit habitat quality may actually increase rather than decrease the impact of diseases¹³². This is because an intermediate quality of rabbit habitat may actually be the worst habitat for current rabbit populations, as shown below in figure 11. Excellent habitat quality allows increases in rabbit populations as a higher proportion of rabbits contract RHD when they are young and thus more likely to be resistant to or to recover from the disease, given that the disease has a lesser impact on young rabbits¹³³. Similarly, in poor habitat, rabbit density, and thus contact between individuals, is low enough that disease transmission rates decline. Thus, by increasing habitat from poor to intermediate, conservationists and hunters may actually increase the impact of rabbit diseases.

Figure 11: Theoretical influence of habitat quality on rabbit abundance, given impact of RHD



Source: Calvete (2005)

Only by increasing habitat quality from poor or intermediate to excellent will such measures be effective in reducing disease impacts. In addition, maximising habitat quality is also an effective way to reduce the impact of common predators on specific rabbit populations in the short term (see section 4.9). Much work is needed, particularly in collaboration with the agricultural community (see section 4.7) to provide excellent rabbit habitat to boost and recover wild rabbit populations. Excellent habitat will include the provision of food sources,

native forest cover, water supplies, artificial shelters and breeding dens and a reduction in competition from grazing livestock and/or managed big game. Such work has been pioneered in some areas, but is not widespread, sustained or co-ordinated enough. Initially habitat improvement work should be focused on areas where rabbit habitat is already quite good and rabbit densities not very low, so as to provide the maximum quality of habitat and increase the chances that high density populations can be sustained¹³⁴. However, in general, such work will require changes in farming policies that are currently incompatible, and increases in the profile of rabbit conservation, which is particularly low in farming areas (see section 4.7).

Beyond improving habitat quality and developing vaccines, other measures implemented to reduce rabbit disease impacts include reducing myxomatosis insect vectors: e.g. spraying insecticides into warrens. Such methods have proven effective at reducing the transmission of myxomatosis in the United Kingdom. However, studies have shown that controlling myxomatosis vectors in Spain and Portugal has not been effective – and is unlikely ever to be effective – given the greater diversity of disease vectors that exist in the Iberian Peninsula¹³⁵.

Beyond controlling disease vectors, some other measures have been proposed but not yet implemented to reduce disease impacts. Firstly, given the fact that young rabbits are much less affected by RHD than adults, it has been suggested that young rabbits should be deliberately infected with (rather than vaccinated against) this disease. Once recovered and released, these young rabbits would then have life-long immunity to the disease and would confer some immunity on their off-spring (see section 1.3). However, field trials have not yet been attempted and the implementation of such measures may be prevented by legitimate concerns over the deliberate spread of a highly infectious and problematic disease. Secondly, it has been suggested that individuals from rabbit populations where immunity to diseases seems to have evolved (including those outside of the Iberian Peninsula) be translocated into other rabbit populations in Spain and Portugal to assist the evolution of disease immunity. However, such measures would risk spreading diseases further – including disease strains not yet present in some Iberian rabbit populations¹³⁶ – and would be resisted by concerns over, and important controls against, the mixing of rabbit eco-types, sub-species and diseases.

One particular barrier to progress in reducing the impacts of rabbit diseases is inadequate scientific understanding as to how the diseases affect wild rabbit populations, particularly in conjunction with each other and the other pressures (i.e. habitat loss and human-induced mortality). A lot of what is known about rabbit diseases comes from laboratory work, studies with domestic rabbits, theoretical modelling and research outside of the Iberian Peninsula¹³⁷. Thus improving progress with reducing the impacts of RHD and myxomatosis in general will require more research into the impacts of diseases on wild populations in Spain and Portugal.

Beyond researching and reducing the impact of existing rabbit diseases, it will also be necessary to avoid the negative impact of new diseases, including a possible new GM immunocontraceptive virus that could be developed and released in Australia (see section 2.2). International regulation of genetically modified viruses is not yet well developed¹³⁸. However, some relevant recommendations have been made, e.g. by the World Health Organisation that reproductive control of wild fauna should be reversible and use non transmissible vectors¹³⁹, which would rule out the use of immunocontraceptive viruses. Avoiding the release of such a GM disease will require lobbying on the part of those interested and/or working in rabbit conservation in Spain and Portugal. At present, however, rabbit conservation in Spain and Portugal probably has too low a profile, and is too poorly co-ordinated to allow effective lobbying on this issue, particularly in the face of probable strong lobbying from Australian conservationists and farmers keen for more rabbit control measures.

In addition, the development of LapinVac in Spain risks conservationists appearing hypocritical in calling for the new Australian GM disease not to be developed. Thus a commitment not to release LapinVac needs to be made in negotiations with Australian counterparts, aiming for similar commitments for them not to release the new GM disease.

4.6. Reducing the impacts of human-induced mortality

Human-induced mortality has been one of the three main causes of rabbit decline (see section 1.3.4). Thus reducing the impacts of human-induced mortality is necessary for rabbit recovery¹⁴⁰. However, attempts to reduce the impact of rabbit hunting and agricultural rabbit control have had limited progress due to a number of obstacles, as described below.

4.6.1 Reducing mortality impacts of hunting

To date, efforts to reduce the negative impact of hunting on rabbit populations have focused on four main themes: protected areas, hunting legislation, agreements with conservationists and self-restraint by hunters. Officially protected areas have helped reduce the impact of hunting on rabbits in some locations, and have allowed some populations of rabbits and rabbit predators to survive as a result. However, reducing or removing the impact of hunting – by protected areas or other means – is no guarantee for rabbit recovery, as shown by Doñana National Park, where rabbit hunting is prohibited but where rabbit populations have not recovered. Moreover, even where successful, using protected areas to reduce or prohibit hunting as a way to recover rabbit populations will not be feasible over large areas given the significant funds and political support needed to effectively manage protected areas and the likely level of opposition from the hunting community, which currently hunt in 70% of Spain.

A second method used to reduce the negative impact of hunting has been legislation concerning hunting periods and the licensing of rabbit hunters. Most of Spain and Portugal has rabbit hunting periods running from approximately October to February¹⁴¹. Hunting periods restrict the overall amount of hunting and prevent hunting during the Spring and early Summer when most females are raising young. However, rabbit hunting seasons and other hunting legislation are not well adhered to. Although there are over 1.3 million licensed hunters, there are probably many more who hunt unlicensed. In addition, it has been alleged that many hunters illegally hunt outside of hunting seasons. Thus the impact of existing legislation is limited, and this is in part due to hunters having a lack of awareness of, and concern for, the importance of hunting legislation, along with a lack of political support for regulating and monitoring hunting so as to adequately enforce legislation.

Beyond poor compliance, existing legislation itself has been argued to be inadequate. The October to February hunting season, whilst better than allowing hunting all year, does allow hunters to legally hunt in December and January, when most females are pregnant and when rabbit populations are at their lowest annual levels¹⁴². This contradicts standard good practice for natural resource management and has been argued to be the best period to hunt to control rabbit populations and the worst period to hunt to conserve populations¹⁴³. The fact that current hunting seasons contradict rabbit conservation is not surprising given that most have not changed significantly for almost 100 years¹⁴⁴ and were originally devised to control and eradicate rabbits when rabbits were much more abundant and when impacts on agriculture were much more significant. Many conservationists, scientific experts and even some hunters have called for changes in the official rabbit hunting season. However, whilst many are in agreement that the current hunting season is sub-optimal for rabbit recovery, there is little expert agreement as to the best period for hunting seasons to be changed to.

Due to criticism of the existing rabbit hunting season, a number of revisions have been suggested. For example, it has been suggested that rabbit hunting be moved to the summer when rabbit abundance is highest and when killing the same number of rabbits might have the least impact. However, the success of summer hunting as a conservation strategy depends upon hunters not killing more rabbits when more are available (which seems unlikely) as well as hunters not having a preference for adults rather than young rabbits (which also seems unlikely given greater economic gains from, and interest in, killing adults). Moreover, it has been alleged that a recent trial of official summer hunting in Andalucia proved “disastrous” for rabbit populations. Similarly, some research has suggested that over-hunting is actually more likely in the summer than the autumn because hunters change their preferences for young and adult rabbits during the year¹⁴⁵, and some experts argue that summer hunting is detrimental as it coincides with the peak in myxomatosis¹⁴⁶. A second revision to hunting seasons that has been suggested is for September to November¹⁴⁷. This season would avoid the possibility of killing pregnant females in December or January. However, this season would still coincide with the annual minimum in population abundance. In general, revisions to official rabbit hunting seasons are being obstructed by insufficient research into the impacts of hunting on rabbit populations¹⁴⁸, insufficient co-ordination between rabbit experts, and insufficient political support for rabbit conservation to overcome some pressure from hunting lobbies to maintain established hunting practices and avoid greater hunting regulation.

