

# Conservation Action Plan for the Iberian Lynx in Portugal

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Ministério das Cidades,  
Ordenamento do Território e  
Ambiente

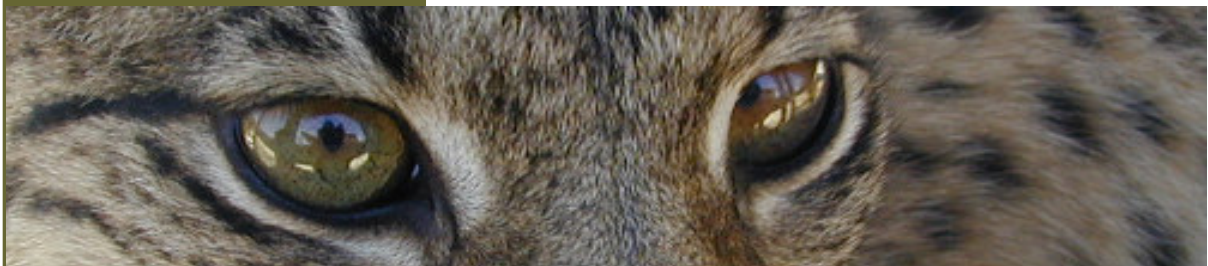
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## **EXECUTIVE SUMMARY**

### **Purpose of this document**

The Iberian lynx Conservation Action Plan was developed in order to provide a consistent and effective approach to preserve the species in Portuguese territory.

Presently, the Iberian lynx is critically endangered, in a pre-extinction stage, and only the application of effective conservation measures can prevent its disappearance. In the global context of the factors that may affect lynx survival, the lack of official documents that regulate the species conservation could allow for the increment of the effects of regression factors and delay the conservation decision making process.

This document, which is supported by the resolution n. ° 152/2001, of October 11th, of the Ministries Council, was developed in order to be used as a tool for the organization of the recovery process for the Iberian lynx.

### **Guiding Principles**

This proposal provides guidance on future options, provides management consistency, and offers necessary flexibility in order to achieve the maximum goal of conserving the lynx in Portugal. The plan relies in four guiding principles:

:

1. Use the best scientific information available on Iberian lynx. We used scientific information from previous research throughout the range of the species, recognizing that major differences exist, both in behaviour and ecology, between the Doñana area (the best studied population) and the rest of the lynx range;
2. Act in a conservative way in terms of habitat alterations. A conservative approach is the best way to conserve the lynx historical range in order to maintain potentiality for future reintroduction.
3. Consider the habitat requirements of other wildlife species. An action plan that integrates recommendations for other endangered species is more likely to be successfully implemented.
4. Develop a useful, proactive action plan to conserve the lynx in its historical range, articulated with the Spanish Lynx Conservation Strategy. The conservation actions proposed in this plan will focus on suitable areas for lynx or in areas that can be successfully improved for future reintroduction, independently of their conservation status. Actions will be taken on breeding and dispersal habitats and will be mainly focused in the Portuguese-Spanish border. Therefore the collaboration with Spanish authorities will be a key factor for the success of this plan.

### **Document Organization**

Part I of the document provides an assessment of lynx status and threat factors. An overview of lynx ecology is presented first, followed by an identification and description of risk factors.

Part II contains recommended conservation measures that address each of the risk factors.

## **1. INTRODUCTION**

### **1.1 Action Plan objectives**

The Iberian lynx (*Lynx pardinus*) Action Plan was developed in order to provide a consistent, realistic and effective approach to conserve the species in Portuguese territory

This plan presents effective conservation actions, for a time interval of five years, in areas such as species protection, habitat protection and improvement, rabbit (*Oryctolagus cuniculus*) recovery, lynx captive breeding and reintroduction. For the application of these actions it is necessary to create a base-line strategy based on international collaboration, sustainable legal support, applied scientific research, long term financial support and local population awareness.

### **1.2 Documents that support the Action Plan**

The elaboration of the Lynx Action Plan was started in 1997, in a time where the species status was already critical in the country. During the last decade several documents that support this plan were produced, regarding the species conservation and, in a wide base, Nature Conservation:

1- **Directive n.º 92/43/CEE, of 21 of May**, transported to Portuguese legislation by the Governmental decree n.º 140/99 of 24 of April – This document was created for the conservation of European natural habitats and wild fauna and flora (Habitats Directive). The main objective of this diploma is the conservation of European biodiversity through the creation of natural areas of community interests, named as special protection zones. The Iberian lynx is listed in the Annex II of this directive which immediately implicates the creation of SPZ for its' conservation. The species is also listed in the Annex IV, being considering a priority species that should be submitted to rigorous conservation measures. The Action Plan implementation is supported by the Article n.º 6 of the Directive, which establishes the commitment of member states in applying the necessary conservation actions and legal measures for the conservation of Annex II species;

2- **Recommendations nº19 (1991) and n.º 82 (2000) of the European Council**. These recommendations include a list of measures that should be applied by Portugal and Spain, focusing on habitat protection and the elimination of non-natural causes of mortality. According to these recommendations, Portugal is obliged, every four years, to inform the Committee on the application of these recommendations;

3- **Recommendations/conclusion of the meeting “Population and Habitat Viability Analysis for the Iberian lynx” – Cabañeros, Spain, February 1998**. During this meeting several work groups were created, including habitat management, rabbit recovery, mortality, population viability, research, captive breeding and legal aspects. Several conservation problems were established and possible solutions sought. This plan integrates a substantial amount of the proposed actions;

4- **European Action Plan for the conservation of the Iberian lynx – 1999**. Financially supported by WWF with Portuguese collaboration. Summarises the species situation and points out conservation measures for the lynx recovery;

5- **Spanish strategy for Iberian lynx conservation** – Approved in Spain in February 1999, as a result of the application of Spanish conservation law for endangered species;

6- **Iberian lynx captive breeding plan**– Approved in June 2001 by the Comisión Nacional de Protección de la Naturaleza (Ministério del Medio Ambiente) this document intends to initiate a captive breeding programme for the species and establish a genomic resource bank, in order to counterbalance the species extinction in the wild, acting as a species “insurance”. Portugal officially assumed the responsibility of financially supporting several aspects of the plan and the construction of a breeding centre in the country.

7- **Ministries council resolution nº152/2001 of 11 of October** – Defines the application of a national strategy for nature conservation and biodiversity by the establishment of ten strategic options in order to achieve the proposed objective. Strategic option n.º 5 is directed to the development, in all national territory, of specific conservation actions, based on the application of the following actions directives:

- a) To adopt, till January 2002, of a global ICN plan that includes a programme of action plans of priority species of fauna and flora;
- b) To promote ex-situ conservation actions and genomic banks for endangered species;

**8- Conclusions of the Iberian lynx international seminar (Andújar 29-31 of October 2002)** – The conclusion n.º 11 refers to the urgent need of the approval and application of the Portuguese Action Plan for Iberian lynx conservation.

### **1.3 Document updating**

This document should be reviewed and adjusted to reflect new information. We propose that an interagency review should be conducted every five years.

## **2. BASE LINE STATUS**

The baseline status which led to the development of this Action Plan:

1. A critical situation for the species, with a global effective of approximately 150 individuals, dispersed by two confirmed populations (Doñana e Andújar-Cardena), both located in Andalusia;
2. A pre-extinction situation in Portugal;
3. Previous experiences
  - 3.1 – Implementation of Serra da Malcata Nature Reserve in 1981, with the purpose of conserving the local Iberian lynx population;
  - 3.2 – Life Project “Conservation of the Iberian lynx in Portugal” (1994-1998);
  - 3.3 – Life Project “Recovery of habitat and prey of Iberian lynx in Serra da Malcata” (1999-2003);
- 4 Basic scientific information on the species ecology and biology, as a result of several reports and publications;
- 5 A captive breeding centre in Doñana National Park;
- 6 Iberian lynx captive breeding plan and the establishment of a captive breeding team;
- 7 Portuguese participation on the Spanish Iberian lynx work group and in the captive breeding team;
- 8 Six captive lynxes (2mm;4ff) in El Acebuche reproduction centre (Doñana National Park- Spain);
- 9 Ratification, by the Spanish central government and the Andalusia Junta, of the protocol for capturing founders for the breeding programme (June 2003);
- 10 A protection figure for important areas for lynx conservation, throughout the creation of the Natura 2000 network;
- 11 Progressive habitat destruction and prey reduction;

In summary:

- 1- Exists a general conscience that an urgent conservation effort should be conducted, in a coordinated and interagency way;
- 2- There is a considerable knowledge on the conservation measures that should be applied;
- 3- It is necessary to apply a Conservation Action Plan that would allow lynx reoccupation of its historical range.

### **3. OVERVIEW ON IBERIAN LYNX ECOLOGY**

The Iberian lynx is an independent taxonomic identity, at the species level, being considered a distinct species from the Eurasian lynx (*Lynx lynx*). This fact is supported by morphological, paleontological, genetic and phylogenetic data.

#### **3.1 Biological characteristics**

Oestrus period: January-July with a peak in January-February.  
Gestation: About two months.  
Births period: Mostly in March-April;  
Litter size: two to four cubs, more frequently three;  
Cub mortality: usually only two cubs per litter survive;  
Age of trophic independence: 7 to ten months;  
Dispersion: at the age of 8 to 23 months. Maximum dispersion 42 km;  
Age of first reproduction: females can reproduce at the age of two years;  
Reproduction levels: average 0.8 layers/female/year.

