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Iberian lynx reintroduction plan in Andalusia

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Abstract

One of the principal goals of the Iberian lynx LIFE conservation project is to initiate the first reintroduction of the species in recently extinct nuclei. The previous work to select the best area for the reintroduction of the Iberian lynx in Andalusia began in 2005. The two selected areas to perform the reintroduction into are :Guadalmellato and Guarrizas valleys, both areas showing optimal habitat structure and resources abundance. A brief abstract of the previous works and a planning of the future steps in the Iberian lynx reintroduction are presented in this communication.

Introduction

The Iberian Lynx (*Lynx pardinus*) is the species of the genus *Lynx* which historically, has manifested a more limited distribution, as it is endemic to the Iberian Peninsula (Ferrer & Negro 2004). Although it was found in practically all parts of the peninsula up until the 19th century, during the 20th century numbers diminished alarmingly to the point where in the 1980s there remained a series of isolated nuclei in the mountain ranges in the south east of the peninsula (Rodríguez & Delibes, 1992; Fig. 1). During the following decade there was to be a continued decline which would continue up until 2001 with the identification of two populated nuclei for the species: Doñana and oriental Sierra Morena, with between them no more than 150 exemplars (Guzmán et al. 2004; Fig. 1). The causes that have led the species to this scenario, and which in turn have led the IUCN to catalogue the species as "critically endangered", has been the decline in the rabbit population (its basic prey) due to viral diseases, destruction of habitat (the lynx needs Mediterranean scrub) and mortality of an antropic nature (road casualties, poaching, etc.) (Rodríguez & Delibes, 1992; Guzmán et al. 2004).

The Iberian lynx is a territorial feline whose diet is composed of about 95% wild rabbit (*Oryctolagus cuniculus*) (Gil-Sánchez et al. 2006) and whose optimum habitat is a 55% cover of Mediterranean scrubland (Palomares et al. 2000). The size of the territory of the Iberian lynx is variable depending on the quality of the habitat and the abundance of resources, oscillating between 300 hectares in optimum conditions and 12.000 Ha in sub-optimal conditions. The fact that there are only two nuclei of breeding populations means that the species is extremely vulnerable. One necessary step to reduce the risk of extinction is the creation of new populations, either by natural settlement or via reintroduction.

Spanish National Strategy for the conservation of the Iberian lynx: Point 7.5 in the National Strategy refers to the increase in the number of the lynx population, and the objective set out is to achieve the presence of at least a viable breeding population in every autonomous region included in the Strategy document. This is four-stage plan. First is the "localisation and selection of the areas" which

must be done, according to UICN criteria, within the area that the species occupied in the 1980s about which there is very precise information. The second phase is the "adaptation of the reintroduction areas", which consists of a series of measures to ensure that the chosen location is fit for purpose and viable in the long term. The third stage included in the strategy is the "selection and preparation of the lynx", whereby studies are carried out to determine the origin, genetic aspects and the most suitable social structure for the founding of new breeding populations. Ideally, specimens for the programme should be taken from the wild, as far as this is possible in the donor populations. The final phase of the strategy is the execution of the reintroduction projects, setting as an objective for 2012 the inclusion of all the autonomous regions mentioned in the National Strategy document, with each region having in place a reintroduction programme with political backing and adequate evaluation at each stage of execution.