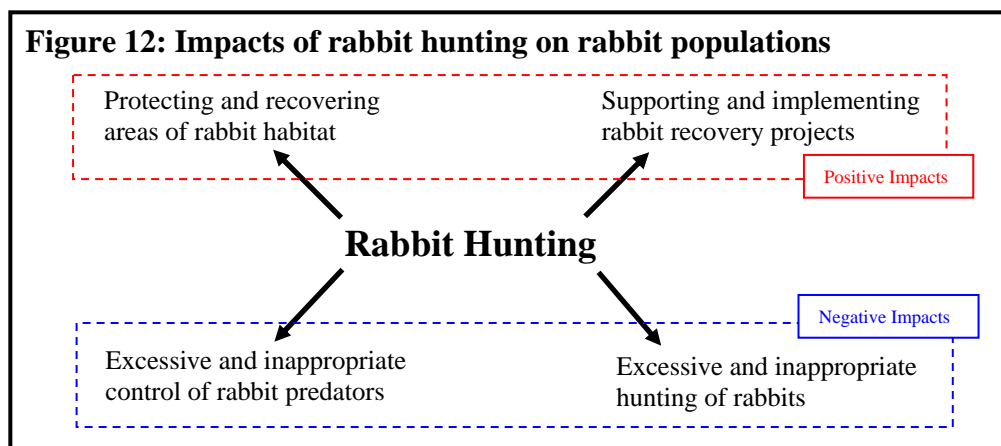
Beyond hunting legislation and protected areas, the impacts of hunting on rabbits has been addressed in certain areas by agreements between hunting estates and conservation organisations. These agreements have been created in particular in areas important for the Iberian Lynx in Castilla-La Mancha and Andalucia, by the respective regional governments, WWF/Adena and Fundacion CBD Habitat. In some areas NGOs have been more able to negotiate agreements than governments because many hunting estates are distrustful of, and reluctant to work with, government officials. Amongst other impacts, these agreements stipulate reductions in rabbit hunting and some of those agreements with NGOs include financial payments to landowners to compensate lost revenue due to reductions in hunting. These agreements have been important in (amongst other things) maintaining rabbit populations in some areas important for the lynx and Imperial Eagle. However, it will not be practically or financially possible to create agreements with hunting estates over the much larger areas needed for the long-term and widespread recovery of rabbit populations across the Iberian Peninsula. In addition, a few experts and organisations disagree in principle with paying land owners to reduce rabbit hunting, arguing that legal and/or moral obligations should be sufficient – especially where rabbits are very scarce and/or particularly important for endangered predators – and that by paying some land owners this might discourage other landowners, who have not and can not all be paid, to also reduce rabbit hunting.

Beyond the influence of governments and NGOs, some parts of the hunting community itself have instigated self-restraint to reduce the impact of hunting on rabbits, because some hunters actively support nature conservation and/or recognise that hunting has been one of the main factors contributing to rabbit decline. This self-restraint includes the setting of hunting quotas by hunting associations and the designation of no-hunting reserves. These initiatives are important. However, they are not implemented widely enough, are not sufficiently complied with and are often inappropriate. For example, hunting associations often set hunting quotas that are not supported by scientific research and without knowledge of the effects on wild rabbit populations¹⁴⁹. Similarly, some hunting associations have responded to declines in rabbit abundance by not setting any hunting restrictions at all rather than increasing restrictions, contradicting good resource management¹⁵⁰. In addition, it has been alleged that some individual hunters fabricate hunting bag count records, either to avoid sanctions from

hunting associations for over-hunting or because they do not want to appear to be a bad hunter. Moreover, in general, most hunters focus more on reducing rabbit predators than on hunting restraint¹⁵¹, even though the latter is more important for rabbit recovery.

Some conservation groups, scientific experts and the Council of Europe¹⁵² have called for moratoriums on rabbit hunting, particularly in areas where rabbit densities are declining¹⁵³ and/or surviving rabbits are particularly important for endangered rabbit predators¹⁵⁴. Such moratoriums have not yet been imposed but could undoubtedly help conserve local rabbit populations. However, they would need to be carefully explained to, and implemented in collaboration with, local hunting associations to ensure compliance and to avoid jeopardising other collaborative work being implemented with, and reliant on the good will of, hunters.

When working to reduce the negative impacts of hunting on rabbits it is important to recognise that rabbit hunting has also had – and will continue to have – some positive impacts on rabbit populations. As shown below, along with the negative impacts of over-hunting and inappropriate predator control (see section 4.9), rabbit hunting also has the positive impacts of protecting and restoring rabbit habitat that might otherwise be lost to more damaging land uses (e.g. intensive agriculture) and supporting and implementing rabbit recovery projects.



In general, it is important to recognise that the hunting community is diverse with some hunting associations and individual hunters actually supporting nature conservation and/or the long term and widespread recovery of rabbits, whilst many other hunters conduct practices that are highly damaging to both rabbit and wider nature conservation, and are criticised, including by some hunters. A specific initiative that could exploit this diversity within the hunting community and help bring about a significant reduction in the negative impact of hunting is the creation of an accreditation scheme for “sustainable rabbit hunting”. This has already been suggested by several organisations and experts, but not yet created in either Spain or Portugal. An accreditation scheme would prescribe practices beneficial to rabbit (and wider) nature conservation – including monitoring and habitat improvements – and would also prohibit damaging practices. Verified compliance with these standards would allow hunting estates and/or associations to receive an accreditation, which would be a source of pride and would also allow particular estates to market themselves as supplying “sustainable hunting”. However, at present, the creation of an accreditation scheme is being obstructed by a lack of innovation and political support, and the low profile of rabbit conservation.

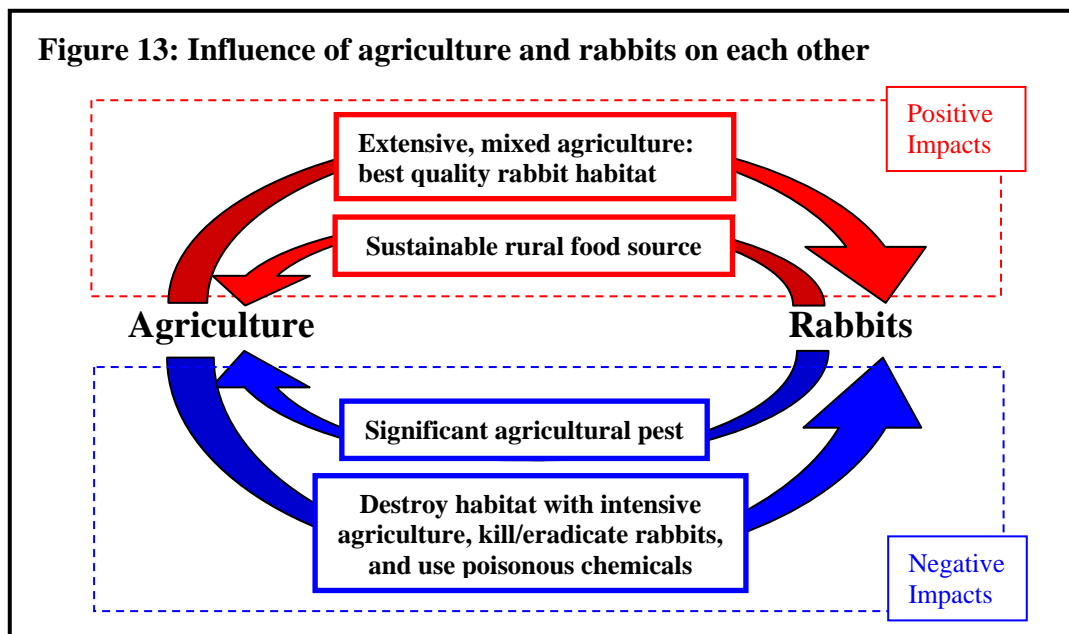
Beyond an accreditation scheme, sustainable rabbit hunting could take advantage of wider trends promoting “sustainable development” and, in particular, the new EU Natura 2000 initiative. Sustainable rabbit hunting could offer significant long term gains for both the rural economy and nature conservation, if adequately promoted and regulated by governments and NGOs. However, at present, development policies and nature conservationists do not

sufficiently promote sustainable hunting as a form of sustainable development and nature conservation. In addition, rabbit conservation currently has neither the profile nor the political support, and those involved in rabbit conservation are not sufficiently well co-ordinated or connected, to instigate such long-term and radical shifts in rabbit hunting practices.

4.6.2 Reducing mortality impacts of agriculture

Agricultural practices – including digging up warrens and shooting, poisoning and trapping rabbits – have been responsible for the reduction and extinction of some rabbit populations, particularly in conjunction with the effects of rabbit diseases (see section 1.3.4). This impact of agriculture is in addition to the destruction and fragmentation of much rabbit habitat by modern intensive agricultural practices (see section 1.3.3), and needs to be addressed.