#### **3.2 Habitat**

An average home range of the adult lynx has ideal 40% cover of understorey vegetation and should have the presence of isolated trees (Palomares, 2001). Rabbits should also be abundant, with densities of a minimum 4.6 rabbits per hectare in spring (lynx reproduction season) and about 1.0 rabbits per hectare in autumn.

According to Palomares et al. (1999) several habitat types are suitable for lynx dispersion, namely: 1) Mediterranean scrubland, 2) eucalyptus plantations and 3) pine plantations. Other sorts of habitat such as open areas with no vegetation, crop fields or olive trees landscapes, could constitute a barrier depending on its extension. However in this last case, it was possible to verify that areas with extensions less than 5 km, between suitable patches could be used by lynxes, and, in one case, an animal crossed a theoretical barrier with, approximately 16 km of extension. Based on this information Palomares et al. (1999) gave the following definition for a lynx dispersing habitat:

- 1- Areas covered by Mediterranean scrubland or by industrial plantations are suitable for lynx dispersion;
- 2- Areas of open habitat of less than 5 km of extension, between suitable areas, could be used for dispersion;
- 3- Areas between 5 to 16 km of extension, could be crossed, although with difficulty and potential risks;
- 4- Areas with more than 16 km of extension are considered impenetrable barriers.

#### **3.3 Food habits**

Among available prey, Iberian lynx strongly select, and depend upon, European rabbits (*Oryctolagus cuniculus*), i.e. they are feeding specialists. Rabbits consistently account for 80-100% of the consumed biomass in the lynx diet. Such a high percentage varies little regardless geographical, seasonal and annual variations. The energetic daily needs of one adult individual have been estimated as 600-1000 kcal, which is very close to the amount of energy one adult rabbit contains. One breeding female with two kittens may need up to three rabbits per day. All these calculations lead to the tentative estimate of 1 rabbit/ha as the minimum rabbit density that might allow lynx breeding.

#### **3.4 Home-ranges and territories**

As many other cat species, lynx maintain a solitary way of life. Adults defend their home ranges as territories against intruders of the same sex, especially in areas where rabbits are scarce. Male territories encompass one or more female territories. Females only breed when they hold a territory. Habitat quality, especially the rabbit abundance component, influences mean home range size, the social system and, as a result, lynx density. In the best known habitats of northern Doñana, lynx density is as high as 0.8 adults/km<sup>2</sup>, whereas in other parts of this area with only moderate rabbit densities, it ranges between 0.1 and 0.2 adults/km<sup>2</sup>. The estimated absolute density across most of the lynx range fluctuates around 0.08 adults/km<sup>2</sup>.



#### 4. THREAT FACTORS

An extensive literature revision on Iberian lynx risk factors (Ferrerias, 1991; Oreja, 1998; Ceia et al., 1998; Delibes et al., 2000; Ferrerias et al., 2001) allowed us to synthesise them in Table 1. These factors include programmes, actions and activities that can directly influence lynx and its habitat.

*Table 1 – Iberian lynx risk factors*

<b>I. Factors that affect lynx productivity</b> <ul style="list-style-type: none"><li>a) Conversion of Mediterranean scrubland in intensive forested areas</li><li>b) Conversion of Mediterranean scrubland in intensive agriculture areas</li><li>c) Rabbit regression</li><li>d) Infertility</li></ul>
<b>II. Factors that affect lynx mortality</b> <ul style="list-style-type: none"><li>a) Predator control actions</li><li>b) Illegal use of traps and snares</li><li>c) Shooting during hunting practices</li><li>d) Road kills</li><li>e) Diseases</li></ul>
<b>III. Factors that affect lynx movement</b> <ul style="list-style-type: none"><li>a) Landscape fragmentation</li><li>b) Roads and other infrastructures</li></ul>

## 5. PAST AND CURRENT SITUATION IN DISTINCT NUCLEI

### 5.1 Malcata-Tejo-Nisa-S.Mamede (Central western mountains)

#### 5.1.1. Malcata

Malcata has been pointed out as a lynx occurrence area since the 19th century (Lopes, 1899). The 1998 census (Ceia *et al.*, 1998) classified this territory with high importance for lynx conservation, being estimated a Portuguese sub-population of 7 to 9 animals, which occupied approximately 450 km<sup>2</sup> (medium density of 1,8 lynxes/100 km<sup>2</sup>). According to Delibes *et al.* (2000) this sub-population was integrated in the Gata-Malcata-San Pedro-S. Mamede meta-population, composed by 75 to 95 individuals distributed throughout 2 050 km<sup>2</sup> (Annex 1). Bessa-Gomes (2000), in her viability analysis of lynx Portuguese populations, stated that, although Malcata had low lynx effectives, this population could persist as a sink of nearest Spanish nucleus, even considering the most pessimists scenarios.

Despite the relative optimistically perspective pointed above, several studies, conducted since the mid-1990s, described an incompatible situation with the previous described data (Sarmento & Cruz, 1998; Eira, 1999; Sarmento *et al.*, 2001). The species is not detected, with reliable methods, since 1997 and in Spain the most recent data describes a possible extinction of historical lynx nucleus of Sierra da Gata and Hurdes (Guzmán *et al.*, 2002) (Annex 1).

#### 5.1.2 Tejo-Erges

The southern part of this territory (Tejo, Ponsul and Erges rivers), was defined by Ceia *et al.* (1998) as a probable ecological corridor between the populations of S. Pedro-S. Mamede and Gata-Malca. This conclusion was supported by the report of three lynx sightings, between 1987 and 1993, that, according to the authors, could signified dispersion between the nuclei of Cilleros-Malcata or Cedillo-Malcata

The lynx nucleus of Cedillo and Cilleros, classified with regular presence by Rodriguez & Delibes (1990), is probably extinct (Guzmán *et al.*, 2002). Although in recent years a considerably high camera-trapping effort was conducted in these areas, no lynx detections were achieved (Guzmán *et al.*, 2002) (Annex 1).

Considering the historical importance of the Malcata nucleus for lynx conservation in the country, this area was submitted, during recent years (Sarmento *et al.*, 2004), to an intensive surveying effort. A significant sample of potential lynx scats was submitted to DNA analyses and camera-trapping efforts applied gave to the authors a 95% probability of detecting, at least, one resident animal. Although the negative results can not entirely support the conclusion of the species extinction an extremely negative perspective is pointed out.

#### 5.1.3 Nisa

Previous studies classified the Nisa geographic area with lynx regular presence (Ceia *et al.*, 1998), being calculated a population nucleus of 3-4 adult individuals, distributed throughout 200 km<sup>2</sup> (medium density – 1.75 lynxes/100 km<sup>2</sup>) (Annex 1). The study referred above also pointed out the possibility of a recent lynx recolonization, in this area, carried out by dispersing individuals. This conclusion was supported by a lack of observational data since 1957 to 1970.

During recent surveys (Sarmento *et al.*, 2004), lynx presence was not detected and it was possible to verify low habitat suitability patterns for the species. Mediterranean scrubland areas are scarce and fragmented, and rabbit is probably absent from 40% of the area, and, when present, estimated density is extremely low (<0.5 rabbits/hectare).

In the nearby Spanish lynx historical range (Cedillo), a similar situation was verified by Guzmán *et al.* (2002). Rabbit was absent from 42% of the territory, and in 33% was present in low density. Guzmán *et al.* (2002) conducted in this area a camera trapping effort of 978 camera-days and no lynx photographs were taken.

#### **5.1.4 S. Mamede**

S. Mamede mountains, located south from Nisa, were referred by Ceia *et al.* (1998) has an area of undetermined status for lynx (Annex 1). Sarmiento *et al.* (2004), after a total searching effort of 170 man-hours, did not collect any lynx positive scat and, as in Nisa, it was found an unsuitable landscape for this feline.

Recent abundant reports of lynxes from the Campo Maior Special Protection Zone (ZPE) are highly likely to be erroneous, since the small amount of Mediterranean scrubland habitat present is too scarce, fragmented and surrounded by intensive agricultural cover.

Serra de Ossa, a 45 km<sup>2</sup> Mediterranean scrubland area, located South-west from S. Mamede, suffered, according to Ceia *et al.* (1998) a lynx recolonization process, by vagrants from Nisa and Adiça. However, probably due to low rabbit density, it was and impossible to obtain any lynx data during the more recent surveys (Sarmiento *et al.* 2004), and evidences suggested that it is even possible the absence of the species.

#### **5.1.5 Metapopulation Gata-Malcata-S.Pedro-S.Mamede**

When Delibes *et al.* (2000) defined the meta-population of Gata-Malcata-S. Pedro-S. Mamede, they estimated the total amount of Iberian lynx habitat at 2050 km<sup>2</sup> with a population of 75-95 individuals (assuming a mean density of 1 animal per 21-27 km<sup>2</sup>).

Considering that there are fewer prey resources compared with the past, which causes lynxes to wander in larger range in search of food, coupled with low numbers of lynxes, it can lead to the disappearance of evidences. With the human disturbances, fragmented habitats and low prey density, lynxes could no longer keep their relatively stable territories and reproduction could be compromised and local extinction could be an hypothesis. For this meta-population, there are no reliable evidences in the last five years (Table 2).

