RECOVERY OF HABITATS AND PREYS OF LYNX PARDINUS IN SERRA DA MALCATA

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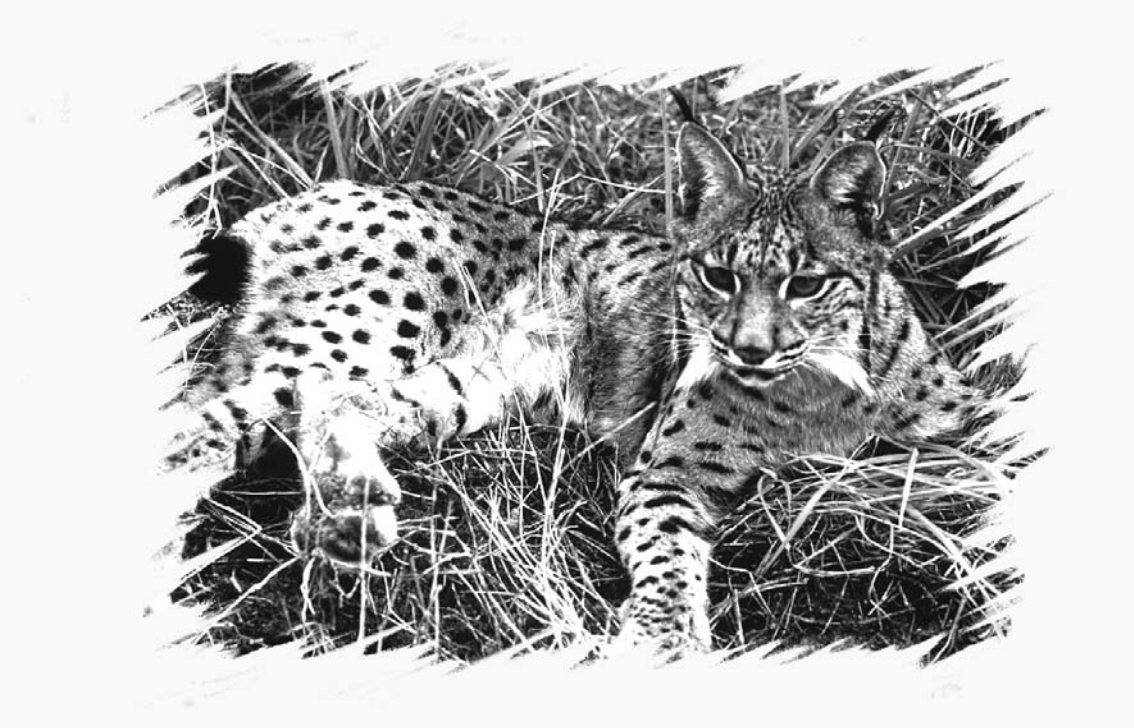

FINAL REPORT

September 1999- September 2003

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Recovery of Habitats and Preys of the Lynx pardinus in Serra da Malcata

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On the cover: lynx photo taken by Carlos Carrapato in the Iberian Lynx Captive Breeding Centre, Doñana National Park.

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1. Introduction

1.1 The species

The Iberian lynx (*Lynx pardinus*) is a cat species with a highly restricted geographic distribution, occurring only in Portugal and Spain. Presently, it is classified as the most endangered carnivore in Europe (Delibes *et al.* 2000) and as the most endangered feline in the world (Nowell & Jackson 1996), having been recently listed by the IUCN as critically endangered.

Identified, since the mid 1990-ies, as an independent taxonomic entity distinct from the Eurasian lynx (*Lynx lynx*) (Beltrán *et al.*, 1996), this species' numbers have declined over the last century, and this decline has increased in the last 10 years (Guzmán *et al.*, 2002).

Iberian lynxes were once distributed through much of the Iberian Peninsula (Delibes, 1979). Now, however, they have been extirpated from most of their range - they are extinct in most Spanish autonomous regions and in a significant percentage of the Portuguese territory. Today, Iberian lynx population numbers vary between 150 and 200 animals distributed between two reproductive populations: Doñana and Cardeña-Andújar (Guzmán *et al*, 2002). (Figure 1).

1.2 Conservation problems

The ultimate cause of the Iberian lynx's decline has been a combination of human persecution, habitat loss and rabbit (*Oryctolagus cuniculus*) regression (Delibes *et al.*, 2000). As a result of this process, lynx persists only in areas with relatively low human population densities.

Although lynx numbers have declined markedly, it is not too late to prevent its extinction. However, to conserve this species we must concentrate our efforts on habitat protection and improvement, rabbit recovery, captive breeding and reintroduction programmes. It is also necessary to increase basic knowledge on lynx reproduction biology and on landscape ecology. If we can use this knowledge to halt the Iberian lynx's decline, then we can prevent its extinction, but it is quite certain that it is going to take decades to recover former populations, particularly in Portugal.

1.3 Conservation action plan

In order to reverse the accelerated Iberian lynx decline the Institute for Nature Conservation (ICN) developed an Action Plan for the species. This plan was elaborated with the objective of providing a consistent and effective approach to prevent the species' disappearance in the country. Proposed conservation actions and management tools rely on the most recent information from research throughout the species range. The fundamental goal of this plan is to improve natural conditions in order to carry out a long-term lynx reintroduction programme.