Reducing the killing and control of rabbits by farmers cannot, however, simply involve blanket reductions in rabbit control aiming at widespread increases of rabbit populations in all agricultural areas. This is because rabbits and agriculture have had – and continue to have – both positive and negative impacts on each other, as shown in figure 13 below. Firstly, whilst modern intensive agriculture has destroyed and fragmented rabbit habitat, agriculture has in the past – and could again in the future – provide the best rabbit habitat in the form of mixed, low-intensity farming (e.g. agroforestry). Thus work to reduce the impacts of rabbit control by farmers needs to avoid antagonising the agricultural community and rather needs to include encouraging farmers to provide the best rabbit habitat, e.g. as required to overcome the impacts of rabbit diseases (see section 4.5). Secondly, whilst rabbits have in the past provided – and could again provide – a significant local sustainable food source for farmers and their customers, rabbit populations have also caused significant damage to agriculture and continue to do so in some areas of the Iberian Peninsula, requiring governments in Spain to provide farmers with significant financial compensation for rabbit damage. Thus, although from a pure nature conservation perspective, widespread and sustained rabbit recovery in all agricultural areas would be desirable, this will not be financially or socially possible.



Given the fact that rabbit decline has been uneven, with many areas containing few or no rabbits, and some containing rabbit populations at relatively high density (see section 2.1), and given that in some of these areas rabbits continue to have significant negative impacts on agriculture, the location of work to reduce the control of rabbits by farmers needs to be

carefully planned¹⁵⁵. In particular, such work needs to be focused on those agricultural areas most important for nature conservation – including Natura 2000 areas, areas particularly important for the recovery of endangered rabbit predators, and areas where rabbit populations are very scarce. In other lower priority areas for nature conservation, rabbit control by farmers needs to continue to be permitted and encouraged – including by conservationists – to recognise economic and social realities, and to foster sufficient good will amongst the agricultural community for them to support rabbit conservation in higher priority areas. Unfortunately at present, however, the monitoring of rabbits and the planning of rabbit conservation is not sufficiently advanced to permit such strategic planning of rabbit control.

In areas important for nature conservation, rabbit killing and control by farmers needs to be reduced, particularly where rabbit populations have declined. To date, some environmental groups have campaigned against the excessive use of pesticides and fertilisers that kill many rabbits¹⁵⁶. Similarly, some farmers in some areas have been encouraged to exclude and/or translocate rabbits, rather than kill them, when they are found to be damaging valuable crops. However, even in some areas important for nature conservation some farmers continue to: use poisonous chemicals; shoot, snare and poison rabbits; and, dig up rabbit warrens.

Rabbit and agriculture could be made compatible with each other, particularly in areas important for wider nature conservation. Recovered rabbit populations could be used as a sustainable agricultural resource, and agriculture could be made compatible with – and even beneficial for – rabbit populations with a return to more extensive, mixed farming; e.g. agro-forestry. However, there are many barriers to such a “win-win” situation.

Firstly, many farmers in Spain and Portugal – like those in many other parts of the world – continue to regard rabbits purely as a pest to be controlled and eradicated, rather than a natural resource to be lived with, at least in some areas. In particular, some farmers seem to be unaware of the importance and needs of rabbit conservation in the Iberian Peninsula, and some fail to recognise that some rabbit damage is caused by rabbits losing natural food sources (e.g. to drought) rather than due to an over-abundance of the species¹⁵⁷. Secondly, most outreach work by rabbit conservationists to date has been focused on hunters rather than farmers. Although work with the hunting community will be vital for rabbit recovery, agriculture is also very important as it has caused significant rabbit decline but could also benefit rabbit recovery by providing the best quality habitat. It has been argued that it is harder for conservationists to work with farmers than hunters because within a farming area of a given size there will be a lot more landowners – and thus necessary partners – than in a hunting area of the same size. However, it is also the case that many conservationists have not identified the agriculture community as a key partner to work with in rabbit recovery.

Thirdly, government policies continue to allow the inappropriate and excessive control of rabbit populations in Spain and Portugal. For example many “exceptional permits” are granted for rabbit hunting in agricultural areas in the summer, in addition to the standard autumn/winter hunting season, and even when rabbit populations have declined significantly. Fourthly and finally, although farmers are granted significant financial compensation from governments for damage to their crops by rabbits in Spain, this compensation is not linked to a requirement to conserve rabbits, and farmers that receive compensation can also eradicate rabbits and receive “exceptional permits” for summer hunting – which can be sold on to hunters. Compensation for rabbit damage could be used to encourage farmers to instigate rabbit-friendly policies in key areas, but this opportunity is not being exploited at present. Thus a lot needs to change to reduce rabbit control in agricultural areas identified as important for nature conservation, and this is in addition to – and needs to parallel – work to encourage farmers to protect and recover rabbit habitat, as described in the next section.

4.7. Protecting and restoring rabbit habitat

As described in Chapter 1, the loss of Mediterranean scrub forest to intensive agriculture, exotic forestry, water reservoirs and forest fires has been one of the main causes of rabbit decline in recent decades. In addition, as described in Chapter 2, surviving areas of habitat continue to be threatened by these factors. Thus successful rabbit recovery will need to include actively preventing the further loss of areas of rabbit habitat, as well as the restoration of habitat, particularly in key areas to link up populations already fragmented by habitat loss.

Protected areas of public and private land including national parks, natural parks and nature reserves have been important in Spain and Portugal at protecting areas of rabbit habitat from development, and the existence of protected areas helps explain why some rabbit populations have managed to survive. The creation of many natural parks in Spain in the 1990s, administered by the new regional governments, was particularly important for safeguarding rabbit habitat. However, many rabbit populations are located outside of protected areas, and particularly situated in hunting estates, which have been one of the best land uses for conserving rabbit habitat. Thus beyond maintaining and possibly expanding existing protected areas, safeguarding remaining rabbit habitat in the future will need to involve working outside of protected areas and, in particular, with hunters. In general it will be important to encourage hunters to implement sustainable hunting (to reduce the impacts of hunting on rabbits), and to reduce the over abundance of big game on many estates (to improve rabbit habitat), whilst avoiding the possibility that estates may abandon hunting altogether in favour of other land uses – such as intensive agriculture – which have a much worse impact upon rabbit habitat. In addition, it will be necessary to change policies and practices in agriculture, forestry and water management that continue to promote habitat loss and undermine rabbit conservation.

Even if all existing rabbit habitat could be protected in the future, habitat restoration would also be important to link up fragmented rabbit populations and to reduce the impacts of rabbit diseases (see section 4.5), and would also benefit many other species in Spain and Portugal. Restoring rabbit habitat will require changes in particular in official agricultural policies at the regional, national and EU levels away from the promotion of monocultures in favour of mixed farming and agroforestry. On going changes in EU farming subsidies towards more agro-environmental funds could help in this regard, as could new Natura 2000 areas, which promote sustainable development and nature conservation: Natura 2000 proposals cover 25% of Spain. However, few funds have been supplied from governments or the EU for Natura 2000 areas, and both Natura 2000 and agro-environmental funds are quite new, and their positive benefits for rabbit (and wider nature) conservation have yet to be demonstrated. In addition, more engagement and communication with farmers is required by conservationists to encourage farmers to recover habitat and implement rabbit-friendly practices; as noted above, most outreach work by conservationists is focused on the hunting community.

Specific actions that could help restore rabbit habitat include the replacement of Eucalyptus plantations, a reduction in grazing pressure from domestic livestock and/or big game on hunting estates, and the re-creation of mixed forest/pasture landscapes. Eucalyptus has been removed from small areas, such as in and around Doñana National Park¹⁵⁸ and this seems to be having a positive impact on rabbit populations. Removal of Eucalyptus needs to take account of possible resulting erosion and negative impacts on some bird species that have come to rely on Eucalyptus forests. In addition, more wider removal of Eucalyptus is probably being obstructed by the practical difficulty of removing the trees and roots, and a lack of political support for nature conservation to balance the strong economic interests linked with Eucalyptus plantations. Similarly, economic realities continue to encourage land owners to increase the grazing of livestock and/or big game on private estates, and the

political and financial support available for rabbit (and wider nature) conservation is insufficient to counterbalance these trends. Finally, quite a lot of work has been undertaken by hunters and conservationists to re-create mixed forest-pasture landscapes given that such habitat improvement is important to boost population growth rates, reduce predation and – potentially – overcome the negative impacts of diseases (see sections 4.5 and 4.6). However, more research, innovation, co-ordination and communication is needed to develop and encourage best practice given that habitat improvement work to date has been diverse and largely uncoordinated, and its impact on rabbit populations has not been sufficiently analysed.

4.8. Reintroductions/translocations

Given the high reproductive rates of rabbits, and the relative ease with which they can be captured, and raised and bred in captivity (compared, for example, with larger, rarer animals such as the Iberian Lynx), reintroductions of rabbits bred in captivity and/or translocated from other areas has been one of the main focuses of rabbit conservation. Rabbit reintroductions and translocations have been implemented mainly by the hunting community, along with those working to conserve the Iberian Lynx and other predators. It has been estimated that as many as 500,000 rabbits are released each year in Spain and France¹⁵⁹. Unfortunately, however, most rabbit reintroductions and translocations have failed to boost or recover wild rabbit populations¹⁶⁰, due to a number of factors as described below.