### **5.2 Guadiana Valley**

Ceia *et al.* (1998) estimated the total population at about 4-7 lynxes within an occupied range of some 270 km<sup>2</sup> (based on an average of one cat per 67 km<sup>2</sup>). Their range map shows a highly fragmented range including the Contenda-Barrancos nucleus (irregular presence), the Adiça nucleus (regular presence) and two areas of undetermined status: Alcarreche-Guadelim and International Chança.

#### **5.2.1 Contenda-Barrancos**

According to Palma (1980), Iberian lynxes once occupied most of the large Mediterranean scrubland ranges on the Contenda-Barrancos border, and presently there are evidences that support this statement, particularly the presence of a significant amount of pelts and stuffed animals. More recently, Ceia *et al.* (1998) estimated an extirpated population of 2 to 3 animals, occupying an area of 170 km<sup>2</sup> (Annex 1).

Table 2: Comparison between past and present situation of Iberian lynx in the Central western mountains

<b>Population</b>	<b>Past situation (# lynxes . occupied area)</b>	<b>Present situation</b>
<b>Portugal [ ; SpainE</b>	<b>Ceia <i>et al.</i>(1998) [ ; Rodríguez &amp; Delibes (1990)/Delibes <i>et al.</i>(2000) E</b>	<b>Sarmiento <i>et al.</i> (2004) 6; Guzmán <i>et al.</i> (2002) 4</b>
Malcata [	7-9 (450 km <sup>2</sup> ) [	Not detected 6
Gata-Cilleros E	24-39 (760 km <sup>2</sup> ) E	Not detected 4
Tejo-Erges [	1? (130 km <sup>2</sup> ) [	Not detected 6
Nisa [	3-4 (200 km <sup>2</sup> ) [	Not detected 6
Cedillo E	5-7 (100 km <sup>2</sup> ) E	Not detected 4
S. Mamede [	1 (185 km <sup>2</sup> ) [	Not detected 6
San Pedro E	34 (410 km <sup>2</sup> ) E	Not detected 4
<b>Total</b>	<b>75-95 (2050 km<sup>2</sup>) E</b>	<b>Not detected</b>

### 5.2.1 Adiça

This area, contiguous to Contenda-Barrancos, presents, currently, high habitat suitability for lynx, particularly high rabbit density that could allow lynx reproduction. Ceia *et al.* (1998) judged there were about 2-3 lynxes in the 100 km<sup>2</sup> of suitable habitat in Adiça (Figures 1 and 13) and a lynx positive scat was found in this area in late 2001 (Santos-Reis, 2003).

Although, during recent surveys (Sarmiento *et al.*, 2004) this area was intensively prospected and camera-trapped, with no positive results, a few cats may persist in the Spanish bordering area of Rosal de la Frontera and transients could be occasionally present in Adiça.

### 5.2.2 Mértola

Although, this large Mediterranean scrubland territory was not included as a lynx area in previous surveys (Ceia *et al.*, 1998), Sarmiento *et al.* (2004) estimated a potential Iberian lynx range that totals as much as 10 78 km<sup>2</sup>. The GIS-generated estimate provided an high probability of the existence of a viable lynx population in this area. That was one of the reasons for targeting most of our surveying effort to this territory..

According to the study of Palomares *et al.* (1999) there is a significant connectivity between the Portuguese-Andaluzian border and Doñana, although a few problematic barriers may occur, particularly the Huelva-Sevilla highway and the Tinto river.

Palomares *et al.* (1999) stated that several habitat types are suitable for lynx dispersion, namely: 1) Mediterranean scrubland, 2) eucalyptus plantations and 3) pine tree plantations. Other sorts of habitat such as open areas with no vegetation, crop fields or olive trees landscapes, could constitute a barrier depending on its extension. However, in this last case, it was possible to verify that areas with

extensions less than 5 km, between suitable patches could be used by lynxes, and, in one case, an animal crossed a theoretical barrier with, approximately 16 km of extension. Based on this information Palomares *et al.* (1999) gave the following definition for a lynx dispersing habitat:

1. Areas covered by Mediterranean scrubland or by industrial plantations are suitable for lynx dispersion;
2. Areas of open habitat of less than 5 km of extension, between suitable areas, could be used for dispersion;
3. Areas between 5 to 16 km of extension, could be crossed, although with difficulty and potential risks;
4. Areas with more than 16 km of extension are considered impenetrable barriers.

In yearly 2003, a dispersing female was run over by a car after crossing the barriers of the Huelva-Seville highway and the Tinto river, at a distance less than 40 km from the border (Pereira & Guzmán, *per. com.*). Analysing this event and the Palomares *et al.*(1999) lynx corridor definition it becomes more likely the hypothesis that the frontier between Portugal and Andalusia could be the only area in the country with the possibility of having lynxes, although local historical populations are in the brink of extinction (Table 3).

**Table 3:** Comparison between past and present situation of Iberian lynx in the Guadiana valley and Eastern Sierra Morena.

<b>Population</b>	<b>Past situation (# lynxes . occupied area)</b>	<b>Present situation</b>
<b>Portugal [ ; SpainE</b>	<b>Ceia <i>et al.</i>(1998) [ ; Rodríguez &amp; Delibes (1990)/Delibes <i>et al.</i>(2000) E</b>	<b>Sarmiento <i>at al.</i> (2004) 6; Guzmán <i>et al.</i> (2002) 4</b>
Adiça [	2-3 (100 km <sup>2</sup> ) [	Not detected <b>6</b>
Aroche-Cumbres Mayores- Rosal <b>E</b>	14 (121 km <sup>2</sup> ) <b>E</b>	Not detected <b>4</b>
Contenda-Barrancos [	2-3 (170 km <sup>2</sup> ) [	Not detected <b>6</b>
Alcarreche-Guadelim [	1? (135 km <sup>2</sup> ) [	Not detected <b>6</b>
Chança Internacional [	? (80 km <sup>2</sup> ) [	Not detected <b>6</b>
Mértola[	Not refered	Not detected <b>6</b>
Andévalo <b>E</b>	21-23 (472 km <sup>2</sup> ) <b>E</b>	Not detected <b>4</b>
<b>Total</b>	<b>40-45 (1078 km<sup>2</sup>) E</b>	<b>Not detected</b>

### 5.3 Algarve-Odemira-Sado Valley

#### 5.3.1 Algarve-Odemira

Ceia *et al.* (1998) estimated the total amount of Iberian lynx habitat in Algarve-Odemira at 935 km<sup>2</sup> with a population of 19 to 23 individuals, divided by three sub-nuclei (Odemira, Monchique and

Caldeirão). Mean density was computed at as much as one animal per 45 km<sup>2</sup>, making this population, potentially at least, the most important in the country with as much as 40% of all Iberian lynx range.

According to Ceia *et al.* (1998) and Palma (1994) lynx reproduced in both regions (Algarve and Odemira), but were isolated, from other populations, at least, from the last 50 years. Palma (1994) referred the sighting of melanic animals as a preliminary evidence of genetic depression, although a recent study on the viability of lynx populations in Portugal (Bessa-Gomes, 2000), stated that this population was viable even in absence of emigration.

Field work, carried out in this area since early 1990-s failed to produce any authentic lynx existence proofs (direct proofs or positive scats) and the most recent survey was not an exception (Sarmiento *et al.*, 2004). In total, from 1994 2865 man-hours and 2954 camera-days were applied and evidences were not obtained. This gives us a strong possibility that past generated estimates provided by Ceia *et al.* (1998) and Palma (1994) were probably extremely optimistical and except from observational data there is virtually no information.

### 5.3.2 Sado Valley

This area was considered in the mid XX th century as an important area for lynx, but in recent decades degenerative process of habitat destruction and prey reduction reduce considerably its importance (Ceia *et al.*, 1998). Ceia *et al.* (1998) judged there were about 6-8 lynxes in 340 km<sup>2</sup> of suitable habitat in the Sado Valley (Santa Susana, Azinheira dos Barros and Comporta). As for the Algarve-Odemira range, no consistent lynx presence proofs were obtained after almost ten years of field work and there is a strong possibility of an absence of the species.

The lynx historical meta-population of Algarve-Odemira-Sado valley, that constituted the western range of the species (Delibes *et al.*, 2000), is presently in a situation that could be in the verge of extinction (Table 4). No reliable data is obtained for at least a decade and rabbit density clearly does not allow reproduction, since it requires good-quality habitats.

**Table 4.** Comparison between past and present situation of Iberian lynx in the Meta-population of Algarve-Odemira-Sado Valley

Population	Past situation (# lynxes . occupied area) Ceia <i>et al.</i> (1998)	Present situation Sarmiento <i>et al.</i> (2004)
Santa Suzana	5-6 (225 km <sup>2</sup> ) [	Not detected 6
	1 (115 km <sup>2</sup> ) E	Not detected 4
Azinheira dos Barros	1? (115 km <sup>2</sup> ) [	Not detected 6
Comporta	5-6 (220 km <sup>2</sup> ) [	Not detected 6
Odemira	10-12 (395 km <sup>2</sup> ) [	Not detected 6
Monchique	4-5 (320 km <sup>2</sup> )	Not detected 6
Caldeirão		
<b>Total</b>	<b>40-45 (1078 km<sup>2</sup>) E</b>	<b>Not detected</b>

### 5.4 Global situation of Iberian lynx in Portugal

Historically distributed<sup>1</sup> through most of Portugal, the Iberian lynx is presently in the verge of extinction (Table 5). Intensive rabbit regression and massive habitat destruction are identified as the main causes of decline in recent decades (Rodriguez & Delibes, 2003).