The Action Plan is divided in two main action guidelines: *in-situ* conservation (habitat improvement, species protection and rabbit population recovery) and *ex-situ* conservation (captive breeding and genome resource bank).

The most important management tool for *in-situ* conservation will consist in the implementation of lynx management units that are intended to provide the smallest scale of evaluation, monitoring and management of lynx habitat. These areas will be managed as

theoretical home ranges and will be protected and improved for lynx presence and reproduction.

1.4 Project Context

Serra da Malcata, a protected area created in 1981 for conserving natural habitats and priority species, such as the Iberian lynx, constitutes a top priority area for future reintroduction. Within this context, it is necessary to undertake intensive measures of habitat recovery and prey species increasing, in order to make long-term Iberian lynx reintroduction possible.

The current project has as main goal the development of an integrated Iberian lynx ecosystem recovery process in order to achieve the following objectives.

Specific objectives

1. *Manage the lynx ecosystem in order to optimise its suitability for the species;*
2. *Increase wild-rabbit density;*
3. *Control human persecution;*
4. *Contribute towards the increase of public awareness towards the species' conservation;*
5. *Augment scientific knowledge on the lynx, preys and other elements of the Mediterranean ecosystem.*

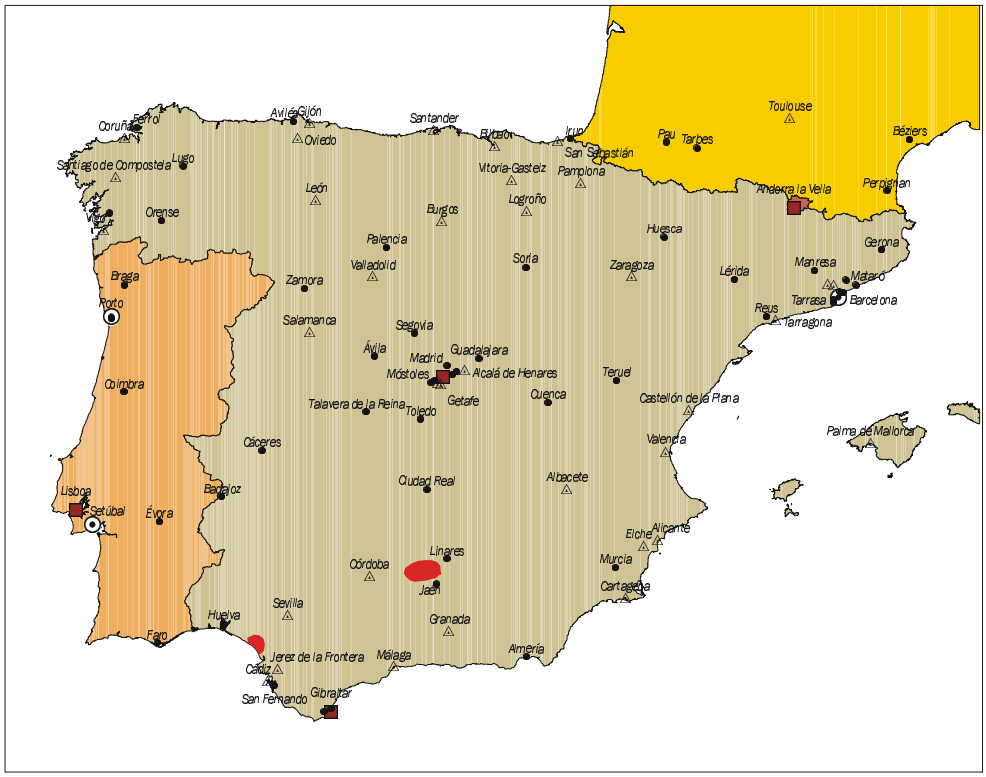

Figure 1- Current distribution of the Iberian lynx (red).

2.Overall project summary

2.1 Description of the actions carried out

2.1.1 Increasing natural regeneration of native tree species

This action was carried out with the purpose of restoring the natural Mediterranean vegetation of Serra da Malcata, by promoting natural regeneration of native tree species. Actions were carried out in a 30 hectare area, located in the southern part of the Nature Reserve and focusing on the following target species: holm-oak (*Quercus rotundifolia*), cork-oak (*Quercus suber*), Pyrenean-oak (*Quercus pyrenaica*) and strawberry tree (*Arbutus unedo*). The scrub understorey cover under the targeted tree species and adjacent areas was elimitaed and, when necessary, the trees were pruned.

2.1.2 Increasing the density of native tree species

In the 30 hectares intervened above, a significant amount of native tree species were planted in order to increase the area covered by Mediterranean woodland, which corresponds to potential areas for lynx reproduction. A total of 6 500 holm-oak and cork-oak plants and 100 individuals of holly (*Ilex aquifolium*) were planted.

2.1.3 Increasing the density of native tree species in the understorey of pine plantations

This action, as the one previously described, aims to increase the area covered by Mediterranean woodland. It was carried out in a 10 hectare area during the Autumn of 2000 in the southern part of the Nature Reserve. The methods described in actions 2.1.1 and 2.1.2 were used.