Firstly, the handling and subsequent release of rabbits into an unfamiliar environment greatly increases stress and mortality rates from predation and disease. For example, it has been found that in a typical rabbit release fewer than 3% of rabbits will survive for longer than 10 days after being released¹⁶¹. Secondly, by releasing rabbits that have been translocated and/or bred from individuals from other areas, conservationists and hunters have at times inadvertently increased the spread and impacts of RHD and myxomatosis¹⁶². As a result, some rabbit reintroductions have been found to actually have a net negative impact on existing wild rabbit populations. Thirdly, many rabbit releases have used domestic rabbits¹⁶³ and/or rabbits of the wrong species¹⁶⁴ or ecotype, which are inappropriate and/or poorly adapted to the environment into which they are released and thus unlikely to survive to establish viable populations. Fourthly, reintroductions and translocations have been motivated mostly by the short term local priorities of hunters keen to have sufficient rabbits in their estate for the next hunting season, and conservationists desperate to provide individual lynx and eagles with sufficient food. In particular, reintroductions fail to address more long term and fundamental problems in rabbit conservation such as how to reduce the widespread impact of established and endemic rabbit diseases (i.e. RHD and myxomatosis). Fifthly and finally, rabbit translocations may have had a negative impact on some donor rabbit populations, pushing some populations from high to low density, particularly in conjunction with rabbit diseases¹⁶⁵.

Despite inherent limitations and poor practical application, however, releases are important and need to be continued, at least in the short term. Without rabbit releases some commercial rabbit hunting and some individual rabbit predators would not be able to survive. Similarly, rabbit reintroductions will be needed in the future to expand and recreate wild rabbit populations, particularly in areas where rabbits are now extinct¹⁶⁶. Fortunately, recent developments are leading to an improvement in the design and practical application of rabbit translocations and reintroductions by a number of actors, as described below.

Studies have suggested that the success of rabbit releases can be increased by releasing rabbits into forested areas to provide shelter from predation, or into open areas that are fenced to that exclude common predators such as Red Foxes¹⁶⁷. Fences reduce excessive rabbit dispersal and predation, particularly during the critical first week after releases, when rabbits are

establishing themselves in the local area¹⁶⁸. Fences also serve to reduce food competition by excluding other animals, e.g. grazing ungulates. Some rabbit releases – particularly those associated with predator conservation in Andalucía and Castilla-La Mancha – now routinely involve fenced areas of various sizes (e.g. 1 ha – 40ha), sometimes with the provision of controllable rabbit exit points that can allow individual rabbits to disperse further once a new rabbit population has been established. These fences are also specifically designed to allow access to endangered Iberian Lynx and Iberian Imperial Eagles. Current research in Doñana National Park is now aiming to confirm the importance of fenced areas by releasing rabbits into fenced and un-fenced areas and monitoring the success of releases¹⁶⁹.

In general recent research and official reports now recommend that releases involve:

- a feasibility study to determine whether or not they are necessary or appropriate¹⁷⁰;
- improving habitat in the release area prior to any releases¹⁷¹;
- quarantine times (e.g. two weeks) to allow the assessment of disease infection and the removal of infected rabbits from those to be released¹⁷²;
- disturbing local predators, particularly Red Foxes, during the week after release¹⁷³;
- fences to reduce dispersal, predation and food competition (see above);
- vaccinations to ensure that rabbits do not die from diseases in the first few weeks¹⁷⁴ (although some experts do not agree with this practice) – see section 4.5;
- releasing rabbits directly into burrows and only a small number at a time¹⁷⁵;
- releasing rabbits into the best quality habitat¹⁷⁶;
- repeated releases to achieve high density, sustained rabbit populations;
- artificial shelters and breeding dens to help newly released rabbits establish themselves in new areas, and avoid predation;
- the strict use of the correct sub-species and ecotype in all releases¹⁷⁷, and;
- rabbit monitoring before, after and during any projects, to evaluate their success¹⁷⁸.

There is still a long way to go, and many rabbit releases still fail to implement existing best practice let alone develop improvements. Barriers to progress with reintroductions and translocations include: a continued lack of understanding as to how the different factors affecting rabbit populations interact; a lack of co-ordination amongst the various actors involved in rabbit releases, and; a lack of quality control of the releases themselves. In addition, the general lack of comparable monitoring continues to restrict the possibilities for learning from the successes and failures of different rabbit reintroductions and translocations.

4.9. Reducing impacts of common predators

Rabbit predators have not caused the decline in rabbits. Rabbits existed for millennia at high densities in Spain and Portugal alongside a large number of rabbit predator species¹⁷⁹. Moreover, rabbits have evolved to be tolerant of high predation levels through – in particular – high reproductive rates. Nevertheless, the recovery of some rabbit populations in the short term, that have declined due to habitat loss, human-induced mortality and diseases, but may be being kept at a low level partly due to a “predator pit”¹⁸⁰, may be partially dependent upon management actions to reduce the impact of common opportunistic predators.

Reducing the impact of rabbit predators has been one of the main focuses of hunters and gamekeepers working to reverse rabbit decline. However, this focus has been excessive and the methods used by some hunters have been inappropriate and counter-productive¹⁸¹. Rabbit hunters have spent a lot of time, effort and money on reducing the impacts of rabbit predators, some of which might have been more effectively spent to increase other work they implement to recover and protect rabbit habitat, reduce the impacts of human-induced mortality, and reduce the impacts of disease (e.g. by improving habitat) – all of which are more important for rabbit recovery. This has been partly because hunters have misunderstood the factors that really cause rabbit decline and because individual hunting estates and gamekeepers have implemented rabbit recovery work largely independently from each other and conservationists, and have thus failed to learn about or implement best practice.

In addition to being excessive, the methods used by the hunting community to reduce the impacts of rabbit predators have been mostly based on the non-selective killing of rabbit predators, which is often inhumane, illegal, ecologically damaging and counter-productive. In particular, non-selective predator control (e.g. snares, leg traps and poisonings) has killed many top predators, helping to bring some – e.g. the Iberian Lynx and the Iberian Imperial Eagle – to the edge of extinction; for example it has been estimated that at least 69 Iberian Imperial Eagles were poisoned between 1990 and 2000, the total population of the species in 2000 being no more than 300 individuals¹⁸². This widespread killing of top predators by gamekeepers and hunters, beyond being problematic in itself, has also reduced the predation on, and the natural control of, common opportunistic predators such as foxes and mongoose, which are killed and excluded by lynx and eagles¹⁸³. Thus non-selective predator control may actually have increased the overall predation of rabbits¹⁸⁴. In addition, non-selective predator control has affected several vulture species, that are not even rabbit predators – e.g. 40 endangered Black Vultures were recorded as killed by illegal poisoning in Andalusia alone between 1987 and 2003, and the actual number killed may be as much as ten times higher¹⁸⁵.

The use of non-selective and illegal predator control methods is very widespread. For example, in Andalusia in a recent survey, 33% of hunters and gamekeepers, admitted to illegally using poison to control predators, and studies have shown that the use of poison is widespread and increasing¹⁸⁶. NGOs and government agencies have attempted to address this issue by increasing outreach work with, and vigilance of, hunters. However, a lot more work is needed to enforce and encourage compliance with existing legislation. In particular, hunters and gamekeepers have widely used – and continue to use – non-selective predator control methods partly because alternative efficient species specific methods are not widely available¹⁸⁷. Thus more innovation is required. In addition, although the attitudes of some in the hunting community have changed, the attitudes of many have not, with many deliberately persecuting all types of rabbit predators, including endangered species. Similarly – as noted above – there is still a lack of understanding and awareness in the hunting community as to the main causes of rabbit decline and the best techniques for achieving rabbit recovery.

Reversing rabbit decline need not have a negative impact on rabbit predators, and indeed in the long term it will be beneficial for many such species. Firstly, more focus should be placed on reducing disease impacts, recovering/protecting habitat and reducing the impacts of human-induced mortality, as these are more important factors driving rabbit decline. Secondly, work to artificially reduce the impacts of predators should be confined to the short term given that long-term artificial reductions in the impact of rabbit predators will be neither economically or practically sustainable nor would they adhere to nature conservation ideals of recreating self-sustaining ecosystems. In the longer-term, work should be focused on recovering top predators so that natural control on common opportunistic predators can be restored, and maximising habitat with sufficient vegetation cover to provide rabbits with

shelter from predators. Thirdly, work to reduce the impacts of common predators should be additionally confined to only those particular low density rabbit populations where future research shows that common opportunistic predators are frustrating rabbit recovery, given that at present little proof exists. Fourthly, work that is carried out with common opportunistic predators should be focused more on reducing the *impacts* of the predators than on reducing the number of predators themselves. Fifthly and finally, any work that is carried out to kill common rabbit predators needs to be species-specific and avoid affecting non-target species.