Since the beginning of the 1990-s, the Iberian lynx is vanishing from the country. In recent years, reliable information is becoming more rare. Since 1994, 278 excrements were submitted to DNA analysis, including 168 from Sarmiento *et al.* (2004), 104 from Pires & Fernandes (2001) and six from Santos-Reis (2003) and it was only possible to obtain positive results from three. Two were collected in Vale-da-Ursa, in March 1997, in Serra da Malcata and the other one was collected in Adiça in late 2001 (Santos-Reis, 2003).

This scarcity of data allied with low habitat adequacy, in most historical lynx range, points to a catastrophic situation of the species in the country. Lynx conservation requires good-quality habitats where animals can settle and breed, and adequate connectivity between these areas, since the species traditionally exhibits a meta-population structure (Ferrerias, 2001; Palomares, 2001). According to Palomares (2001) general characteristics of habitats sustaining reproductive lynx populations should include:

- 1- Isolated trees
- 2- Ideally, 40% cover of understorey vegetation (half of which should be tall shrubs);
- 3- Abundance of rabbits (at least 4.6 rabbits per hectare in the lynx breeding season).

In the Portuguese lynx historical range we can only find significant areas with this sort of environments in the south-eastern part of the country, particularly in the Andalusian border, where we lack on recent evidence of lynx presence.

Although we can not confirm extinction, the scenario is highly pessimistic. No direct evidence is obtained since January 1992, when an adult female was captured for scientific purposes in Serra da Malcata (Castro,1992). This event constitute the last direct contact of scientifics with Iberian lynx in Portugal and marks the acceleration of the species extinction process that increased dramatically in the second half of the 1990-s.

**Table 5:** Comparison between past and present situation of Iberian lynx in Portugal

<b>Population</b>	<b>Past situation (# lynxes . occupied area) Ceia <i>et al.</i>(1998)</b>	<b>Present situation Sarmiento <i>at al.</i> (2004)</b>
Malcata-Tejo	5-6 (225 km <sup>2</sup> ) [	Not detected <b>6</b>
Nisa-S. Mamede	1 (115 km <sup>2</sup> ) <b>E</b>	Not detected <b>4</b>
Vale do Guadiana	1? (115 km <sup>2</sup> ) [	Not detected <b>6</b>
Odemira-Monchique-Vale do Sado	5-6 (220 km <sup>2</sup> ) [	Not detected <b>6</b>
<b>Total</b>	<b>40-45 (1078 km<sup>2</sup>) E</b>	<b>Not detected</b>

<sup>1</sup> Historical distribution can be defined as the area a species occupied at the time of its maximum expansion.

## 6. CONSERVATION ACTIONS

### 6.1 Approach to the development of conservation measures

The following conservation actions are intended to conserve lynx populations in Portugal, and to reduce or eliminate threat factors. Conservation measures have the goal of provide guiding lines for conservations agents in order to conduct actions that can positively affect lynx and/or to help avoid negative impacts through thoughtful planning of activities. It is expected that plans that incorporate these actions and projects that implement them, will lead to the species conservation across its range.

As previously described, there is a considerable lack of knowledge on the dynamics of the process that conducted lynx populations to the present pre-extinction stage and therefore we don't know the potential effects of several actions upon the species. As a result of this fact, most measures described in the plan are based on the available literature and the document updating will be based on the augment of the information resulting from scientific work and population monitoring.

### 6.2 Application level

The proposal of Action Plan will be applied in all the areas located in the lynx historical distribution geographic area<sup>2</sup>, that presented suitable characteristics for the species present or landscape features that can be optimised for lynx survival and that can be relevant for the species life-cycle, independently of their protection status (Annex 2). We include in this definition residence, dispersal and reproduction habitats.

### 6.3 Scales of management

The conservation measures will likely be implemented through three scales of decision-making: home-range level (micro-scale), population level (macro-scale) and ecological corridors, providing broad direction for management activities by establishing goals, objectives and guidelines.

**1- Micro-units for lynx management (MULs):** The micro-units for lynx management are intended to provide the fundamental or smallest scale for evaluation and monitoring of the effects of management actions on lynx habitat.

The MULs should be considered as theoretical home-ranges that should incorporate all the habitat requirements for the Iberian lynx life cycle and should be managed as the species was present even in case of no detection. Therefore, if we choose to apply a reintroduction plan, landscape suitability should be increased or preserved in order to ensure a proper success.

- Guiding lines for establishing MULs<sup>3</sup>
  1. The size of MULs should be of 650-1 000 hectares of suitable continuous *habitat* or superior areas in case of fragmented habitat;
  2. Rabbit density should vary between 1 individual per hectare, during the low density period, and 4.6 rabbits per hectare during the lynx breeding season;
  3. General characteristics of MULs should include isolated trees, approximately 40% of scrubland cover and pasture land areas;

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<sup>2</sup> Includes the historical populations of Malcata, S. Mamede, Vale do Guadiana, Sado and Algarve-Odemira (Delibes *et al.*, 2000)

<sup>3</sup> Conception based on Palomares *et al.* (2001)



4. For each MULs potential lynx habitat should be mapped and reproduction, shelter and hutting areas should be identified;
5. Reproduction habitat should constitute, at least, 10 % of the total area;
6. Any act or activity that could altered this structure should be forbidden;
7. Connectivity between MULs should be maintained.

**2- Macro-units for lynx management (MALs).** The planification of actions and programmes should not be only focused in the home-range level (MUIs). The landscape patrons of significant areas, that correspond to potential populations should be taken into account. Therefore, several MULs that correspond to theoretical populations will constitute a Macro-unit for lynx management (MALs).

- 4- **Ecological corridors.** Dispersal is a key issue for lynx survival, since the meta-population equilibrium could only be achieved when the genetic flow between populations is maintained. Thus, the presence of linear landscape elements that provides for survivorship and movement, is critical in terms of conservation. Although this sorts of habitats usually do not allow reproduction and natality, they are essential for the species life-history requirements.

According to Palomares *et al.* (1999) several habitat types are suitable for lynx dispersion, namely: 1) Mediterranean scrubland, 2) eucalyptus plantations and 3) pine plantations. Other sorts of habitat such as open areas with no vegetation, crop fields or olive trees landscapes, could constitute a barrier depending on its extension. However in this last case, it was possible to verify that areas with extensions less than 5 km, between suitable patches could be used by lynxes, and, in one case, an animal crossed a theoretical barrier with, approximately 16 km of extension. Based on this information Palomares *et al.* (1999) gave the following definition for a lynx dispersing habitat:

- 1- Areas covered by Mediterranean scrubland or by industrial plantations are suitable for lynx dispersion;
- 2- Areas of open habitat of less than 5 km of extension, between suitable areas, could be used for dispersion;
- 3- Areas between 5 to 16 km of extension, could be crossed, although with difficulty and potential risks;
- 4- Areas with more than 16 km of extension are considered impenetrable barriers.

## **6.4. CONSERVATION MEASURES**

### **Goals and objectives**

The goal of this plan is to apply pre-release strategic reintroduction activities in order to make long-term reintroduction of Iberian lynx possible, in order to assure the viability of the species as a fundamental element of Mediterranean ecosystems.

### **Strategic objectives**

1. To contribute for the recovery of the Iberian lynx Portuguese populations by creating natural conditions that can support a consistent time-effective reintroduction programme, in order to re-establish the historical nuclei.

### **Operational objectives**

1. To apply an effective conservation of lynx priority habitats and rabbit population in order to preserve and/or improve the quality of MGLs;
2. To minimize non-natural causes of mortality;
3. To include Portugal in the lynx captive breeding programme, by the implementation of structures for ex-situ conservation and by establishing a network of experts;
4. To establish a continuous system of lynx monitoring in Portugal.

### **Criteria:**

1. This plan is applied in all historical lynx distribution areas that currently present natural patterns suitable for its presence, such as reproduction, residence and dispersion habitats;
2. Areas that can be effectively recovered for lynx conservation and future reintroduction are also defined as selected zones for the plan application
3. The MGLs definition, as intervention or impact assessment areas, will be done using GIS generated models by mapping lynx potential habitats and rabbit abundance distribution.

## **I. Ex-situ conservation**

Considering that the status of the Iberian lynx has been significantly worsened in the last decade, the Dirección General de Conservación de la Naturaleza (DGCN, Ministerio del Medio Ambiente/MIMAM – Spain) elaborated, in 1999, a strategy plan for the conservation of this species in Spanish territory. This document is based on the European Action Plan for the Iberian lynx (European Counsel/WWF, 1999) and on the results of the meeting on Iberian lynx population viability (UICN/MIMAM, 1998). All three documents point out that captive breeding (ex-situ conservation) is an essential tool for the conservation of the species.

A meeting with specialists took place in Madrid (25-27 October 1999) with the participation of ICN. This meeting had the objective of developing a proposal for the captive breeding plan. The document was approved in June 2001 by the Comisión Nacional de Protección de la Naturaleza (MIMAM, Spain) and it intends to establish the captive breeding program and a genetic resource bank in order to contribute, decisively, to deter the strong regression of lynx populations. Portugal has assumed its' determination to participate by financially supporting the various aspects of the plan, scientifically contributing to its' implementation and by establishing a lynx reception and captive breeding.

After the small scale captive breeding stages, the third stage of the captive breeding program will require keeping approximately 200 animals in captivity, which will imply the diversification of captive breeding centres. The Reserva Natural da Serra da Malcata, is a protected area with historical presence of lynx and vast areas with low human presence, hunting prohibition and with a permanent working team, being strongly recommend as an exceptional site for the establishment of an animal reception and captive breeding centre. Other alternative sites are being studied.