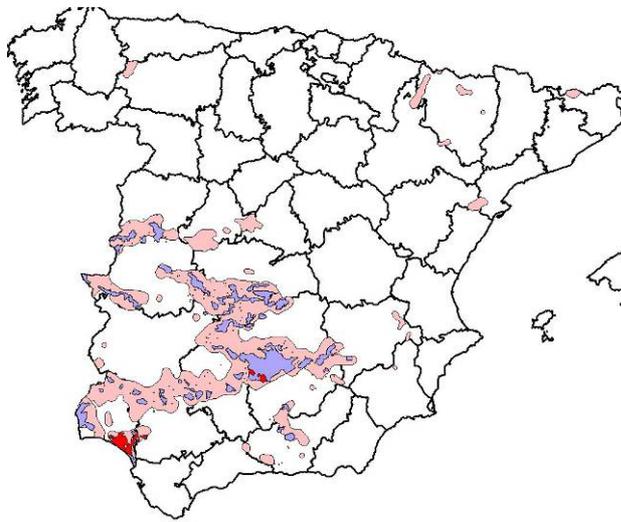


Figure 1. Distribution of the Iberian lynx in Spain in 1960 (pink), in 1990 (blue) and present day (red), according to Rodríguez & Delibes (1992) and Guzmán et al. (2004)

LIFE Project: "Conservation and Reintroduction of the Iberian lynx in Andalusia" (LIFENAT 06/E/209): Within the group of actions for conservation of the species included in this project is the section referring to the creation of a new breeding nucleus through reintroduction. The execution of the objective is designed based on the National Strategy document and follows directives of the UICN in reintroduction. The first stage designated in

the strategy, referring to localisation and selection of areas for reintroduction, has been based on the work "Análisis de los hábitat adecuados para el lince ibérico en Andalucía", (Analysis of adequate habitats for the Iberian lynx in Andalusia) developed within the framework of the Project LIFE "Recuperación de las poblaciones de Lince Ibérico (*Lynx pardinus*) en Andalucía" (Recuperation of the Iberian lynx populations (*Lynx pardinus*) in Andalusia which was carried out between 2002 y 2006 (LIFENAT 02/E/8609). In this work three areas in Sierra Morena were selected by a multi-criteria analysis as being most suitable to host an Iberian lynx reintroduction project. Habitat, availability of resources, the level of protection in the studied zones and the historic distribution of the species in the 1990s, were all taken into account. The resulting selection of zones was from the southern sector of the Sierra de Hornachuelos, and the environs of the rivers Guadalquivir and Guarrizas.

Identification and selection of areas

Identification of the areas of reintroduction: As already mentioned, the task of the identification of the Iberian lynx reintroduction areas in the autonomous region of Andalusia was carried out within the framework of the LIFENAT 02/E/8609 project and thereby the three aforementioned areas were identified. Nevertheless, and although this document will serve as a base for the reintroduction to be carried out during the duration of the current LIFE project, during its first year a similar task was carried out (based on a multi-criterion analysis) for the identification in the Iberian peninsular as a whole, as it was already agreed with our partner the Junta de Extremadura.

Selection of the final area for reintroduction in Andalusia:

Once the optimal areas for the reintroduction of the Iberian lynx in the autonomous region of Andalusia were identified, we proceeded with carrying out a detailed study of multiple field variables, within the LIFENAT 06/E/209 project. This study had the aim of realising a definitive selection of the best area, so several variables were taken into account such as microhabitat suitability, abundance of trophic resources, current threats to the species, connection with current lynx populations and finally the social attitude of the local population before the reintroduction of the lynx. It was determined that although there were three suitable zones

the ideal zone to carry out the reintroduction of the Iberian lynx within the framework of the up and running LIFE project is the zone surrounding the river Guadalquivir, in the province of Cordoba, as it presents a better structure of micro-habitat than the zone around the Guarrizas, which remained in second place. Hornachuelos took last place due to its smaller capacity and currently fewer possibilities for metapopulation integration. Hence, the planned reintroduction in the LIFE Project will take place in Guadalquivir, even though, as stipulated in the Project, adaptation actions will begin in parallel in Guarrizas with a view to prepare for following reintroductions which will remain dependent on the preliminary results obtained in Guadalquivir.