The impact of rabbit predators can be reduced, without killing the predators themselves. Firstly, in the long term, increasing rabbit populations by reducing the impacts of diseases and human-induced mortality, and recovering and protecting habitat, will reduce the impacts of common predators – which are higher when rabbit populations are lower¹⁸⁸. Secondly, the use of fences around particularly vulnerable rabbit populations, and newly introduced populations (see section 4.8) can help to effectively reduce the impacts of predators, provided that fences are maintained. Thirdly, the provision of artificial rabbit shelters and increases in the amount of vegetation cover also effectively reduces predation rates without the need for direct control of predator species. Fourthly, foxes can be disturbed, rather than killed, particularly following rabbit releases, e.g. by personnel periodically visiting a vulnerable area, particularly at night¹⁸⁹. Finally, the densities of foxes, Wild Boar and feral cats and dogs could be reduced by removing artificial food sources without resort to inappropriate predator control methods¹⁹⁰.

Figure 14: artificial rabbit shelter



Photo: C. Ferreira

Figure 15: enclosure to exclude foxes



Photo: U. Breitenmoser

As an absolute last resort, and only in the short term, common rabbit predators can be killed to reduce predation rates on vulnerable rabbit populations. Methods used need to be humane, legal and species-specific. However, this continues to be obstructed by a lack of innovation into effective species-specific predator control methods¹⁹¹ and a lack of communication regarding the best practices that are available. In addition, there is a lack of quality control and vigilance to ensure that hunters, gamekeepers and others only implement humane, legal, species-specific predator control methods, and then only when predator control is justified.

Beyond altering predator control practices, the hunting community itself needs to recognise that its own actions have helped to increase predation from Wild Boar in some areas. Wild Boar can have significant predation impacts, particularly on young rabbits which are often dug up and eaten whilst still in their burrows¹⁹²; e.g. individual Wild Boar have been killed with over 30 young rabbits in their stomachs¹⁹³. In general, it has even been argued that the combined predation and competition impacts of Wild Boar may exceed predation impacts from foxes and mongoose¹⁹⁴. Some commercial big game hunting estates have artificially increased the density of Wild Boars due to significant economic gains from hunting: e.g. hunters can pay up to hundreds of euros to hunt just one boar. However, changes in the practices of big game hunting estates will be difficult to instigate and will require changes in hunting policies and the political support for, and profile of, rabbit conservation.

4.10. Barriers to progress

There is NO LONGER a lack in the following areas obstructing rabbit conservation:

- Knowledge of the extent and causes of rabbit decline.
- Innovation into rabbit enclosures, shelters, breeding dens and live traps.
- Funding for short term rabbit recovery projects in particular locations.

However, progress in rabbit conservation is STILL being obstructed by:

- Insufficient funding for widespread and sustained rabbit recovery.
- Poor co-ordination of rabbit monitoring and conservation efforts.
- Poor understanding as to how the different factors affecting rabbit populations interact, and as to why some areas contain many rabbits and some none at all.
- Insufficient research into disease, hunting and predator impacts on rabbit populations.
- A lack of innovation in techniques to: reduce the impacts of rabbit diseases; implement effective, humane, species-specific and local rabbit predator control, and; create an accreditation scheme for sustainable rabbit hunting on private estates.
- Insufficient quality control of the implementation of rabbit releases, rabbit habitat improvement and rabbit monitoring, particularly in the long term.
- Contradictory hunting, agriculture, water and forestry policies.
- A lack of political support for rabbit conservation and required actions.
- A lack of awareness in the hunting community as to the specific requirements of, and need for, sustained and widespread rabbit recovery.
- A lack of awareness in the agricultural community as to the general importance of, and need for, rabbit recovery, particularly on agricultural land.
- A lack of awareness amongst many conservationists – particularly at the international level – that rabbit conservation is a critical conservation issue in Spain and Portugal.

4.11. Conclusions

Progress in rabbit conservation in Spain and Portugal started very late and has subsequently had an overly narrow focus. In addition, most of the important goals in rabbit conservation have not yet been adequately achieved and, as a result, a significant positive impact on surviving wild rabbit populations has yet to be demonstrated. This is due to a number of obstacles, most of which have yet to be overcome, as outlined above. The ways in which these obstacles could and should be addressed in the future are described in the next chapter.

5. Required changes and initiatives

Reversing rabbit decline is an essential but difficult task for nature conservation in Spain and Portugal. A lot more progress is needed in the monitoring of rabbits and the planning and implementation of conservation actions. The particular changes that are needed to overcome obstacles, and thus enable more progress, in the future are described below.

5.1. More funding

Quite a lot of funding has been provided for rabbit conservation to date by the hunting community and via conservation programmes for the Iberian Lynx, Iberian Imperial Eagle and other predator species; for example over €10 million has been spent on rabbit recovery projects via EU LIFE projects for endangered rabbit predators in Spain in the last 8 years alone¹⁹⁵. However, funding from the hunting community understandably tends to fund projects of immediate relevance to hunters and fails to support some projects addressing wider issues in rabbit recovery. In addition, some funding from the hunting community has supported projects that contradict wider nature conservation: e.g. the Spanish Hunting Federation funding LapinVac and individual estates funding non-selective predator control. Similarly, rabbit projects funded by conservation programmes for endangered predators have tended to focus on those relatively small areas and particular issues important for particular predator species. Finally, there is a particular lack of funding for rabbit recovery in Portugal.

In general, more funding is required for long-term and widespread rabbit recovery and monitoring. In particular more funds are required to support widespread and sustained habitat improvement and recovery work, needed to reduce the impacts of diseases, reduce the impact of common predators and link up isolated and fragmented populations. This ought to be possible given that rabbit recovery matches well with current (e.g. EU) priorities for funding holistic nature conservation (i.e. given that rabbit recovery is important for many other species) and rural sustainable development (i.e. sustainable rabbit hunting and farming). In particular, a lot of funding for rabbit recovery could be made available by re-orientating existing subsidies for agriculture and the compensation of rabbit damage, so that farmers can only receive funds if they conduct practices compatible with rabbit conservation. However, this will require significant changes in existing farming policies (see section 5.7). Moreover, increasing funding for rabbit conservation in general is currently being obstructed by the lack of importance given to rabbits and rabbit conservation, as has also been the case with other lagomorph species¹⁹⁶. A specific measure that would help raise funds for rabbit conservation is the re-classification of rabbits¹⁹⁷ under IUCN Red List criteria (see section 5.8). In addition, and in general, rabbit conservation needs a higher profile and more political support to be able to attract more funding for a variety of required actions (see sections 5.8 and 5.9).

5.2. More research

A large amount of scientific research has been undertaken focusing on the European Rabbit, which may be one of the most researched mammals in the world¹⁹⁸. However, whilst quite a lot of research has been undertaken in Spain and Portugal in the last ten years relevant to rabbit recovery, most rabbit research has been conducted outside of the Iberian Peninsula and primarily concerns the control and eradication of rabbits in areas where they have been introduced. Thus there are many important areas pertinent for rabbit recovery requiring additional research. Particularly important areas that experts have identified include:

- Explaining why some areas still contain rabbit populations and others do not.
- Explaining how the factors that have caused rabbit decline interact.

- Demonstrating how habitat improvements help or hinder the reduction of disease impacts (i.e. confirming or refuting findings of theoretical models).
- Identifying the best practice techniques in rabbit recovery and monitoring.
- Analysing the precise impacts of rabbit hunting on rabbit populations.
- Determining when is the best time to hunt rabbits to conserve populations.
- Analysing the dynamics, prevalence and impacts of rabbit diseases.
- Analysing the attitudes of hunters and farmers towards rabbit recovery.
- Analysing the precise impacts of rabbit predators on rabbit populations.

This extra research will require additional funding and political support, and will rely on better disease surveillance and rabbit monitoring (see section 4.3). It will also require more collaboration amongst scientific experts and an increase in the profile of rabbit conservation amongst the scientific community, particularly at the international level. Some research will also depend upon action-research whereby research and innovation are run in parallel, relying on close collaboration between researchers and conservation managers.

A particular initiative that has been suggested that might improve research related to rabbit recovery is for a “research list” of areas of scientific uncertainty most relevant to rabbit conservation. This would help scientists – particularly at the international level – direct their research towards those issues most relevant to the needs of conservation managers, provided that such a list is drawn up between key conservation managers and experts, and is widely supported and publicised, for example on its own dedicated web page.

5.3. More innovation

Progress has been made in a number of key areas of innovation relevant to rabbit recovery. These include: the design of artificial rabbit warrens and shelters¹⁹⁹; the design of enclosures to exclude rabbit predators²⁰⁰, and; the design of live traps to allow for effective rabbit translocations²⁰¹. Notwithstanding these achievements, however, more innovation is still required in a number of areas to facilitate rabbit recovery, including:

- **Efficient, selective predator control technique** – to allow for the efficient control of common opportunistic predators in certain areas without threatening endangered top predators that naturally control common predators.
- **Techniques to reduce the impact of rabbit diseases in wild populations** – given that it is still not possible to predict or control the impact of diseases, and given that both diseases continue to have a significant impact on wild rabbits.
- **A system of accreditation for sustainable rabbit hunting estates** – to encourage sustainable hunting and to differentiate between the different attitudes and actions apparent within the hunting community.