2.1.4 Substitution of old trees by new ones in previous plantations

During the autumn of 2000 the substitution of old trees by new ones in previous plantations undertaken during 1995 started. Plantations were made during the project "Recovery of Natural Vegetation in Protected Areas" and took place in the central areas of Serra da Malcata. This action, as well as the one previously described, aims to restore the natural habitat cover for lynx.

2.1.5 Plantation of fruit trees

Considering that lynxes can potentially feed on roe deer (*Capreolus capreolus*) and considering that this species is naturally recolonising the Serra da Malcata area, management procedures were applied to increase feed for this ungulate so as to help settle animals in the intervention area.

Their diet is varied and includes buds and leaves of deciduous trees and shrubs, bramble, rose, ivy, herbs, conifers, ferns, heather, grasses and fruits. We used a total of 200

individuals of wild apple trees (*Malus silvestris*), wild pear trees (*Pyrus bourgaeana*) and blackthorn trees (*Prunus spinosa*).

Plantations took place in the central Malcata area where optimal microclimatic conditions occur, in order to increase planting success.

2.1.6 Artificial rabbit warrens

In order to increase shelter for rabbits, 95 artificial warrens were constructed during the LIFE project in areas located in central and southern Malcata. These structures were built using eucalyptus (*Eucalyptus* spp.) and olive tree (*Olea europaea*) roots, covered with hearth, to form a volume of approximately 15 m^3.

2.1.7 Construction of a captive breeding centre for rabbits

The construction of a captive breeding centre for rabbit was concluded in March 2001. This structure, with a total area of 1718 m^2, is located in the central area of the Reserve (Ventosa) and was built with the main objective of producing rabbits for restocking operations.

2.18 Recovery of olive groves

A total of 5 hectares located in areas adjacent to the Bazágueda river were restored. Olive trees were pruned and the understorey was levelled and sown.

2.19 Recovery of chestnut tree plantations

This action, applied to a total area of 2 hectares, consisted in removing dead chestnut trees (*Castanea sativa*) and pruning living individuals. The understorey was also levelled and sown. This action had the purpose of creating suitable habitat conditions for rabbits and roe deer.

2.1.10 Prescription burning in pastures

Prescribed fire is a useful tool for maintaining suitable habitat for lynx as it decreases understorey cover and so increases trophic resources for rabbit density. Prescription burning was applied to clean pastures, invaded by scrubby vegetation, in order to increase rabbit density.

2.1.11 Creation of pastures

Shrub areas were levelled and sown with the following herb species: *Secale cereale*, *Festuca* spp. and *Lolium perene*. A total of 87 hectares of pastures were opened, in southern and central Malcata, in areas with low rabbit density or without the presence of this lagomorph. This management procedure aims to significantly increase rabbit density.

2.1.12 Management of shrubs through prescribed fire

This action, undertaken in a total area of 5 hectares, was applied in southern and central Malcata, in areas where the vegetation is dominated by *Chamaespartium tridentatum* and *Erica australis*. The main objective is to increase the regeneration of young evergreen species and graminoids in order to increase available biomass for rabbit feed.

2.1.13 Poaching and forest fires patrolling

During the last four years, a systematic patrolling system was applied in order to control poaching in the Nature Reserve.

During patrolling it was possible to ascertain the existence of high levels of poaching at Serra da Malcata, not only in the game reserves but also in fully protected areas.

Although this sort of activity is still a substantial problem, after four years of intensive survey, it was possible to significantly reduce the poaching activities in some areas. Patrolling will continue in order to minimize the use of illegal hunting techniques and, by doing so, eliminate a major threat to lynx reintroduction.

2.1.14 Rabbit vaccination campaigns

During the project, this sort of action was only carried out in the rabbit captive breeding centres, where animals were box-trapped and vaccinated against myxomatosis and VHD.

For myxomatosis we used the commercial brands Mixovac® and Lyomyovac®, which are vaccines developed for the Shope syndrome, which is a similar virus to the myxomatosis agent.

For VHD we used the commercial brands Cylap® and Arvilap®, consisting of an inactivated virus. These vaccines can give an 18-month immunity period and present a high degree of innoculty.

In future rabbit recovery programmes this type of intervention will be maintained in captive raised animals, using safe vaccines, and its application on free-living animals will depend on the development of safe and easy-to-apply vaccines.

2.2.15 Rabbit restocking operations

In an attempt to solve the generalised rabbit regression problem, we conducted, from 1999 to 2000, nine restocking operations in five geographic areas. A total of 330 rabbits were released and success varied a lot. Although we verified some significant drawbacks, this technique appears as extremely useful for recovering rabbit populations.

2.2.16 Analysis of the incidence of rabbit epizootic diseases

Since 1999, it was possible to collect blood and tissue samples from 23 rabbits. These samples were submitted to a laboratorial diagnosis based on ELISA tests and immunoassays, with the purpose of detecting the VHD calicivirus and anti-bodies (analysis conducted in ICETA – Vairão). As a result of this methodology, it was possible to detect the VHD virus in three individuals exhibiting VHD symptoms. Due to the low samples obtained these results are not conclusive regarding the effect of this pathology on the population dynamics of Malcata rabbit populations.