The animals to be received can have the following sources:

1. Captive bred animals resulting from the evolution of the captive breeding program;
2. Iberian lynx cubs captured during the annual Iberian lynx cub collection program.

### **Objectives:**

The ex-situ conservation has the following objectives:

1. The establishment of an animal reception and captive breeding centre in Portugal;
2. To define the organic structure of the breeding centre and the origin and functions of the captive breeding team;
3. To integrate the breeding centre into the Iberian network of animal reception and captive breeding centres;
4. Contribute to the increment of knowledge on Iberian lynx captive breeding;
5. Contribute to the enhancement of public opinion on Iberian lynx conservation and on the meaning of the extinction of species;
6. Establish a biomaterial and genetic resource bank for the species;

### **> Proposed actions:**

**1. To establish an agreement between Spain and Portugal for the captive breeding of the Iberian lynx.** Considering that the current status of the species does not allow for the capture of founder animals for the captive breeding program in national territory, the establishment of a formal agreement between the two countries is therefore crucial so to guarantee the translocation of Spanish bred Iberian lynxes to Portugal in the future

**2. Establishment of animal reception and captive breeding structures.**

### 2.1 Centres directed towards the breeding of viable animals for reintroduction.

An animal reception and captive breeding centre will be established in the RNSM. Structurally, it will follow the guidelines offered in the abovementioned document. These structures will be designed with behavioural enrichment in mind, so as to increase the animals' survival in its' natural habitat, as close as possible to their wild born counterparts. Structures oriented for breeding viable animals for reintroduction will be implemented.

The reception of animals into these infrastructures will be directly dependent on the success of the first stage of the captive breeding program, of the availability of captive Iberian lynxes and of the success of the Iberian lynx cub collection program (Annex V). It is therefore crucial that a self sustainable, viable and well managed captive population is established before animals can be moved onto other breeding centres.

### 2.2 Incentives for the participation of zoological parks and collections

The evolution of the captive breeding program should be strongly supported by the active participation of zoological institutions. These have recently integrated the conservation of biodiversity into their objectives and, through the captive breeding of their collections, assumed an essential role on the conservation of endangered species throughout the world.

A considerable progress on the theoretical frames and practical implications of captive breeding programs has been made in the last 20 years. There is presently considerable knowledge regarding the numerous aspects of such initiatives available to scientists and zoological park curators and managers.

A strong institutional cooperation between conservation authorities and zoological institutions is therefore considered relevant and their participation should be strongly encouraged. The Iberian lynx captive breeding program must evolve towards an EEP within the structure of the European Association of Zoo and Aquaria (EAZA). This evolution will lead to the creation of a Species Committee directed by a coordinator, which will be responsible for managing the species' studbook. This institutional cooperation is therefore fundamental, should include national and international zoological institutions and research laboratories, and should focus on the following:

- 1 – The reception of captive-bred animals after the first stages of the program;
- 2 – Research into the fundamental areas involved in captive breeding (reproductive physiology, ethology and healthcare);
- 3 – Fundraising campaigns and environmental education

## **3. Establishment of the animal reception and captive breeding centre team**

The captive breeding of endangered species implies the development of complex techniques which can only be mastered by a multidisciplinary team under adequate coordination. Following the recommendations of the European Association of Zoo and Aquaria (EAZA), the following team members are proposed:

1. A coordinator;
2. An husbandry specialist;
3. An healthcare specialist;
4. A reproductive physiology specialist;
5. A genetic management specialist.

The infrastructures that will support the centre are only meant to carry out actions of health management and control (parasite control, simple treatments, etc.) and to allow for the collection of biological samples as described in the Manual de Protocolos para el Programa de Conservación ex-situ del Lince Ibérico (MIMAM, 2000). The application of more complex methodologies, such as surgical interventions or assisted reproductive techniques may be carried out at respected institutions under agreements signed between them and the ICN, as mentioned in 1.

#### **4. Establishment of a Biological Resource Bank (BRB)**

The main function of the BRB is the collection, storage and use management of the biological material obtained from animals at the breeding centre, animals caught from the wild, animal casualties collected or biomaterials offered by Spain.

##### Objectives

1. To keep germplasm samples, helping to preserve the maximum genetic diversity possible for Iberian lynx populations;
2. To assure the good condition and maintenance of the deposited samples;
3. Cooperate in the use of the stored samples for assisted reproduction techniques or genetic studies;
4. To propose, promote and conduct research on experimental and technical aspects relevant for a more efficient collection or storage of the biomaterials held.

##### Location of the BRB

To determine as the application of this plan evolves.

##### Coordination/supervision and the management of resources/samples held at the BRB

The coordination/supervision, maintenance and care of the samples held at the BRB will be the responsibility of the BRB coordinator.

## II. In-situ conservation

### A. Conservation measures related with habitat and preys

The total area covered by Mediterranean scrubland has been submitted to a regression process for the last decades. The use of this ecosystem is presently under poor use and there is a generalized policy aiming at the conversion of these structures into intensive forested areas, agriculture fields, big game areas, and cattle farms. At the same time, the abandonment of rural areas in recent decades caused the disappearance of traditional agriculture, which led to the disappearance of mosaic landscapes that were prime lynx and rabbit habitats. .

Along with habitat loss, rabbit decline is one of the major if not the most important lynx regression factor. The near complete extinction of rabbits in major areas of lynx historical range has been a gradual process, mostly caused by viral diseases such as myxomatosis and RHD. The above-mentioned changes in habitat quality also contributed to the decline of rabbit populations. Therefore, measures aimed at lynx habitat improvement have to include actions directed at rabbit population recovery (e.g. small-scale land clearing and cereal growing, artificial warrens, drinking troughs).

The loss of connectivity between populations and the inhibition of immigration conducted to a collapse of the metapopulation equilibrium. The extinction probability is strongly reduced in populations with an occupation area of at least 500 km<sup>2</sup>; survival rates of small populations can be maximized if their distance is at least a minimum of 30 km (Rodríguez & Delibes, 2003). Therefore, the cited authors suggest the application of the following conservation measures, in two levels:

1. To reinforce the rabbit populations recovery using effective techniques of habitat restoration and increasing the breeding success, by acting in a large scale level, using the most recent scientific knowledge in this area;
2. To spatially locate the conservation interventions in external population areas in order to reinforce population connectivity and promote dispersion.

#### Objectives

1. To maintain the MGL's in optimal conservation status, i.e. presenting suitable characteristics for lynx presence and reintroduction;
2. To recover potentially suitable MGL's using a management strategy aimed at recreating residence, dispersal and reproduction habitats;
3. To increase MGL's rabbit density in order to achieve a suitable rabbit density for lynx reproduction.

#### > Proposed actions

**1. To buy/rent or apply management agreements in MGLs.** A substantial amount of lynx potential areas are located in private land and their conservation depends on the management strategy applied by land owners. The necessary intervention needed to conserve this species represents, in most cases, the establishment of mechanisms only possible applicable if conservation authorities own the land or negotiate management plans with the landowners

- 1.1 To buy 903 ha in Serra da Malcata Nature Reserve, with the objective of applying management actions and to install a reintroduction centre;
- 1.2 To buy, rent or establish management agreements on priority areas for lynx conservation after the process of MGL identification.

**2. To develop, in partnership with landowners, effective management plans for private land MGLs** – With the objective of recovering and/or maintaining potential lynx areas, located in private

land. Conservation management plans will be developed with landowners in order to associate conservation priorities with landowners' interests. The management plans should cover aspects such as potential impacts on lynx habitat, landscape connectivity and rabbit recovery and also economic incentives (see action 11).

**3. Recovering Mediterranean scrubland areas** – Increasing the percentage of the area covered by Mediterranean scrubland formations, by planting autochthonous trees (*Quercus suber*, *Q. Rotundifolia*, *Arbutus unedo*), in order to promote lynx potential breeding areas and ecological corridors.

**4. To install rabbit feeding areas** – In scrubland areas small pasture lands will be installed in order to provide food resources for rabbits; to increase the hedge effect; and to create areas where lynxes can hunt their prey.

**5. Construction of artificial rabbit warrens** - Rabbit dependence on soft soil makes its densities higher in areas that present those characteristics allow for warrens excavation. One of the management strategies for increasing this lagomorph's density is to create shelters, by constructing artificial warrens.

**6. Creation of water points**– In some parts of lynx historical range (particularly in the southern latitudes) the climatic conditions during the summer are extremely severe and the lack of water can limit biodiversity. The creation of artificial water points can therefore contribute to lynx survival and potential prey occurrence.

**7. Wild rabbit restocking/reintroduction** - Usually rabbit translocation actions are not submitted to correct genetic and health management, possibly leading to several negative situations 1) introduction of pathogens; 2) outbreeding depression; 3) genetic contamination. Despite these potential risks these techniques are oftenly pointed as the only solution for recovering rabbit populations in extinction areas.

6.1 Construction of rabbit breeding pens, by using autochthonous individuals and optimised structures such the ones defined by the Lynx Work Group. This action aims to provide adequate genetically selected and healthy animals for restocking and reintroduction.

6.2 Conduction of restocking and reintroduction actions in MGLs. These actions will be conducted using the criteria defined by the Lynx Work Group, necessary to control the following aspects 1) natural conditions of habitat areas; 2) quarantine (transport, husbandry, vaccination, deworming); 3) characteristics of released animals (sex ratio, age structure, density, genetic origin); 4) food supply.