Innovations in these three areas may be highly technical, but they may also be rather “low tech” and more social. An accreditation scheme for sustainable hunting will mainly be based upon prescribing, verifying and awarding best practice in monitoring and sustainable management of rabbit populations. In addition, it has been suggested that selective efficient control of opportunistic predators may be best achieved through the training and financing of dedicated rabbit predator control experts, who would directly supervise and conduct the control of common opportunistic predators on private estates²⁰². Similarly, new techniques to control the impacts of rabbit diseases may be based more on refining work in habitat improvements, rather than on the development of new rabbit vaccines (see section 4.5). In general, innovation in these three – and other – important areas could be better fostered by:

extra funding; better co-ordination and collaboration between experts and conservation managers, and; raising the profile of rabbits and rabbit conservation.

5.4. Improving communications

More and better communications are required to inform diverse actors in particular about best practice in rabbit recovery techniques and the importance and needs of rabbit recovery in Spain and Portugal. Some useful knowledge and experience has been gained by scientists and technicians in recent years regarding best practice in rabbit recovery techniques. However, unfortunately, a lot of this valuable information and insight has not been available to many of the conservation managers implementing rabbit recovery projects, and rabbit recovery has suffered as a result. This has been due to several factors, as described below.

Firstly, useful scientific publications relevant to rabbit recovery have not been aimed at, made widely accessible for or read by many conservation managers and technicians. Secondly, a lot of useful insight gained by conservation managers and technicians has not been recorded and published. Thirdly, this lack of information exchange has been exacerbated by poor co-ordination and collaboration between the various actors involved in rabbit recovery.

Recently, useful publications have been produced that have learned from the work of, and have been aimed at, technicians and conservation managers conducting rabbit recovery projects. These include publications in 2002 by the Government of Aragon²⁰³, a manual on rabbit recovery by the Spanish Environment Ministry in 2003²⁰⁴ and a new manual on rabbit recovery techniques, soon to be published also by the Spanish Environment Ministry. These latest two manuals include extremely useful overviews of different techniques used by different organisations for rabbit refuges, releases, habitat improvements and other projects. Such publications are important and need to be made more widely available, and more such publications need to be produced, to cover more areas, particularly Portugal.

A specific initiative that would help the general provision of information on rabbit recovery – as has been suggested by a number of experts – is a website dedicated to rabbit conservation and recovery. Such a website could be modelled on a recently created web-based compendium for the Iberian Lynx²⁰⁵. This would require funding and political support, but would be highly beneficial in allowing experts, technicians and others interested in rabbit recovery work to obtain and to disseminate useful and relevant information.

Beyond the provision of technical information about best practice in rabbit recovery, more general communications are needed – particularly via the mass media and aimed at hunters and farmers – regarding the general importance and needs of rabbit recovery. This is important to raise awareness amongst diverse actors, and to change individual practices, e.g. inappropriate rabbit predator control and the inappropriate hunting and/or control of rabbit populations that have declined due to disease. Some useful and important general publications on these issues have already been produced by various organisations – including by Fundacion CBD Habitat, WWF/Adena, SOS Lynx and government agencies – although more are needed. In particular more communications are needed aimed at the agriculture community, given that most outreach to date has been aimed at hunters rather than farmers, and that the collaboration of the agriculture community will be important to reduce the impacts of human-induced mortality and to adequately protect and improve areas of rabbit habitat. In general, more communications on the importance and needs of rabbit recovery could make use of a dedicated web site on rabbit recovery, and will require more funding. In addition, increases in the co-ordination of, political support for and profile of rabbit recovery will also be required to communicate important messages powerfully and effectively.

5.5. Better quality control

The need for improvements in quality control of rabbit recovery projects has been stressed by a number of experts and technicians. This is because even the limited information that is available regarding rabbit best practice techniques has not been adequately implemented, and rabbit recovery has suffered as a result. This has been due to several factors. Firstly, it has been alleged that several rabbit conservation projects have been more concerned about spending available funds rather than ensuring adherence to known best practice. Secondly, some rabbit recovery projects – particularly those implemented by the hunting community – have not adequately focused on maintaining recovery projects in the long term (i.e. for at least 5 years), as required to ensure that interventions do translate into actual rabbit recovery. Thirdly, most recovery projects have not been adequately monitored and reported on²⁰⁶ – and have been implemented on private land where public access is limited – such that it is very hard to independently scrutinise rabbit recovery projects to ensure good practice.

Specific improvements in quality control are required to improve – in particular – the quality of rabbit monitoring, habitat improvements, rabbit reintroductions and translocations. This increased quality control will require a greater openness and frankness in the reporting and evaluation of recovery projects. In particular those organisations funding rabbit recovery (either for game management or nature conservation) should insist upon a demonstration of best practice, and adequate project evaluation. This will be all the more important with hoped for improvements in research, innovation and information provision, to ensure that good work in these areas is not wasted and rather is translated into improved rabbit recovery projects.

5.6. More co-ordination

Poor co-ordination has been one of the main barriers to progress in rabbit conservation. Firstly, there has been poor working relations amongst some rabbit experts, and between some experts and some conservation personnel. This has meant that some key individuals rarely communicate with each other, and seldom collaborate, even though they share the same ultimate objectives in rabbit conservation. Secondly, there has been poor collaboration between organisations working in different geographical areas. In particular, co-ordination in rabbit projects has been poor between various Spanish Autonomous Regions, and between Spain and Portugal. For example, EU LIFE projects involving rabbit conservation in the 1990s in Spain suffered because each Autonomous region developed techniques – particularly in rabbit monitoring – that were incompatible with each other. This lack of co-ordination is a function of wider collaboration problems between administrations and departments, which has also been apparent in the conservation of other species such as the Iberian Lynx²⁰⁷ and Iberian Imperial Eagle²⁰⁸. In particular, Spanish Autonomous regions are quite new (created in the 1980s), have the prime responsibility for nature conservation in Spain, and are only now developing experience in collaborating with each other in many areas. Thirdly, there has been insufficient co-ordination between those individuals and organisations addressing rabbit recovery for different ultimate aims: e.g. hunting and endangered predators.

Some co-ordination is on-going between governments, conservation NGOs and hunting groups with respect to rabbit conservation in some areas of Spain and Portugal. However, this co-ordination of rabbit conservation is mostly secondary to the co-ordination of predator conservation (e.g. Andalusian Iberian Lynx LIFE project), is not present in many geographical areas, and has not yet involved some important actors such as farmers.

In order to have coherent planning, implementation and evaluation of rabbit recovery projects, improved working relations between key individuals, and improved collaboration between organisations and geographical areas will be essential. This will take time and effort. However, two particular initiatives that could help increase co-ordination are a rabbit conference and a rabbit expert working group. This is suggested by the fact that poor collaboration and working relations holding up other nature conservation in Spain and Portugal (e.g. of the Iberian Lynx) has been significantly overcome by conferences (e.g. in Lynx conferences in Andújar in 2002 and Cordoba in 2004) and dedicated working groups of relevant experts from Spain and Portugal (e.g. Iberian Lynx Working Group).

An international conference was held in November 2001 in Cáceres, Spain focusing on the wild rabbit as both a hunting and ecological resource. However, subsequent conferences have addressed rabbit conservation either as one of many other issues (e.g. Iberian Lynx conferences) or alongside the need to control and eradicate rabbits from where they have been introduced (e.g. II World Lagomorph Conference, Portugal, 2003). In addition, there is still a long way to go to build adequate collaboration and information exchange between and amongst conservationists, hunters, farmers and others interested in wild rabbits in Spain and Portugal. Thus a new conference focusing on reversing rabbit decline is required. The Andalusian Regional Government (Junta de Andalucía) has proposed to organise a dedicated rabbit conference in early 2006. It is hoped that this conference can go ahead, with all relevant actors attending, addressing all the relevant issues and with the proceedings widely and promptly communicated to increase the positive impact of the initiative.

A “rabbit working group” of key experts, conservation managers and representatives of the hunting and agricultural communities, would also be particularly useful to help increase the co-ordination of rabbit recovery, and has been officially recommended, including by the II International Lynx Seminar in Cordoba, 2004. Such a working group could be modelled on the existing working groups for other species (e.g. the Iberian Lynx) and would ideally include representatives from both Spain and Portugal. Several key experts have already professed an interest in creating such a group, and it is hoped that it can be created in the near future. One particular task for the group would be to help encourage and facilitate the elaboration, approval and implementation of an Iberian rabbit recovery strategy. However, the success of a rabbit working group would be partly dependent upon significant increases in both the political support for, and profile of, rabbit conservation (see sections 5.8 and 5.9).

5.7. Changes in official policies

Rabbit recovery requires a number of changes in official policies and legislation concerning hunting, agriculture, development, water supplies and fire prevention; all of which would also benefit many other species, as well as broader nature conservation. Vast areas of rabbit habitat have been lost to and fragmented by forest fires in Spain and Portugal in recent years (see section 1.3.3). Many of these fires have been deliberately lit and discouraging this illegal activity will require stricter legislation regarding the prosecution of arsonists. In addition, policy changes are required because the response of governments to large forest fires – particularly in Portugal – has often been uncoordinated, insufficient and slow. This will require extra funding and political support. However, the huge and diverse impacts of forest fires should mean that these changes will be widely supported and thus possible to achieve.