Adaptation of reintroduction areas

Improving the habitat: The areas Guadalquivir and Guarrizas, selected for the reintroduction, present an optimal habitat structure for the presence of the Iberian lynx without having to perform any improvements, this having been

the most consistent criteria when choosing these areas. However, within the LIFE NAT 06/E/209 project an improvement plan has been developed with the aim to increase the density of rabbits in concrete zones in each area which presents less abundance, and thus maximising capacity for the future. With this in mind execution has begun of the "improvement plan for the habitat in the areas of reintroduction of the Iberian lynx in Andalusia" in which a series of actions such as spot clearings, the implementation of sowing and improving grazing, or the reduction of cattle pressure are included. This improvement plan also includes the area of Guarrizas as in the present project preparation of this area is included. The abundance of rabbits and then habitat structure in the zone of Guadalquivir has such positive values that failure to realise this improvement would not hamper the reintroduction of the lynx in the zone, but once completed it is hoped that capacity will have increased over and above current values.

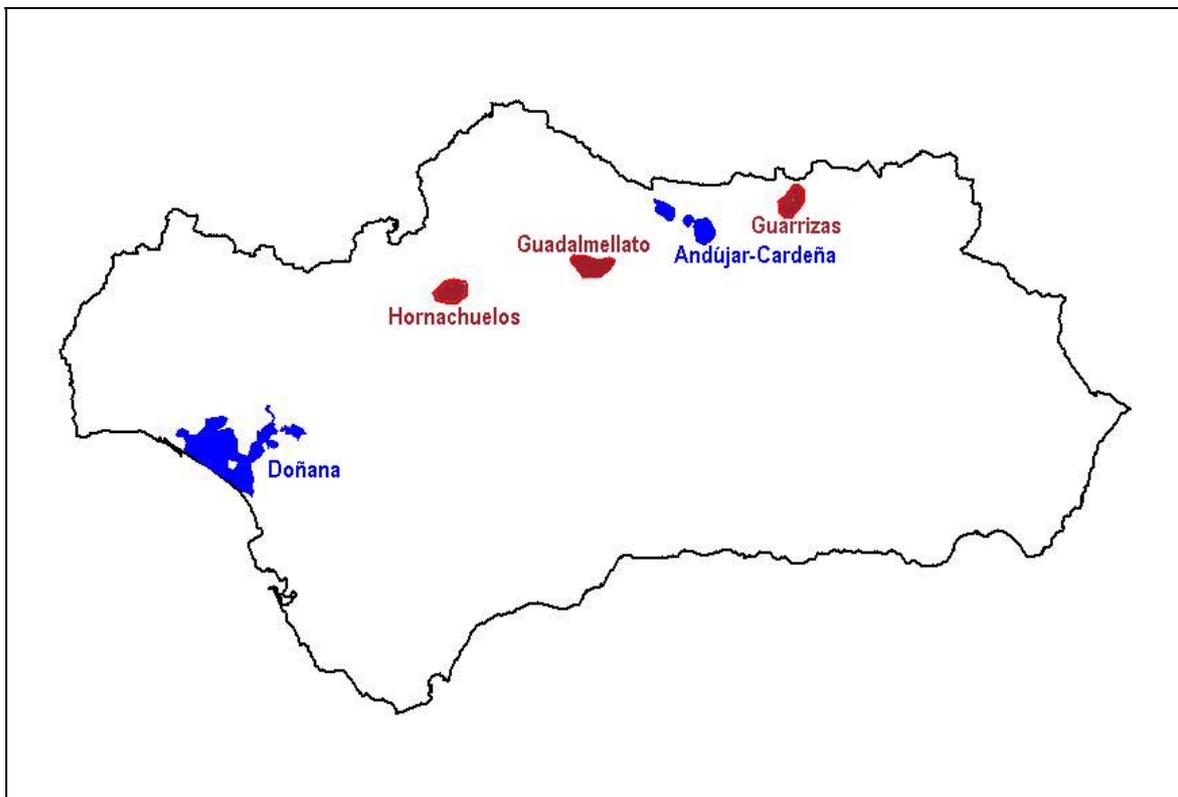


Figure 2. Schematic representation of the three areas pre-selected for the Iberian lynx reintroduction in Andalusia (in red). Current distribution range is represented in blue.