**7. Promotion of programmes aiming to control free-ranging cats and dogs** – The recent increase of the free-ranging dogs and cats' numbers is becoming a considerable conservation problem, since these animals can have critical ecological impact (prey impacts, diseases, etc). Therefore actions with the purpose of controlling these animals should be conducted in MGLs.

### **9. Controlling rabbit diseases**

One of the most limiting factors for rabbit recovery is the incidence of viral diseases. Therefore is crucial to fully understand the prevalence levels of specific pathogens and their epidemiology. This survey is quite necessary in order to establish rigorous criteria for rabbit translocation operations, particularly in capture site selection.

9.1 Incidence and prevalence analysis of rabbit viral diseases (myxomatosis and VHD);

9.2 Promotion of research of vaccines against these and other pathogens.

### **10. Promotion of compatibility between lynx conservation and forest and game management**

The habitat destruction as a direct result of industrial tree plantations is being pointed out as one of the most important factors for lynx extinction. This process is leading to landscape degradation, rabbit regression and habitat fragmentation. The quality of the lynx habitat inside the defined MGLs should be preserved by minimizing human disturbance. Activities that can potentially lead to habitat change should be regulated and submitted to Environmental Impact Assessment. Increasingly popular activities, such as rural tourism and some outdoor sports fit in the frame of a well-conserved lynx habitat. If those and other activities, including hunting, are carried out properly, they may be compatible with long-term lynx survival and should be encouraged.

Amongst the major land uses in potential lynx areas are bird and big game hunting, particularly in Portuguese southern areas of Alentejo. Lynx went extinct on most of these hunting zones probably as a result of continuous and intensive predator control.

Hunters and gamekeepers considered mammalian and bird predators to be extremely harmful for game species, and so predator control is a common practice. Predator control methods are non-selective and can provoke substantial damages to protected species populations.

10.1 Forestry project analysis by the ICN, as a result of the application of the governmental decree nº 140/99 of April 24, and the specific management plans for protected areas, in order to make them compatible with lynx conservation;

10.2 To establish management agreements with forest and game managers to take action on MGLs included in private lands;

10.3 To prevent forestation actions in MGLs that can potentially lead to lynx or rabbit habitat loss;

10.4 To impose regulations on forestry projects in order to guarantee they focus on natural vegetation recovery.

## **11. Socioeconomic incentives**

Public administration should establish mechanisms to encourage private landowners to protect and restore lynx habitat, so that the species presence represents a regulatory asset rather than an economic liability. According to Delibes et al. (2000), possible incentives include subsidies to manage scrubland in proper ways, tax exemption for small game estates, rewards and public acknowledgement.

11.1 To promote and articulate different sources of funding for nature conservation actions;

11.2 To apply Zone Plans in MAL's (as predicted in the Agro-environmental measures code), in order to encourage and scale up funding for projects that are compatible with lynx conservation;

11.3 To prioritise projects that apply measures such as the preservation of ecological representative areas with high biological interest (article 27º portaria nº 85/98 of February 19);

11.4 To stop funding projects that can potentially destroy lynx habitat;

11.5 To establish economic incentives, tax reductions, and other measures aimed at the conservation of Mediterranean scrubland and its proper management towards the optimal requirements of the Iberian lynx.

**12. To match tourism activities with lynx conservation** - To create a list of rules to prevent potential damaging touristy activities such as motor sports in MGL's, and to adapt the Protected Areas Nature Sports Charts to lynx conservation.

## **13. Minimizing the impact of infrastructures**

Man made infrastructures are susceptible to produce substantial impacts on lynx survival and habitats. Urbanisation, road construction and dams presently constitute a menace for lynx habitat by reducing the permeability of the landscape to lynx movements and increasing lynx non-natural mortality.

13.1 To establish coordinated actions between ICN and public agencies responsible for public and private infrastructure planning, from the initial stages, on priority areas for lynx conservation;



13.2 To promote the need for lynx habitat conservation to potential promoters of projects submitted to environmental impact assessment;

13.3 To submit structural projects, programmed for MALs, to ICN appreciation according to the rules expressed in the governmental decree n.º 140/99 of April 24 ;

13.4 To implement and monitor mitigating measures.

## **B. Measures related with non-natural mortality reduction**

The Iberian lynx was withdrawn from the Portuguese game species list in 1967 (Dec.Lei N.º 47847, August 14), and, in 1974, was listed as a protected species (Dec.-Lei N.º 354-A/74, 14). Despite the legal protection the species continued to be persecuted during the ensuing decades. Presently the penalty for shooting a lynx can be up to 6 months in prison (Article n.º 30º Law N.º 173/99 of September 21).

The reduction or preferentially the elimination of non-natural hunting related mortality should focus on two action guidelines:

1. To improve social attitude towards lynx conservation;
2. To increase surveillance capacity and punishment for lynx hunting.

Road kills are another important mortality factor, being therefore necessary to restrict the construction of new roads in MAL's and to apply, whenever necessary, safe road passages to wild animals in already constructed roads.

### **Objective**

1. To reduce potential mortality risks for lynxes in MGLs and dispersion habitats.

## **>Proposed actions**

### **1. Surveillance actions**

1.1 To establish an effective and functional surveillance system in MGLs in order to control poaching activities and the use of illegal traps such as snares and spring traps;

### **2. Compatibility with game activities**

The correct management and recovery of rabbit populations for hunting proposes can be compatible with lynx conservation. So, a proper lynx conservation plan should include actions directed for game management and collaboration with hunting groups/associations

2.1 To establish management agreements between ICN and game organizations and landowners in MGLs, in order to increment rabbit densities and to conserve priority habitats;

2.2 To support and promote professional courses for game keepers and hunters;

2.3 To promote and conduct educational actions on lynx conservation and game management;

2.4 To apply the recommendations of the ICN manual for game projects in MGL's;

2.5 To forbid rabbit density correction actions in MGLs;

2.6 To regulate rabbit hunting in MGLs, adjusting hunting seasons to the species' life cycle, in order to avoid negative impacts the reproductive success.

### **3. To minimize road impacts**

3.1 To establish ICN participation in the decision making process of new roads in MALS and on the establishment of mitigation measures;

3.2 To identify potential risk zones in roads located in MALs and to apply measures that can substantially reduce road kill probabilities;

## **C. Measures related with divulgation and educational actions**

The factors of threat responsible for the current statute of the Iberian lynx have its origins in attitudes and values evidenced by some groups - local or others - towards Nature in general and predators in particular. Concern for ecological or ethical values hardly exists in Portugal. The Mediterranean scrubland is not valued by the landowners or local inhabitants because of its' low income-generating capacity. The negative perception local inhabitants have of predators led to a continuous use of illegal non selective traps, increasing the risk of mortality for the Iberian lynx as previously described.

An unfamiliarity of the public towards the species characteristics (statute, distribution, etc.) is still very much obvious. Considering that a conscientious and active public opinion can have an important role in lynx conservation through pressure groups, it is necessary to implement actions directed towards information sharing and public awareness that complement other actions described in this Plan. High priority proposals will be directed to the target groups directly involved (hunting, agro-forest proprietors, politicians etc.).

### **> Proposed actions**

1. To conduct national campaigns to inform the general public and the conservation agents (decision makers, politicians, hunters and landowners) about the lynx conservation issues;
2. To promote the publication of articles in magazines and newspapers on subjects related to Iberian lynx conservation;
3. To conduct educational campaigns for schools, students and teachers;
4. To promote the edition of divulgation material on the Iberian lynx;
5. To create an internet web site linked to the ICN website,
6. Dissemination of the patronage law to foundations and business in order to finance research, educational and conservation actions regarding the Iberian lynx.

## **D. Monitoring and scientific investigation**

Although the Iberian lynx has been studied for the last 30 years, there is still a considerable lack of knowledge on the species ecology, behaviour and biology. Most of the scientific work was carried out in Doñana, where environmental features are considerably different from the rest of the species distribution area. It is also necessary to develop studies in several scientific areas such as reproductive physiology, genetics, pathology, ethology, and landscape ecology. It is also necessary to study several aspects of rabbit population recovery, particularly viral diseases.

## > Proposed actions

### 1. Habitat and landscape ecology

- 1.1 MGL's and MAL's definition using Geographic Information Systems (GIS) and Spatially Explicit Models (SEM);
- 1.2 Elaboration of Habitat Suitability Models for MALs;
- 1.3 MALS landscape structure analysis and evaluation of their functionality as a connected system of theoretical populations nuclei;
- 1.4 Elaboration of predictive models for rabbits.

### 2. Monitoring

- 2.1 To establish a monitoring network in the lynx historical range in order to confirm the presence of the species and to establish priority areas for capturing individuals;
- 2.2 To conduct genetic studies as a complement to ecological ones (to identify individuals from scat and fur samples);

### 3. Rabbits

- 3.1 Density and distribution studies, habitat use and pathological surveys;
- 3.2 To conduct demographic studies in MALs;
- 3.3 To evaluate habitat and prey density responses to management actions in order to increment the plan's efficacy ;

### 4 Captive breeding

- 4.1 To conduct pathology and parasitology studies on small carnivores present at the RNSM. Disease risk assessment for diseases possibly or likely to be transmitted to lynxes (Due to the implementation of the reintroduction centre);
- 4.2 To conduct studies on captive breeding techniques and protocols as described on the chart depicting the organization of the captive breeding working group (described in page 22).