2.2.17 Educational actions

During the project five educational actions were carried out, focusing on different target classes with 350 participants. Actions were targeted on teachers, students and security forces.

2.2.18 Information bulletin

Initially, we predicted publishing 12 numbers of the information bulletin “HabitatMalcata”. However, since we were unable to access EU funding, due to bureaucratic problems, it was only possible to publish six numbers. We focused on disseminating information on Mediterranean woodland conservation, rabbit restocking and lynx conservation.

2.2.19 Iberian lynx conservation exhibition and project merchandising

An exhibition on the conservation of lynx habitats and preys was prepared with the objective of informing the general public about this project’s actions and objectives. The

exhibition, composed of five panels, was concluded in July 2003. Since we were unable to have access to a significant percentage of EU funding, due to bureaucratic problems, it was not possible to produce the planed project merchandising.

2.2.20 Exchange of information with Spanish teams

Since the project was developed next to the Portuguese-Spanish border and Serra da Malcata contacts with two Spanish autonomous regions (Castilla-León and Extremadura), it was quite important to maintain a permanent contact with Spanish teams involved in lynx conservation. Thus, during the project several meetings and field trips were conducted in order to increase information exchange.

2.2.21 Study of ecological parameters of the Iberian lynx and the Carnivore community

This action was carried out with the following objectives: 1) to map the Iberian lynx presence and the presence of other species of the carnivore community and explain this spatial distribution according to ecological parameters; 2) to define each carnivore population status; 3) to define target areas for the implementation of the management actions.

Final results pointed towards a pre-extinction situation of the Iberian lynx, with no reliable proof obtained. Since 1997 there is no evidence of lynx presence in the study area. A habitat suitability model developed to evaluate project actions revealed that the actions carried out during the project positively contributed towards Iberian lynx habitat and prey recovery, although it is necessary to continue conservation efforts and to enlarge target areas.

2.2.22 Study of ecological parameters of wild-rabbits

In target areas, rabbit density increased from 1999 to 2003, although with some oscillations. In most parts of Serra da Malcata, rabbit density is still low and needs the continuation of management actions. The conservation efforts applied during the project increased hedges, food and shelter resources for rabbits.

2.2 Final results of the project

In terms of biological criteria, the project achieved a proper success in several areas. In managed areas, rabbit density recovery from 2.53 rabbits per hectare to 5.13 rabbits per hectare. Other variables such as lynx carrying capacity and percentage of suitable habitat, also had a positive evolution (Table 1).

Table 1 – Evolution of the success indicators in pre and post project phases.

Success criteria	1999	2003
Rabbit density	2.53	5.13
Lynx carrying capacity	<1	4
Suitable habitat for resident lynxes	481 hectares	2527 hectares

Valuation criteria could be analysed in terms of poaching rate. Although significant progress was made in controlling this phenomenon, we can conclude that public attitude towards this problem did not change. Poachers are still in action and operating. The main difference is that the most problematic areas are now outside the Nature Reserve.

Organisational problems, such as difficulties in having access to funds, were the main cause of project failure. Although we tried to learn about the bureaucratic structure associated with project funding and figured out how to best work within this structure and culture, it was not possible to improve the process and the situation worsened in the last two years.

2.3 Summary of the overall project assessment

The project had a significant positive effect on the recovery of the central Serra da Malcata habitats for the Iberian lynx. Areas that otherwise would be not managed or improve, became suitable for reintroducing the species. Rabbits, the main prey on Mediterranean ecosystems for a significant amount of endangered species, also increase significantly in the project target areas. This fact could influence not only the future success of a reintroduction programme, but also the survival and population level of threaten species such as the eagle owl (*Bubo bubo*), the wildcat (*Felis silvestris*) and the golden eagle (*Aquila chrysaetos*).

The Life project constituted an extremely important conservation base for the Nature Reserve and the Malcata site for two main reasons:

1- It was the first conservation project in Serra da Malcata with continuous and significant conservation actions, acting in a wide geographic range and temporal scale;
2- Project actions will be continued, in a wider range, as a result of the approval of the POA project "Management of habitat and priority species of Serra da Malcata".

2.4 The future: remaining threats and further actions needed

The conservation actions will continued by the application of the POA project "Management of habitat and priority species of Serra da Malcata". The target areas will be significantly increased to most parts of the Nature Reserve in order to continue to improve highly degraded habitats and recovering the density of rabbit populations. It is necessary to maintain the conservation efforts, to apply the conservation strategy expressed in the Lynx Action Plan, in order to make possible a species reintroduction in a long-term. Ensuing actions will also contemplate the construction of a lynx reproduction centre and reintroduction experiences, in control environments, using other lynx species.

3.Activities report

Large and medium sized carnivorous mammals are often considered as key umbrella species because of their role in shaping community structure, their ecological requirements and their need for significant large areas to complete their life cycles (Palomares, 2001). Due to this fact, conservation action plans focused on this species, or the design of areas to protect them, may also achieve benefits for preserving many other species and natural ecosystems. The Iberian lynx is a keystone species that regulates the community structure of Mediterranean ecosystems and with a high conservation importance that can be used to halt the species decline, as well as recover a significant number of priority species and habitats.