Both water reservoirs and illegal/legal urbanisation have consumed and fragmented large areas of rabbit habitat. However, whilst the demand for housing and water supplies is likely to increase further in the future, the impact of water reservoirs and urbanisation on nature conservation need not. This is because many housing and water developments have been

poorly regulated and co-ordinated between regions, and have failed to consider the needs of wider nature (let alone rabbit) conservation. Thus significant improvements in official development and water policies are both possible and required. In particular, legislation needs to be improved to prevent further illegal development in and around protected areas. This will require increases in the political support for, and profile of, rabbit (and nature) conservation.

Perhaps most importantly, rabbit recovery will be dependent upon significant changes in official hunting and agriculture policies and legislation. Existing hunting seasons are too long and have been widely criticised for including rabbit breeding seasons and/or the annual minimum in rabbit populations (see section 4.6). Similarly, there is no legal requirement at present for hunting quotas to be reduced or moratoriums introduced when rabbit populations are declining rapidly and/or very scarce – as has been called for by many experts. In addition, the inappropriate and excessive granting of “exceptional permits” for summer hunting needs to be curtailed²⁰⁹. Thus new and stricter legislation is required, concerning the timing, level and location of rabbit hunting. This will require political support and a high profile for rabbit conservation to counterbalance the likely strong resistance from the hunting community against increases in hunting regulation. More political support will also be required to ensure that any changes to legislation are actually implemented, given that some existing controls on hunting – e.g. regarding the use of predator control techniques (see section 4.9) – are being routinely flouted. However, beyond political support, more research by, and co-ordination between, scientific experts is also required given that much disagreement and uncertainty remains as to the best way to legislate hunting to recover rabbits (see sections 5.2 and 5.6).

Along with hunting, a number of significant changes are required in agriculture policies. Agriculture (and especially EU) subsidies need to be further reformed to increase incentives for farmers to protect and recover native habitat, alongside a diverse mix of low intensity crops, agro-forestry and some grazing, rather than monocultures of crops and/or excessive grazing of livestock. These reforms need to take into account the perverse application of some existing agro-environmental funds, which have funded farmers to remove important scrub-forest to re-plant intensively with native trees, creating a monoculture with little understorey and low ecological value. In addition, policy changes are required so that rabbits are either physically excluded from high value crops or the damage they cause is adequately compensated for, without promoting the eradication of rabbits from important areas. Similarly, farmers should only be eligible for compensation payments if they implement practices compatible with rabbit presence and do not eradicate or kill rabbits. In general, these beneficial changes in agriculture policies will require increases in the political and public support for (and profile of) rabbit and wider nature conservation. In particular, there is a requirement for agricultural policies to have more recognition of Mediterranean scrub forest as an important habitat²¹⁰, and rabbits as an essential native species and rural food source.

5.8. More political support

Some political support does exist for rabbit recovery. This is evidenced by (e.g.) the Spanish Environment Ministry now working to elaborate a rabbit recovery strategy, the Castilla-La Mancha government working on a rabbit management plan and the regional government of Andalucía proposing to organise a dedicated rabbit conference. However, this level of support is quite new and is still insufficient to overcome conflicting policies and interests and to mandate the implementation of the diverse actions required for rabbit recovery. In particular, political support is currently insufficient to ensure the approval and implementation of national rabbit recovery strategies, given that recovery plans and strategies for far more emblematic species (e.g. Iberian Lynx) have taken many years to be elaborated and approved, have still not been approved in some cases, and are a long way from being fully implemented.

Increasing political support will require a lot of lobbying by those organisations and individuals interested in rabbit recovery. This in turn will require a greater degree of co-ordination and collaboration between disparate actors, in particular to counter the strong lobby pressure from conflicting interests; for example, those who would resist more regulation of hunting, or conservationists and farmers in Australia that would support the release of a new GM rabbit virus. A particular initiative that might help in this regard is the creation of an informal “rabbit alliance” between: conservation groups interested in the Iberian Lynx, Iberian Imperial Eagle, other rabbit predators and the rabbit itself; relevant scientific experts; relevant government agencies, and; sympathetic hunting and forestry associations. Such an alliance would help increase the influence of lobbying on behalf of rabbit conservation, as would an increase in the provision of information regarding the importance and need of rabbit conservation. However, in general, and in order to make governments more responsive to lobby pressure and to ensure that sufficient lobbying is undertaken, an increase in the profile of rabbit conservation will be required, as described in the next section.

5.9. Raising the profile of rabbit conservation

European Rabbits are a well known and well loved species, particularly amongst young people. Rabbit conservation thus ought to have a high profile. However, most people know about rabbits as a domestic animal, a game species or an introduced pest. By contrast, most people – including many conservationists – are unaware of the importance and decline of, and need to recover, rabbits in the Iberian Peninsula. Moreover, this lack of awareness has serious consequences, frustrating in particular the planning, co-ordination and funding of rabbit conservation. The low profile of rabbit conservation thus needs to be explained and addressed.

Rabbit conservation has a low profile for a number of reasons. Firstly, at the international level the need to conserve rabbits in Spain and Portugal has been eclipsed by the need to control and eradicate rabbits from countries where they have been introduced. Thus international lagomorph conferences have focused more on the eradication than the conservation of rabbits and international conservation organisations refer to rabbits primarily or exclusively as “Australia's most widespread and destructive pest animal” with “efforts to control this species (being) central to the conservation of other native plants and animals”²¹¹. Whilst there is a need to control rabbits in Australia and elsewhere, the parallel need to conserve rabbits in their native Spain and Portugal is just as important, and deserves similar attention. Secondly, rabbits are not emblematic as a conservation species, and although well-known and well-loved, rabbits tend to be regarded as rather stupid and unimportant animals. Not being seen as an emblematic species has also hindered the conservation of other lagomorphs around the world²¹². Thirdly, it has been suggested that powerful hunting and agriculture interests in Spain and Portugal have actively resisted rabbit conservation being given a higher profile, due to the extra controls on their activities that this might bring²¹³.

Increasing the profile of rabbit conservation is important and will require a number of changes and initiatives. This work will need to include engaging with policymakers and the media. In addition, a rabbit conference – primarily organised to help raise co-ordination in rabbit conservation – could also help raise the profile of rabbit conservation. Similarly, national rabbit strategies and an expert working group would also help. However, perhaps the most important initiative that has been suggested to raise the profile of rabbits and rabbit conservation is the reclassification of rabbits under IUCN Red List criteria.

As discussed in section 2.1, rabbits are classified by the IUCN as Least Concern but classified by ICN in Portugal as Near Threatened²¹⁴. Moreover, under IUCN criteria, due to the rate of

declines, *O. c. algirus* could be re-classified globally and *O. c. cuniculus* regionally. Such a re-classification would help raise funding for rabbit conservation and would help mandate governments to increase rabbit monitoring and improve the planning and implementation of rabbit recovery. In addition, a re-classification would encourage more conservationists and policymakers to address rabbit conservation as an issue in its own right, and would raise the awareness of the importance and needs of rabbit conservation amongst many actors.

A re-classification of rabbits, however, would be controversial²¹⁵. This is because powerful hunting and agricultural interests might perceive that conservationists were trying to restrict their actions. In order to balance the interests of hunting, agriculture and conservation – and to recognise that rabbit decline has been uneven across different regions – regional re-classifications, at least of *O. c. cuniculus*, would be most appropriate. Regional classifications are possible and have been used, for example with the Iberian Wolf, which is classified as Threatened in some regions but Least Concern in others. In addition, it should be stressed that a re-classification would not prohibit all hunting or rabbit control, and that the active support of the hunting and agricultural communities will be essential for rabbit recovery.

5.10. Recommended initiatives

As part of the wider changes required for progress in rabbit recovery (outlined above), a number of specific initiatives are recommended by this report to assist rabbit conservation:

- **Reclassification of rabbits** – to give both sub-species the status they deserve and thus encourage the funding, planning and implementation of rabbit recovery.
- **Research list** – to prioritise and encourage the work of scientific researchers in areas most relevant to, and with most potential for, rabbit recovery in Spain and Portugal.
- **Conference** – to raise the profile of rabbits and rabbit conservation, and increase information exchange and co-ordination between diverse actors.
- **Web portal** – to increase the provision of, and access to, information relevant to rabbit recovery, supplied by experts, conservation managers, hunters and others.
- **Expert working group** – to increase the co-ordination amongst rabbit experts, conservation managers, hunters, farmers and others, and facilitate a rabbit strategy.
- **Iberian rabbit strategy** – to increase the planning, co-ordination and profile of rabbit recovery work at the Iberian level, across both Spain and Portugal.
- **Rabbit alliance** – to increase the political influence and co-ordination between those organisations lobbying on issues relevant to rabbit recovery in the future.

These recommended initiatives represent only a small part of the work needed to improve the monitoring of rabbits and the planning and implementation of rabbit conservation actions. However, these recommendations are a step in the right direction, and would, if achieved, represent a significant improvement on the current situation.