## E. Population reinforcement and reintroduction

The final goal of this conservation action plan is to allow long-term application of reintroduction actions, which, in its final stage, will contribute to establish viable population in the Portuguese lynx historical range.

The IUCN (IUCN/SSC, 1998) reintroduction guidelines refer the need of conducting previous studies on reintroduction viability. These sorts of techniques are extremely complex and warrant a multidisciplinary approach with a correct scientific support. Both the programme implementation phase and its development should be sustained by detailed and correct protocols that should include objectives, procedures and responsibilities. Carnivore reintroductions are often slow, complex and highly costly processes and should be thoroughly analysed.

Iberian lynx reintroduction actions in Portugal will only be done in the long term, since is necessary to previously apply considerable efforts on habitat and prey recovery. Despite this, it is necessary to execute preparatory actions.

## **> Proposed actions**

### **1. To define, in detail, reintroduction goals and objectives;**

1.1 To define medium and long term objectives;

1.2 To define success evaluation criteria, evaluation methods and quantification time scales;

### **2. Feasibility study:**

2.1 Study of status, ecology, life history, physiology and disease susceptibility of wild populations to evaluate the species' needs and the suitability of chosen release areas;

2.2 Habitat viability analysis of the chosen release area and projected population range (environment, resources, carrying capacity, spatial characteristics, etc.);

2.3 Management plans for MALs (see Annex IX);

2.4 Population modelling (PVA and met population model) and sensitivity analysis of short- and long-term demography and distribution;

### **3. Strategic pre-release activities:**

3.1 Research into previous comparable reintroductions and intensive contacts with experts;

3.2 Construction of a multidisciplinary advisory team with expert knowledge on all aspects (biological, economical, sociological, political, legal etc.);

### **4. Elaboration of reintroduction protocols according to IUCN recommendations (IUCN/SSC, 1998);**

### **5. To observe population reinforcement and reintroduction actions to be carried out in Spain.**

## **7. ON-GOING RESEARCH AND MONITORIZATION ACTIONS**

### **7.1 Inventory and monitoring of lynx distribution**

A team of biologists and field assistants conducted, between January 2002 and May 2003, a survey on the status of the Iberian lynx in Portugal. The survey was performed on previously identified lynx areas, as determined by studies carried out in the 1970-s and 1990-s. The following objectives were established:

- 1- To determine baseline status and distribution of the species for result comparison of subsequent surveys on a national scale;
- 2- To develop a simple and reliable method of collecting information to facilitate future surveys;
- 3- To analyse rabbit distribution and abundance within the lynx historical range;
- 4- To define potential areas for capturing founders for a captive breeding programme.

Intensive search for lynx scats for DNA analysis and camera trapping provided a basis for identifying potential lynx areas. Over 4200km were covered during a global searching effort of 1975 man-hours. This effort resulted in the collection of 168 potential scats that were submitted to genetic validation with no positive lynx amplifications. Camera trapping was applied in a total effort of 5647 camera days, in three lynx potential areas. No positive identification was obtained. At the same time, a study on wild rabbit distribution revealed that most historical range nuclei do not support viable lynx populations. Although we can not confirm extinction, the scenario is highly pessimistic. The Iberian lynx is presently on the verge of extinction. Intensive rabbit regression and massive habitat destruction were identified as the main causes of decline in recent decades. In the Portuguese lynx historical range, we could only identify significant areas suitable for lynx in the South-eastern part of the country, particularly in the Andalusian border, where we lack recent evidence of lynx presence.

This survey report is currently available in [www.felidae.org](http://www.felidae.org).

1. A lynx monitoring network (LynxNet) is presently established in Portugal using ICN personnel, scientific institutions and volunteers. Current work is focused on areas that present higher suitability for lynx occurrence; the main objective is to detect potential areas for capturing lynxes for captive breeding.

### **7.2 Monitoring of habitat suitability**

In top priority areas such as Malcata, Guadiana valley and Algarve, rabbit distribution and abundance was systematically evaluated, and a lynx predictive model was constructed for the Natura 2000 network areas in order to establish a global management plan for these.

### **7.3 Effectiveness and validation of conservation measures**

During the last years, particularly in Malcata, an assessment of the effectiveness of the conservation measures is being conducted to verify that they do in fact lead to the conservation of the species, and to examine if the assumptions on which they were based on are correct.

## **8.ON-GOING PROJECTS**

I LIFE project– ‘Recovery of habitats and preys of the Iberian lynx in Serra da Malcata’

EU life project initiated in 1999 and terminated in 2003, with a global funding of 599 000 Euros. The main objective of this project was to create natural conditions for reintroduction of lynx in the long-term by improving habitat quality, prey density and control of non-natural mortality causes.

II POA project ‘Management of habitats and species of Serra da Malcata Nature Reserve’

Project approved in 2003, with a global funding of 3 428 000 Euros. This project continues habitat and prey recovering actions conducted by the Life project and foresees the implementation of a lynx soft release centre.

III INTERREG project ‘Conservation Plan for endangered fauna of Alentejo, central Portugal and Extremadura’

Project approved in 2003, resulting from a partnership between ICN and the Extremadura Junta. With a global funding of 2 303 947 Euros, this project includes the application of lynx habitat and prey recovery, particularly in the Alentejo-Extremadura border.

## 9.IMPLEMENTATION

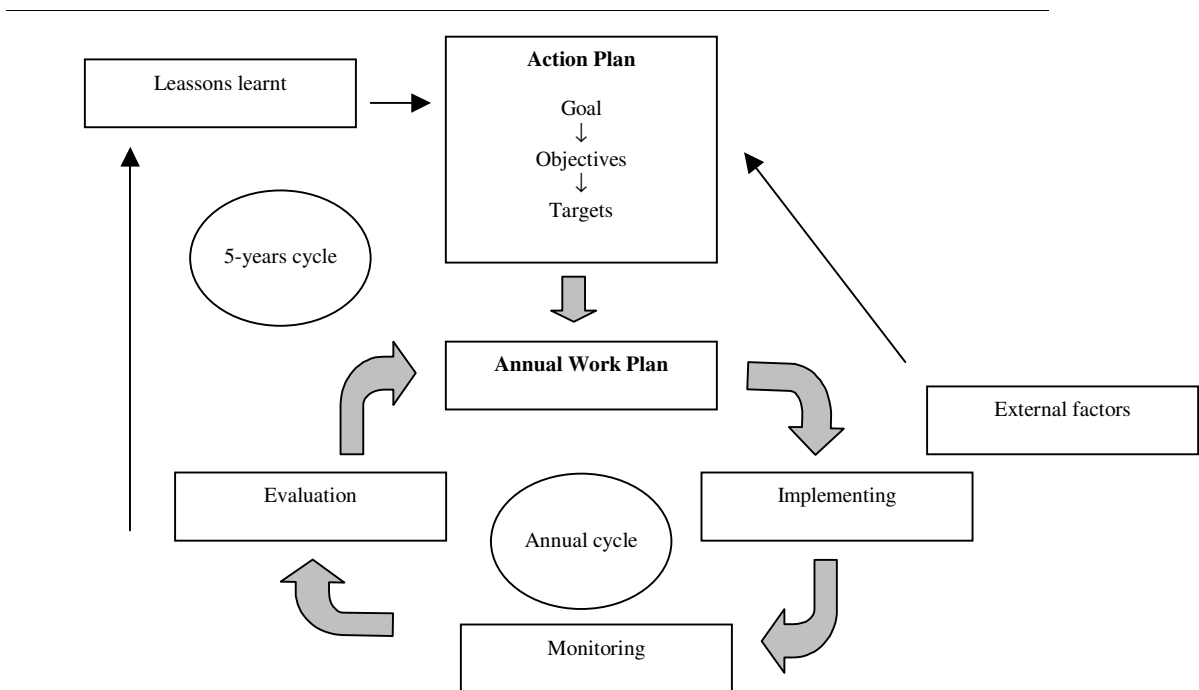
### 9.1 Implementation criteria

Three basic requirements will govern the implementation of the Strategic Plan:

1. all work should remain clearly focused on the objectives, outputs, and targets of the plan;
2. progress must be properly monitored for possible adjustment of targets (if they prove unrealistic and unattainable or if external circumstances change significantly) or of individual activities (if not enough is done to achieve a target);
3. flexibility should be maintained to expand the Plan if new high priority issues and important opportunities arise.

### 9.2 Annual work plan

Strategic planning should be considered as an ongoing and dynamic process, consisting in two interlocked cycles of annual work plans and the 5-year cycle of the action plan (Figure 2). Both have feedback loops – one for the internal monitoring and evaluation of progress, results and achievements, and one for the ongoing monitoring of external factors; these will allow for adjustments and amendments to the plan.



**Figure 2** – Strategic planning as an ongoing process of the annual work planning cycle and the 5-year strategic planning cycle.

### **9.3 Operational structure of the Action Plan**

For an effective achievement of the plans' objectives the following structure should be created: (1) external sensors and actors, those who watch and act as guardians; (2) the pool of experts who analyse data and issues, find solutions, and develop policies and recommendations; and (3) a small inner circle of people who manage, coordinate, communicate, monitor, and evaluate the activities (Figure 4).