Conservation of the Iberian lynx requires good-quality habitats where individuals can settle and reproduce, and adequate ecological corridors connecting these areas, because dispersion is essential for the maintenance of the meta-population equilibrium (Rodríguez & Delibes, 1992; Gaona, Ferreras & Delibes, 1998). General characteristics of habitats sustaining resident lynx populations should be (Palomares, 2001):

- Presence of isolated trees;
- Approximately 40% cover of understorey vegetation (half of which should be tall shrubs)
- Presence of open areas for hunting
- High rabbit density (at least 4.6 rabbits per hectare during the lynx breeding season)

The management actions described bellow aim to improve habitat suitability by shaping it according to the characteristics previously pointed out. The main objective is to create a mosaic landscape than can favour lynx presence and increase rabbit density.

3.1 Non-recurring management actions

3.1.1 Increasing natural regeneration of native tree species

With the goal of restoring the natural Mediterranean vegetation of Serra da Malcata several actions were carried out in order to promote natural regeneration of native tree species. Actions were carried out in a 30 hectare area, located in the southern part of the Nature Reserve, and targeted the following species: holm-oak, cork-oak, Pyrenean-oak and strawberry tree.

The method consisted in eliminating understorey scrub cover around the target tree species and adjacent areas and, when necessary, pruning the trees. This reduces competition between individuals and increases the growing rate and expansion.

3.1.2 Increasing the density of native tree species

In the intervened areas described above, a significant amount of native tree species was planted in order to increase the area covered by Mediterranean woodland[1], which is a top priority habitat for lynx reproduction. The presence of trees can be quite important for this species, since they not only provide a suitable defence against potential predators (dogs, boars or man), but also potential places for females to give birth.

A total of 6 500 individuals of holm-oak and cork-oak and 100 holly plants were planted. By the end of the project we obtained a survival rate of 43% for the first two species and 85% for the third species. This action will contribute towards an increase in 50 hectares of the total area covered by Mediterranean woodland in the next 50 years.

3.1.3 Increasing the density of native tree species in the understorey of pine plantations

This action, as the one previously described, aims to increase the area covered by Mediterranean woodland. During the Autumn of 2000 10 hectares were intervened in the southern area of the Nature Reserve. The methods described in actions 3.1.1 and 3.1.2 were used.

3.1.4 Substitution of old trees by new ones in existing plantations

During the Autumn of 2000, the process of substituting old trees with new ones in existing 1995 plantations, was started. Plantations were made under the project "Recovery of Natural Vegetation in Protected Areas" in the central areas of Serra da Malcata. This action, as the one previously described, was conducted with the main objective of restoring the natural habitat cover for lynx.

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[1] According to Delibes *et al.* (2001) the definition of "Mediterranean scrubland" and "Mediterranean forest" is the vegetation characteristic of the Mediterranean-Iberoatlantic phyto-geographic super-province, which occupies most of the western half of the Iberian Peninsula. The outstanding components are holm-oak, cork-oak and gall-oak (*Quercus spp.*) among the trees, *Phillyrea spp., Arbutus unedo, Pistacia lentiscus* and *Viburnum tinus* among the shrubs, and some *Cistaceae, Erica spp., Rosmarinus spp.*, *Rhamnus spp.* among the scrubs. Patches of wild olive trees (*Olea europaea var. silvestris*), wild pear trees (*Pyrus silvestris*), *Juniperus spp.* or other species can be found, whereas in elevated and moist localities patches of *Fraxinus spp.* or even *Alnus glutinosa* are frequent.

3.1.5 Plantation of fruit trees

Considering that lynxes can potentially feed on roe deer and considering that this species is re-colonising the Serra da Malcata area, management procedures were applied to increase feed for this ungulate in order to try and settle animals in the intervention area.

Their diet varies and includes buds and leaves of deciduous trees and shrubs, bramble, rose, ivy, herbs, conifers, ferns, heather, grasses and fruits. To provide food for this species, we used a total of 200 individuals of wild apple trees, wild pear trees and blackthorn trees.

The plantation occurred in the central area of Malcata, in areas with optimal microclimatic conditions to increase planting success.

3.1.6 Artificial rabbit warrens

The importance of shelter for rabbit survival and reproductive success is a well-documented phenomenon (Villafuerte & Moreno 1997), and a crucial factor for increasing species density. Heavy rabbit mortality in general, and losses of nestlings and very young rabbits, in particular, could be lowered by providing safe nesting and rearing cover. Between 1997 and 1999 a total of 45 shelters were built in Serra da Malcata Nature Reserve using financial support from POA. These structures were built using mounds of eucalyptus and olive trees roots, covered with hearth, to form a volume of approximately 15 m^3. Structures also featured the development or improvement of grassy plots on well-drained sites near well-established protective cover. Studies have shown that nests are usually less than 25 meters from good cover.