Increase the resources abundance: The areas de Guadalmellato and Guarrizas manifest adequate levels of rabbit population for the presence and reproduction of the Iberian lynx, these being higher in some zones even than in the zones presently inhabited by the species. Even so, all the actions included above in C.1 are focused on increasing the rabbit population. In the improvement plan, moreover, other actions to be executed are included such as the renting out of the rights to small game hunting in some zones, with the aim of increasing even more the abundance of resources in the zone.

Selection and preparation of specimens

Origin of the specimens: The use of wild specimens in the reintroduction of carnivores has shown to give better results than the use of individuals born in captivity (Jule et al. 2008). Thus, depending on the possibility of extraction of the species from its two subpopulations, it would be convenient to transfer wild animals as a first option, especially in the first releases (as once the first animals are settled, conspecific attraction is expected to be an important factor in the settling in of posterior releases, as has happened with other lynx species). In successive years the releases would include animals from the breeding programme in captivity, once sufficient adaptation experience of those released and taking into account genetic aspects, with the aim of creating a founding nucleus with the greatest diversity possible. Extractions of individuals from a wild population, especially from one of a critically endangered species, have intrinsic risks which should be carefully evaluated in order not to jeopardize the actual population. As the basis for evaluating these risks on the Iberian lynx populations, an evaluation of the effect of the extraction of specimens from the wild Iberian lynx populations for potential reintroductions was performed by 2001-2002, which results showed that the risk of extracting up to four cubs (two of each subpopulation) per year could be assumed reasonably (Palomares et al. 2002). This study has been followed for six years in the extractions of individuals made for the captive breeding program. Between 2002 and 2008, 36 Iberian lynxes have been extracted from the field (4 juveniles per year plus 12 individuals extracted for other reasons), and both subpopulations seem not to have suffered any negative effect because of that. Given that

2008 was the last year of extractions for the captive breeding program, these extractions can be continued for reintroductions 2009 on. That study, however, lacked data of Sierra Morena subpopulation, and conservative Doñana data were used for both subpopulations. Given that a good knowledge of the status of Sierra Morena subpopulation has been reached nowadays, a new PVA analysis is to be performed to re-evaluate the effect of the extractions. Current demography data on the Sierra Morena Iberian lynx population are much positive than expected in 2001 (and the population has been growing since that), so this study will probably much increase that value of four individuals per year. The population in Sierra Morena is apparently a suitable donor source of specimens for reintroduction. Firstly, the effect of the extractions (almost 6 individuals per year) seems not to have had any incidence on the Sierra Morena population increasing rate. Moreover, accumulated data during the last five years suggests that the population is regulated by the carrying capacity (estimated by the inter-annual availability of rabbit) and manifests indices of saturation (regulation density-dependent on reproduction, frequent aggressions, sedimentation of youngsters in suboptimal periphery areas). The population seems to have reached the carrying capacity by 2008. This situation is a consequence of the high survival levels of territorial specimens, thus, the reproductive success observed originates inter-annually an apparently surplus fraction, with the whole of the metapopulation area acting as a source area. Added to this, is a sanitary risk which comes with having the best population of Iberian lynx confined in a small space and with a high density, as the effects of an infectious epidemic could be devastating. Under this scenario, extraction of lynx individuals from Sierra Morena is going to be continued as in previous years, but the destiny of the animals will be the reintroduction. On the other hand, Doñana subpopulation has remained stable during the last decade, as well as it has suffered a dramatic decrease inside the National Park, so this population has been currently discarded as a donor until the results of this new study come out. When the new PVA is performed, a re-evaluation of the potentiality of the donor subpopulations will be carried out: the possibility of increasing the number of extractions from Sierra Morena and

of beginning the extractions from Doñana will be considered. The use of captive born individuals will permit at all times the re-adaptation of the genetic plan of the population attending to any losses that are produced.