5.11. Conclusions

This chapter has described the changes required to improve rabbit conservation in the future in Spain and Portugal. In addition, a number of specific initiatives are recommended to help instigate these changes. A lot needs to be changed and implemented. However, this is by no means impossible and would, if achieved, have wide ecological and economic benefits given the diverse roles of European Rabbits in Spain and Portugal as a keystone and game species.

Conclusions

This report has used interviews with experts and a review of the available literature to analyse the issues relevant to reversing rabbit decline, one of the biggest challenges for nature conservation in Spain and Portugal. In particular this report has addressed four questions:

Why is rabbit decline important, and what has it been caused by?

Rabbit decline is important because rabbits are an essential keystone and game species in Spain and Portugal, important for plant communities, many invertebrates, the rural economy and some 39 predators, including the critically endangered Iberian Lynx and Iberian Imperial Eagle, which have declined partly as a result of rabbit decline. In addition, rabbit decline has encouraged frustrated hunters to inappropriately increase the non-selective control of rabbit predators, further exacerbating the decline in many predators. Rabbit decline itself has been caused by rabbit diseases (myxomatosis and RHD), habitat loss (due to agriculture, forestry, development, forest fires and land abandonment) and human-induced mortality (excessive hunting and control by farmers). Rabbit predators have not caused rabbit decline but common opportunistic predators may have contributed to the factors frustrating rabbit recovery.

What are the broad objectives and specific goals for rabbit recovery?

The general objective of rabbit conservation is to achieve widespread and sustained rabbit recovery, to support viable metapopulations of rabbit predators and sustainable rabbit hunting, and to maintain the integrity of the Mediterranean ecosystem. A full return to historical levels of rabbit abundance and distribution may not be possible due to persistent diseases and conflicts with agriculture. Widespread and sustained rabbit recovery will require: planning and rabbit monitoring; habitat recovery and protection; a reduction in the impacts of diseases and human-induced mortality; rabbit reintroductions and translocations, and (possibly); a short term reduction in the impacts of common opportunistic rabbit predators in some areas.

Why has rabbit conservation not achieved more to date?

Rabbit conservation has had a late start and narrow focus due to: international isolation and a weaker scientific tradition in Spain and Portugal in past decades; the low profile of rabbit conservation, particularly at the international level, and; the fact that rabbit conservation has only been addressed indirectly and independently under the priorities of conserving endangered predators and managing game stocks. Subsequently, the monitoring of rabbits and the planning and implementation of conservation actions has been further obstructed by: a lack of co-ordination between key actors; a lack of understanding of how the factors that cause rabbit decline interact; insufficient quality control, information exchange and innovation; conflicting development, hunting and agricultural policies; insufficient political support, and; a lack of awareness as to the needs and importance of rabbit recovery.

What needs to change to achieve successful rabbit recovery in the future?

Future rabbit recovery will require: more funding, research and innovation; changes in agriculture, hunting, development and fire prevention policies; more co-ordination and information provision, and; increases in the political support for, and profile of, rabbit conservation. Particular initiatives that would help instigate these changes include: reclassifying rabbits under IUCN Red List criteria; a conference and web portal dedicated to rabbit conservation; a list to prioritise research areas; a new “rabbit alliance” to increase lobbying for rabbit conservation and; an Iberian rabbit strategy and expert working group.

In order to achieve successful rabbit recovery a lot will need to be learned and implemented in the near future, involving a diversity of individuals and organisations working together to address a diversity of problems with a diversity of new and existing solutions. It is hoped that this report can help to encourage and organise this vitally important work.

About the author

Dan Ward has a degree in Natural Sciences (Cambridge University), a MSc specialising in Environmental Policy and experience in conservation projects in Scotland, New Zealand, Ecuador and Spain. He accepts no responsibility for the use that may be made of this report.

About SOS Lynx

SOS lynx is a campaign organisation set up in 2000 to promote the conservation of the Iberian Lynx, and works mainly at the International level. For more information about, and to support, SOS lynx, see: <http://www.soslynx.org>

About Ecologistas en Acción – Andalucía

Ecologistas en Acción – Andalucía is a federation of ecological groups that works to conserve the natural environment, and promotes peace and solidarity. Ecologistas en Acción is not necessarily identified with all the contents of this report. You can contact the organisation by email at: andalucia@ecologistasenaccion.org

About One Planet Living and Pelicano SA

In 2001, UN Secretary General Kofi Annan said: “Our biggest challenge this new century is to take an idea that seems abstract – sustainable development – and turn it into a reality for all the world’s people”. BioRegional and WWF have sought to take up this challenge. One Planet Living (OPL) is a joint initiative that aims to make it easy, attractive and affordable for people everywhere to adopt sustainable lifestyles, and at the same time support nature conservation. Pelicano SA, a Portuguese developer, is a Founding Global Partner of the OPL initiative. For more information about One Planet Living, and Pelicano SA, see: <http://www.oneplanetliving.org> and <http://www.pelicano.pt>

About IUCN Cat Specialist Group

The Cat Specialist Group is a network of some 200 cat specialists world-wide. This network is responsible for the observation of the status and the conservation needs of the 36 wild cat species living on our planet and for the continued Red List assessment. The group serves as a centre of information on wild cats and their conservation, and is one of more than 120 similar groups of scientists, wildlife managers and conservationists involved in various wild animals and plants who make up the Species Survival Commission SSC of the World Conservation Union IUCN. The chairs and members of these groups serve as honorary advisors to the Union. The Cat Specialist Group is interested in rabbit conservation due to the particular importance that rabbits and rabbit recovery have for the Iberian Lynx – the most endangered feline in the world. See: <http://www.catsg.org>

About IUCN Lagomorph Specialist Group

The IUCN/SSC Lagomorph Specialist Group (LSG) is responsible for the conservation and management of approximately 91 species of pikas, rabbits and hares. The LSG was constituted in 1978 and currently has 49 members worldwide. The highest priority activities of the LSG are focused in Mexico, Japan, South Africa, and Central Asia. See: <http://www.ualberta.ca/~dhik/lsg/>

Appendix: diverse perspectives

There is a diversity of perspectives amongst individuals and organisations with respect to rabbit conservation in Spain and Portugal. Firstly, and unfortunately, many individuals and organisations – even some interested and/or working in nature conservation – remain unaware of the decline of, and need to conserve, rabbits in Spain and Portugal (see section 5.9). Secondly, some farmers in Spain and Portugal still complain of supposed “rabbit plagues” and call on governments to instigate tougher rabbit control measures (see section 4.6). Thirdly, and as has been found with other nature conservation issues, even amongst those sympathetic to and/or working in rabbit conservation in Spain and Portugal there is a diversity of perspectives as to the problems to be addressed, and the solutions to be sought.

The matrix below records and analyses the diversity of perspectives amongst this third group – i.e. those already working and/or interested in rabbit conservation – along with the perspective of some farmers. The matrix records the generic problem definitions and preferred solutions of urban environmentalists, rural environmentalists, international professional conservationists, hunters, rabbit biologists, epidemiologists, Iberian Lynx biologists and farmers. These groups are not exhaustive and there is a diversity of opinions within each particular group. Furthermore, the matrix is necessarily over-simplistic and any particular individual or organisation will likely not fit neatly into one particular row. Nevertheless, the matrix is useful to record the diversity of problem definitions and preferred solutions in rabbit conservation, and to identify the various perspectives that they *tend* to be associated with.

Perspective	Problem Definition	Preferred Solution(s)
Urban Environmentalist	Rabbit decline, and thus rabbit predator decline, has been caused by excessive exploitation by hunters and control by farmers.	Stricter controls on rabbit hunting Expansion of protected areas.
Rural Environmentalist	Rabbit decline (and wider ecosystem decline) has been caused by a decline in traditional land use in favour of intensive farming, forestry, infrastructures or urbanisation, and/or a return to closed native forests.	Restore and/or mimic traditional land use, especially agroforestry, by cutting small areas for pasture within native forests.
International Professional Conservationist	There has been an inadequate conservation response to rabbit decline due to a lack of co-ordination and access to, and generation of, relevant scientific information.	Conferences Information sources (e.g. internet)
Hunter	Rabbits have declined on hunting estates due to rabbit diseases and excessive natural predation.	Vaccines, Predator control (including illegal methods), Rabbit breeding and reintroductions.
Rabbit Biologist	Rabbits have declined due to high mortality from diseases.	Vaccines, reintroductions, shelters and breeding dens.
Epidemiologist	Rabbit diseases are endemic and cannot be eradicated.	Alter land management to reduce the impact of rabbit diseases
Iberian Lynx Biologist	Rabbit decline has contributed to decline in Iberian Lynx.	Recover rabbits in lynx areas Provide lynx supplementary food
Farmer	Rabbits continue to cause significant agricultural damage.	Increase rabbit control measures in agricultural areas – e.g. destroy warrens and snare rabbits.

Each perspective is important and no one perspective is necessarily any more valid than any other. Thus it will be important to take all the perspectives recorded above into account when devising effective rabbit recovery strategies in Spain and Portugal in the future.

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