In order to implement the management strategy previously applied to this lagomorph, 95 more shelters were constructed during the LIFE project in target areas located in central and southern Malcata.

▲ **Artificial warrens (a and c) and rabbits using them detected by camera-trapping**

The warrens utilization level was quantified by counting the number of used burrows, in different seasons, along the project duration (Figure 2) and by the use of camera trapping.

We verify that most structures were occupied by rabbits (75% during the last sampling in May 2003), concluding that the animals had a suitable acceptance of the warrens.

3.1.7 Construction of a captive breeding centre for rabbits

In March 2001, was concluded the construction of the rabbit captive breeding centre. This structure, with a total area of 1718 m^2, is located in the central area of the Reserve (Ventosa) and was built with the main objective of producing rabbits for restocking operations.

In the interior of the structure were placed several artificial warrens made of glass fibber (Majanos Mayoral ©) in the middle of feeding areas. The environmental enrichment was based on the recommendations by Piorno & Alves (2000), in order to increase breeding success, capture rates and prevent losses due predation.

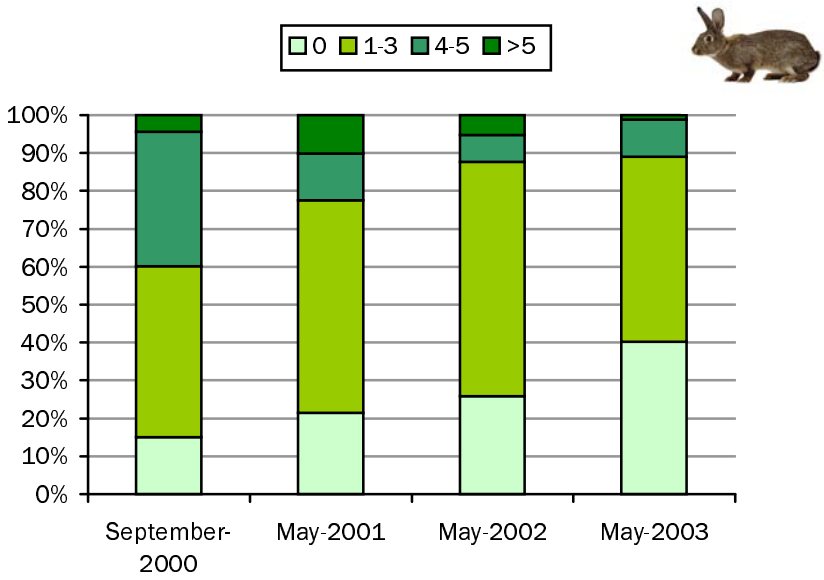

Figure 2 – Utilization level, measure in terms of used borrows by rabbits, of the artificial warrens built during the project.

Rabbits were only introduced in early 2002, due to the necessity of fulfilling the legal aspects of the governmental decree n.º 463/2001 of 8 of May. Breeding success was limited by severe climatic condition, during the winter of 2003, when abnormal snowing had a negative effect on rabbit survival. During the next breeding season we expect to increase rabbit productivity.

3.2 Recurring management

3.2.1 Recovery of olive groves

Olive grove recovery was initiated in 2000, and continued during the following years. We recovered a total of 5 hectares located in adjacent areas of the Bazágueda river. Olive trees were pruned and the understorey was levelled and sown. This process was integrated in the rabbit recovery strategy, with the objective of increasing feeding resources and creating suitable areas for restocking operations.

3.2.2 Recovery of chestnut tree plantations

This action, applied to a total area of 2 hectares, was based on the removal of dead chestnut trees and pruning living individuals. The understorey was also levelled and sown. These actions had the purpose of creating suitable habitat conditions for rabbits and roe deer.

3.2.3 Prescribed fire in pastures

In the Iberian Peninsula rabbit populations have experienced a pronounced decline during the last forty years. Unfortunately there are very few records of this striking decrease; for instance, in the Doñana National Park current rabbit numbers are estimated to be less than 5% of the species population levels in the 1950s (Delibes *et al.*, 2000). Rabbits are now relatively scarce everywhere, and in marginal areas where climate or soil conditions are not optimal, they have disappeared. The rabbit collapse has been ultimately attributed to two main causes: changes in land use and disease. It is believed that these factors originally weakened rabbit populations, making them more vulnerable to several proximate factors including high hunting pressure and high predation levels by generalist species.

Rabbits seem to benefit from fire, since they increase their activity in burned areas (Moreno & Villafuerte, 1995). Thus, prescription burning is a useful tool for maintaining habitat suitability for lynx, by decreasing understorey cover and so increasing rabbit density. Therefore, this management tool was used to clear pastures invaded by scrubby vegetation in order to increase food supply for rabbits. The effect of this action upon rabbit population numbers is described in chapter 4.

3.2.4 Creation of pastures

Mediterranean scrubland has been traditionally exploited for a number of practices that have almost disappeared. Furthermore, whereas the massive abandonment of rural areas 45 years ago caused the disappearance of traditional agriculture, the current trend of people coming back to natural areas, carrying different, more impacting activities than formerly, involves even more detrimental consequences for lynx habitat (Rodriguéz & Delibes 2002).