Preparation of the specimens: Specimens from natural environments will be released via a system of soft releases, after realising protocolary quarantine. Specimens from the breeding programme in captivity should receive preparation in semi-free conditions and will only be released once their ability to survive in the natural environment is demonstrated (predatory abilities, resource search). Lynx born in captivity that are to be selected for reintroduction programmes can be identified according to genetic criteria – even before their birth and, from the first moment, they will receive a type of handling which includes minimum interaction with humans and fosters natural conditions. The age of transfer will depend on different factors, although it is recommended that the younger the better as they will have better abilities to adapt to the new environment and developed immune defences to face the dangers in the natural environment. Before transferring to the pre-release cages, lynx born in captivity will undergo a sanitary examination to ensure their good health. The time these specimens are in the pre-release cages will depend on various factors including the age of the animal (never before it is able to hunt and defend itself) and its behaviour. The infrastructures for the pre-release of animals born in captivity will be the same as those transported from their natural environment. In the medium to long term (2010 onwards) it is expected that the breeding programme will provide some 20-40 lynx per year for reintroduction programmes. The planning of the release method should include an increase in the number of fenced areas, and a decrease in their size. A large part of the design of future releases will depend on the lessons learned from the first ones. Depending on this information a comparative study could also be planned on the differences between hard release and soft release for individuals from the wild.

Execution of the reintroduction

For the elaboration of the release methodology, meetings were held with the

members of the LIFE team, with KORA, Iberian Lynx *Ex-situ* Breeding program.

Infrastructures for release: Each release unit will consist of three installations of soft release of between 4 and 6 Ha forming a 3km- sided triangle (half the average distance between Iberian lynx territories in Sierra Morena). Each installation will consist of a minimum of 40% dense scrub and at least 20% grassland. (The installations will have a minimum of 3 structures which can be used as a shelter (tree stumps, large shrubs, rocky shelters or artificial shelters), likewise two supplementary feeding stations and a water point. The installations should provide an abundance of rabbits. Because of its abundance of rabbits and good habitat structure, the first release unit will be in the estates of El Cotillo and Nava Llanas, according to the plan and whose precise location will be determined in the field.

Release procedure: A soft release method will be carried out. The annual release units will release three pairs (male and female) simultaneously per year, until the re-evaluation of the new PVA is performed. To do it, three enclosures for acclimatisation (1 pair per enclosure) will be used. Two of the pairs will be sexually mature specimens (extracted from the field when they are still not territorial) and the third will not. According to the selection study, in the framework of the current Life Project (2006/2011) releases will begin in the area of Guadalmellato and will continue with Guarrizas area as soon as possible. The intention is to set up one release unit in 2009, with the precise analysis of the results of this first release the successive releases will be planned. Two of the installations will house the reproductive pairs of Iberian lynx which will have to be introduced at least in December (one month in advance of mate season), although preferably it will be done during the autumn. The third installation will house 2 youngsters (regarding the description the two release scenarios the more conservative option was chosen, that of two juveniles of the opposite sex), which will be introduced at any moment of the year and will be liberated after two months, sufficient time, a priori, to adapt to the release site and recognition of the presence of adult lynx in enclosures. The installations for breeding will house the pair for two weeks before the birth, in which moment the male will be removed to the exterior to prevent its presence in a small

area at the moment of birth and will enable the female to move freely. Thus it is hoped that the female will serve as an element of fixation for the male and will prevent negative interaction with the cubs. The installation will be opened five weeks after the birth, sufficient time for the cubs to grow enough to avoid a critical period of fighting.

Objetives:

a) Short term: (1) 1st year, begin liberation in 2009 in Guadalmellato, (2) 2nd year, achieve stabilisation of released lynx, and (3) 3rd -4th years: begin releases in Guarrizas.

b) Medium term: (1) Achieve 15 established territorial females, (2) reach maximum genetic variability, and (3) begin releases in Hornachuelos.

c) Long term: (1) Achieve carrying capacity for 30 territorial females in Guadalmellato and Guarrizas, and (2) 15 established territorial females in Hornachuelos.