Restoring land use practices that facilitate the presence of rabbits, based on scientific grounds and introducing modifications in agricultural, forestry and hunting practices that favour an increase in rabbit density, is a priority action for recovering lynx habitat.

Studies, carried out in Doñana National Park (Moreno & Villafuerte 1992) concluded that rabbits can be significantly increased by opening pastures in areas covered by shrubs. The study mentioned above concluded that size, area and shape of the pasture could directly influence rabbit density. Pastures 8 to 10 meters in width were optimal for rabbits.

This type of management intervention is being carried out in the Nature Reserve since 1997 and is also a priority of the current project.

Shrubs were levelled and sown with the following herb species: *Secale cereale*, *Festuca* spp. and *Lolium perene*. A total of 87 hectares of pastures were opened in south and central Malcata in areas with low rabbit density or without this lagomorph. The results of this management procedure on rabbit density is described in detail in chapter 4.

▲ Mosaic landscape created in central Serra da Malcata

3.2.5 Management of shrubs using selective fire

This action, conducted in a total area of 5 hectares, was applied in south and central Malcata, in areas were the vegetation is dominated by *Chaemaespartium tridentatum* and *Erica australis*. The main objective is to increase the regeneration of young evergreen species and graminoids in order to increase trophic resources for rabbits, since this species feeds mainly on these types of plants.

3.2.6 Illegal hunting and forest fires patrolling

Available information indicates that a significant amount of lynxes are directly killed by humans (Ferreras, 1992, Oreja, 1998). Full intentional illegal hunting still occurs, but its importance as a relative source of mortality is difficult to assess because these events are usually kept confidential and, in most cases, the veracity of the information is difficult to determine. In Portugal, the proportion of reports that involved illegal hunting during the 1980's was estimated at 21%. Lynxes are sometimes killed by hunters waiting in hides for red deer or wild boar on the large hunting estates of the Iberian mountains. There are also reports of lynxes caught by dogs during big game hunting, although this kind of death is rather uncommon. In Portugal, illegal shooting during legal game events or fox hunting, has been identified as the most important cause of non-natural mortality of lynx in recent time.

Traps have been, and still are, the main human related threat in the lynx range. In the past, when rabbits were abundant, hundreds of traps worked daily for several weeks in each hunting estate for rabbit harvesting. Many furbearers, including lynx, died in those traps, as selling fur complemented the income of professional trappers.

Therefore, it is crucial to reduce or, preferably, eliminate this threat for the success of lynx conservation. This can be accomplished by (Delibes *et al.*2000):

- Improving the attitude of the society, in general, and of hunters, in particular, towards the Iberian lynx. Any person who shoots a lynx should be reported and evicted by his own social group, and the legal mechanisms that exist should be enforced against poachers. For this purpose, specific awareness campaigns are needed.
- Increasing patrolling and, where appropriate, punishing lynx shooters; investigate the possibility of making managers of hunting areas or organisers of hunting events bear the civil liability of illegal deaths and, thus, collaborate in finding the poacher.

In order to control poaching in the Nature Reserve area, during the last four years, a systematic patrolling system was applied.

During the patrolling actions it was possible to ascertain the existence of high levels of illegal hunting practices in Serra da Malcata (Figure 3), not only in the game reserves but also in fully protected areas. Most of the occurrences were related to wild boar trappings, particularly through the use of snares and decoys (Table 3). During the survey it was even possible to detect a live badger (*Meles meles*) trapped in a snare.

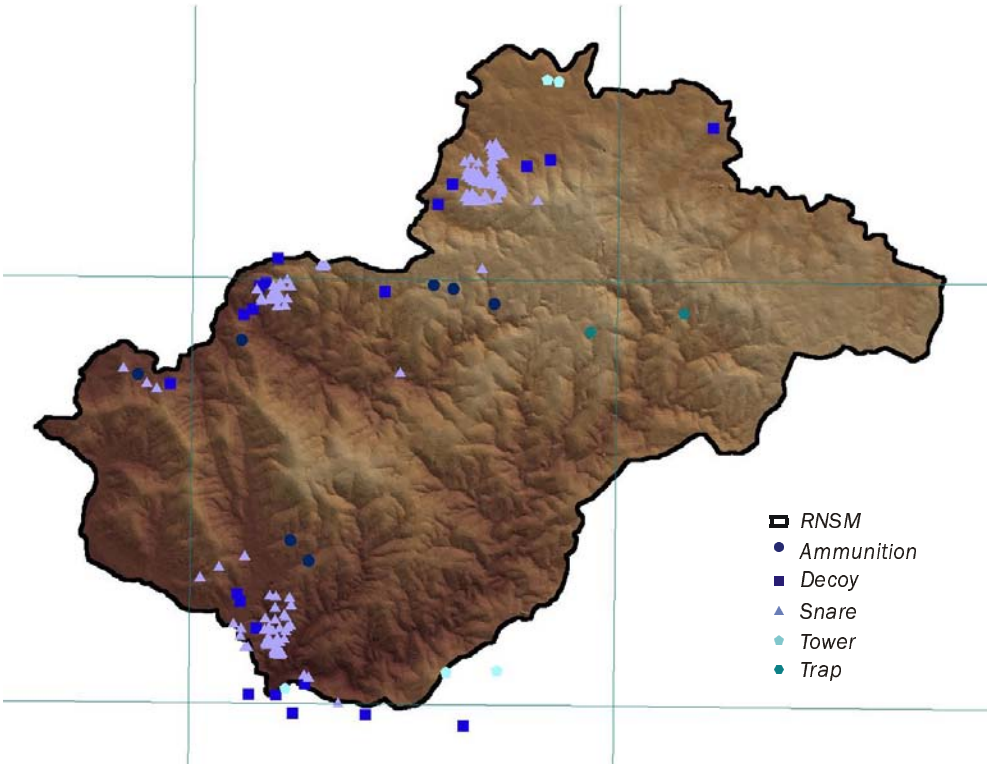

Figure 3- Geographic distribution of illegal hunting structures detected on Serra da Malcata during the project time frame (1999-2003).

Table 3 – Obtained results from the campaigns of illegal hunting structures detection. ZIC – full protection area; RCO – game reserves (north SMNR).

	ZCI (%)	RCO (%)	Outside (%)	Total (%)
Towers	1 (2)	7 (10)	2 (3)	10 (5)
Snares	43 (90)	54 (74)	55 (79)	152 (80)
Traps	1 (2)	0 (0)	0 (0)	1 (1)
Decoys	3 (6)	12 (16)	13 (19)	28 (15)
Total	**48**	**73**	**70**	**191**

During 2002, the survey effort was substantially increased and the number of located structures shot from 15 to 102. During 2003, the survey effort was maintained and the number of detected structures decreased (Figure 4).

Although this sort of activity is still a significant problem, after four years of intensive survey it was possible to significantly reduce the poaching activities in some areas. Patrolling will continue in order to reduce the use of illegal hunting techniques and by doing so, eliminate one major threat for lynx reintroduction.

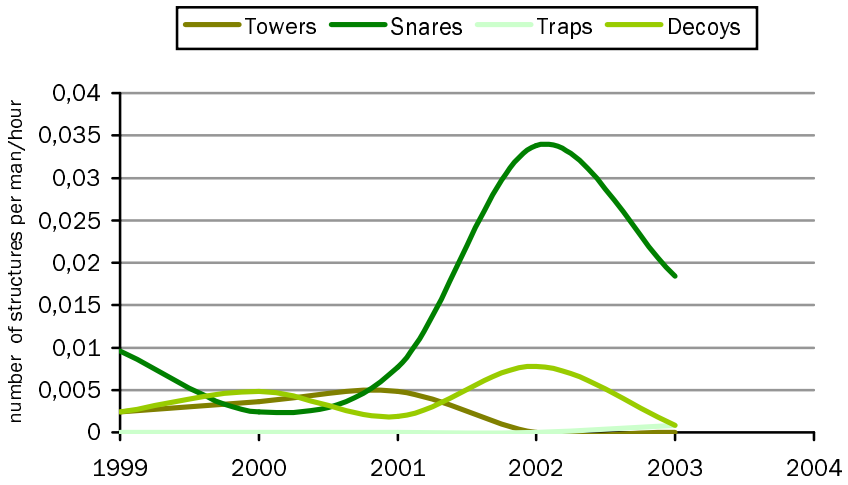

Figure 4 – Annual variation of the detection rate of hunting illegal structures in the intervention area.

3.2.7 Wild rabbit vaccination campaigns

The additive effect of myxomatosis and rabbit haemorrhagic disease (RHD) reduced European wild rabbit numbers in most of its historical range, especially in the ecologically less-favourable habitats. This had adverse effects on the reproductive effort of predators, including the Iberian lynx. In an effort to improve rabbit populations, several management tools have been applied in the last decade, including vaccination campaigns.

During the project, this sort of action was only carried out in the rabbit captive breeding centres, where animals were box-trapped and vaccinated against myxomatosis and VHD.

For myxomatosis, we used the commercial brands Mixovac® and Lyomyovac®, which are vaccines developed for the Shope syndrome, which is a similar virus to the one causing myxomatosis. Although this vaccine is currently widespread for vaccinating rabbit, its efficiency and innoculty (Lamark 1998) are not perfect.

For VHD we used the commercial brands Cylap® and Arvilap®, with an inactivated virus. These vaccines can give an 18-month immunity period and present a high degree of innoculty.

Recently, a recombinant Myxoma-virus (MV) that expresses the RHDV major capsid protein VP60 has been developed. Concern about the field use of such horizontal transmissible recombinant viruses for wild rabbit management, sometimes with opposing goals, has already been expressed by the European Agency For The Evaluation Of Medicinal Products. Since vaccination campaigns on free-ranging animals are difficult and costly they may not be justified. Moreover, the success of a horizontal transmissible recombinant MV depends on a certain host density. If the new vaccine is not effective in low-density rabbit populations it will be of little use, and the risks may outweigh the eventual benefits to economy and conservation.

So, in future rabbit recovery programmes this type of intervention will be maintained in captive raised animals, using safe vaccines, and its application on free living animals will depend on the development of safe and easy to apply vaccines.