Previous information on the demographic evolution of the species: **The case of the River Yeguas nucleus.** The River Yeguas Valley nucleus of population has experienced a recuperation process between 2003- 2008, which could serve as an example to apply in areas of reintroduction for the design of a potential scenario. This nucleus has been continuously monitored by means of photo-trapping since 2003. The location of the cameras, linked to the rabbit sources (supplementary feeding stations, rabbit release enclosures, areas with high rabbit densities, etc), has allowed monitoring almost the 100% of the individuals living there along the years. All individuals in the nucleus are thus individually known, and familiar relationships were well known (maternal relationships were unambiguously known, whereas paternal were supposed according to male-female contact during mating season). This nucleus, with an average survival of territorial females of 79.9% (based in recaptures between years as an inter-annual mean value of survival rate), has increased in four years as described in the figure below. The increase came about exclusively due to the local production of cubs and was associated with an increment in the carrying capacity (probably thanks to the recuperation programme), since rabbit

population increased x3 during that period. Moreover, an important supplementary feeding program is being carried out since 2003. The dynamics of the recuperation can fit a linear or a quadratic function (see figure 3).

Application of the available information to the design of two possible scenarios

Objective: To liberate Iberian lynxes until achieving the settlement of 15 territorial females in Guadalmellato and Guarrizas, equivalent to half the carrying capacity. Once 15 territorial females occur, detain releases unless from a genetic point of view it is

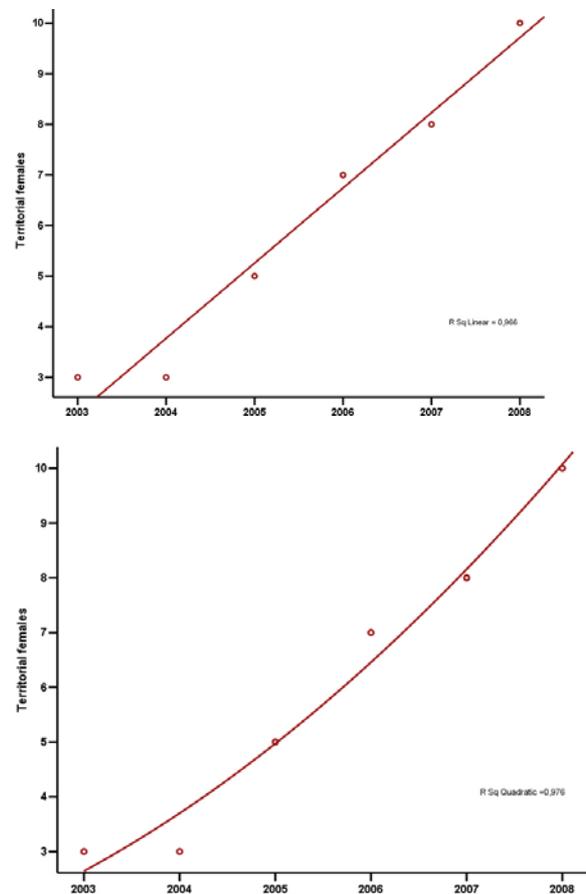


Figure 3. Linear and quadratic adjustment of the increasing trend in territorial female Iberian lynxes living in the River Yeguas Valley population nucleus

necessary to add new individuals. The justification of this objective is that it is estimated that a sufficient number of territorial females to enable natural growth and to reach capacity limit (without taking into account genetic management, which will

depend on the results of the genetic monitoring of the reintroduced population).

Scenarios of acclimatisation of specimens

- Scenario A: Survival rate and settlement of founding specimens similar to that obtained in the River Yeguas area: 79.9%.

- Scenario B: Survival rate and settlement in founding specimens 50%.

In both scenarios it is considered that the acquisition of 6 territorial females can suppose a starting point for the beginning of a population nucleus. It is considered that 6 is a prudent number since it is double the number of territorial females which began the Yeguas nucleus.

Release plan

Scenario A: Liberation of three pairs per year in the first two years, one pair per year during the following two years (these last two to compensate for fortuitous losses) and the necessary specimens to complete the genetic management. The objective of 6 founding territorial females will be reached in 2 years as settlement is expected from the first year of liberation. Also, according to the exponential growth model observed in Yeguas, once 6 territorial females have been acquired three

more years will be needed to achieve the objective of 15 territorial females.

Scenario B: Liberation of three pairs per year during the first four years, one pair per year during the following four years (these last four are to compensate for fortuitous losses) and the necessary specimens to complement the genetic management).

The objective of 6 territorial females will be achieved in 4 years (survival rate and settlement of 50%). Also, once the 6 territorial females are acquired, according to the exponential growth model observed in Yeguas, 3 more years will be needed to reach the objective of 15 territorial females. In any case, the evolution of the liberated specimens in the first two years will define the type of real scenario and subsequent provision of releases.

Spatio-temporal planning

Short to medium term: see table 1.

Long term: On the basis of the success obtained in the two selected areas in the present programme, between years 5 and 9 programmes of reintroduction could be initiated in other suitable areas in Andalusia; in particular in the southern sector of Sierra de

YEAR	GUADALMELLATO		GUARRIZAS	
	Num. Pairs		Num Pairs	
	Scenario A	Scenario B	Scenario A	Scenario B
1	3	3	-	-
2	3	3	3	3
3	1	3	3	3
4	1	3	1	3
5	Genetic management	1	1	1
6	Genetic management	1	Genetic management	1
7	Genetic management	1	Genetic management	1
8	Genetic management	1	Genetic management	1
9	Genetic management	Genetic management	Genetic management	Genetic management
...	Genetic management	Genetic management	Genetic management	Genetic management

Table 1. Short to medium goals of the Iberian lynx reintroduction program.

Hornachuelos and in the rest of the areas with a potentially apt habitat, according to the model realised with the LIFENAT 02/E/8609 project, but were rejected due to the fact that rabbit density was inferior to the selected areas, social surveys and improvement programmes would be needed until the

necessary requisites were achieved to be included as an area apt for releases.

Monitoring

Sanitary monitoring: Sanitary monitoring will be carried out both on the reintroduced lynx population and on the associated fauna which represents a sanitary risk for the lynx. The

sanitary monitoring consists of a programme of pre-release surveillance, a continuous programme of observation of risk agents and a follow up of post release of the liberated animals.

Lynx population monitoring: The monitoring of the lynx population will be carried out according to the habitual protocol of work on the LIFE project. The methods used will be photo-trap, radio tracking and tracking by indirect means. All liberated specimens will be radio tagged with GPS emitters, and during at least one week after release in the natural environment, will be subjected to 24 hour intense surveillance.

Rabbit population monitoring: The monitoring of the wild rabbit population will be carried out according to the habitual protocol set out in the LIFE project.

Public awareness

In order to carry out the correct dissemination of the reintroduction strategy of the Iberian lynx, on the one hand a sociological study was carried out by the Instituto de Estudios Sociales Avanzados (IESA-CSIC) for the selection of the best areas of reintroduction and on the other a specific communication programme for the reintroduction zones. The sociological study made highlighted the positive acceptance of the local stakeholders with regard to the Iberian lynx reintroduction programme, likewise it gave an insight into some of the weak points which could be considered among some more sensitive sectors as in the case of the hunting sector. This will help for later work on sensitisation which will be carried out. On the other hand we have a specific programme of communication which forms part of a larger plan which spans the whole communications strategy for the reintroduction and

conservation project of the Iberian lynx in Andalusia. Organised in two large blocks: (1) Communication of the reintroduction process to areas outside the reintroduction zones and (2) communication of the reintroduction process inside the reintroduction zone, a necessary tool which will help to communicate this process in an ordered and more efficient way.

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