#### **I - Coordination**

The Action Plan coordination will be conducted by ICN which will be responsible for the following tasks:

- 1- To analyse the species conservation status and possible threats
- 2- To integrate, at the actions level, organizations and public and private agencies that can contribute to the plan objectives;
- 3- To define the levels of action for different geographic areas;
- 4- To establish priorities for conservation and research;
- 5- To evaluate the results of applied conservation actions;
- 6- To make technical and scientific information available to the contributors to the action plan application;
- 7- To act in conflict solving;
- 8- To promote the search for financial support;
- 9- To periodically evaluate the application of the action plan.

#### **II – Lynx monitoring team (LMT)**

The Lynx Monitoring Team (LMT) is responsible for the application of monitoring methodologies and for the implementation of a proper organized network of trained personal..

The data obtained will be permanently updated in order to be used in the application of the conservation strategy.

The LMT is currently functional, being composed by a permanent team of biologists and field assistants and is responsible for the following tasks:

- 1- To apply a continuous system of lynx data collection in Portugal;;
- 2- To apply and develop lynx detection methodologies;
- 3- To define the geographic area of action;
- 4- To produce annual reports;
- 5- To inform the coordinators of the progress achieved;
- 6- To collaborate with the Spanish lynx monitoring teams.

#### **III – Habitat and prey management team (HMT)**

This group is responsible for the development, application and evaluation of habitat and prey recovery actions.

The HMT is responsible for the following actions:

- 1-To evaluate the presence and temporal evolution of rabbit populations in the plan target areas;
- 2- To develop methodologies of rabbit population monitoring;
- 3- To develop studies on habitat use and pathology impacts in MALs;
- 5- To evaluate rabbit and habitat response to management activities;
- 6- To apply measures of habitat and prey recovery;
- 7- To collaborate with the agencies responsible for game resources;
- 8- To supervise and inform of the effects of projects that can compromise the lynx conservation;
- 10- To articulate the species conservation directives with the ICN game policy;



11- To inform the coordinators on the progresses achieved.

#### **IV – Captive breeding team (CBT)**

The captive breeding teams' purpose and constitution are described in chapter I (ex-situ conservation) of conservation measures and will integrate the ECCLI in the future.

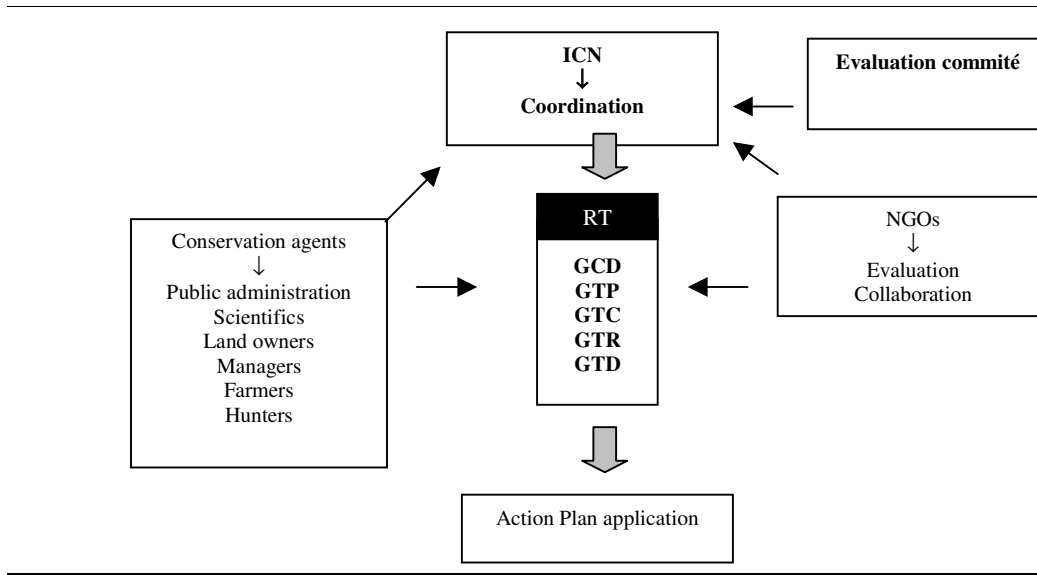
Presently, there is a preliminary team in place, and various agreements have been signed between participating parties regarding their future role in this project. This group will be responsible for the application of the measures and actions describe in Figure 1, constantly informing the coordinators on the progress obtained.

#### **V – Lynx reintroduction team (LRT)**

The lynx reintroduction team (LRT) will be responsible for connecting ex-situ with in-situ conservation (see Annex V), by helping to select potential animals for reintroduction and target reintroduction areas. This group should elaborate reintroduction protocols according to IUCN guidelines, in order to apply the actions described in chapter E.

#### **VI – Information dissemination team (GTD)**

The GTD will be responsible for the dissemination of information on every action planned and described in chapter C to all relevant parties.



**Figure 3** – Strategic plan for the implementation, evaluation and monitoring of the Action Plan.

**VII – Regional Teams (RT)**

Regional teams will be responsible for the implementation of MALs management plans and will be composed by members of several work groups

**VIII – Evaluation committee**

An evaluation committee will be created in order to annually evaluate the project and produce recommendations to improve its application. The committee will be composed by international recognized experts on feline conservation.

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**Anexo I – Past and present distribution of Iberian lynx**

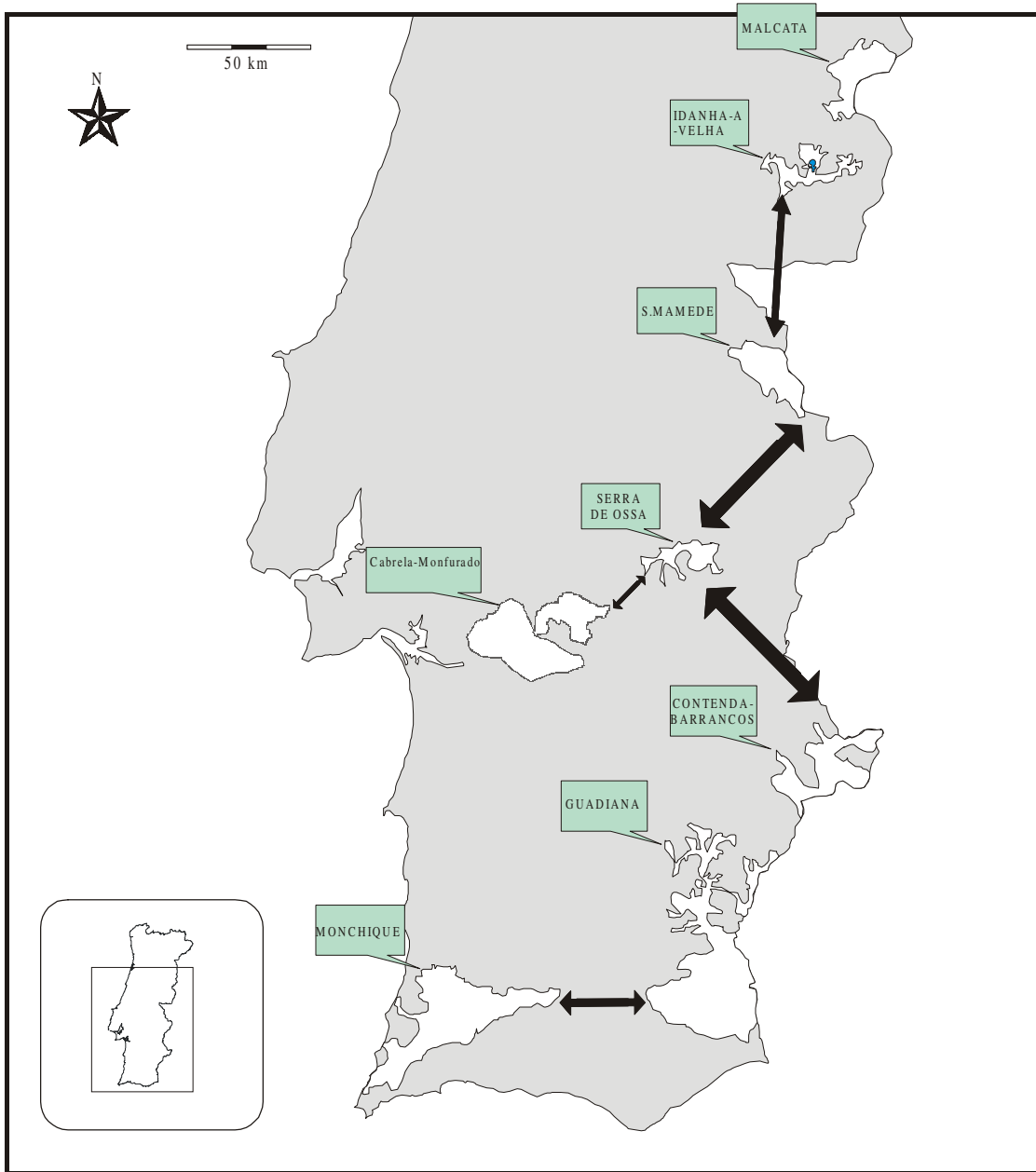


Geographic distribution of Iberian lynx populations according to the data of Rodriguez & Delibes (1990) (Spain) and Ceia *et al.* (1998) (Portugal). 1 - Algarve-Odemira-Sado Valley; 2- Gata-Malcata-San Pedro-S.Mamede; 3- W.Sierra Morena-Guadiana; 4- Alberche; 5- Gredos; 6- Subbéticas; 7- Doñana; 8 -Central Sierra Morena; 9- Central population.

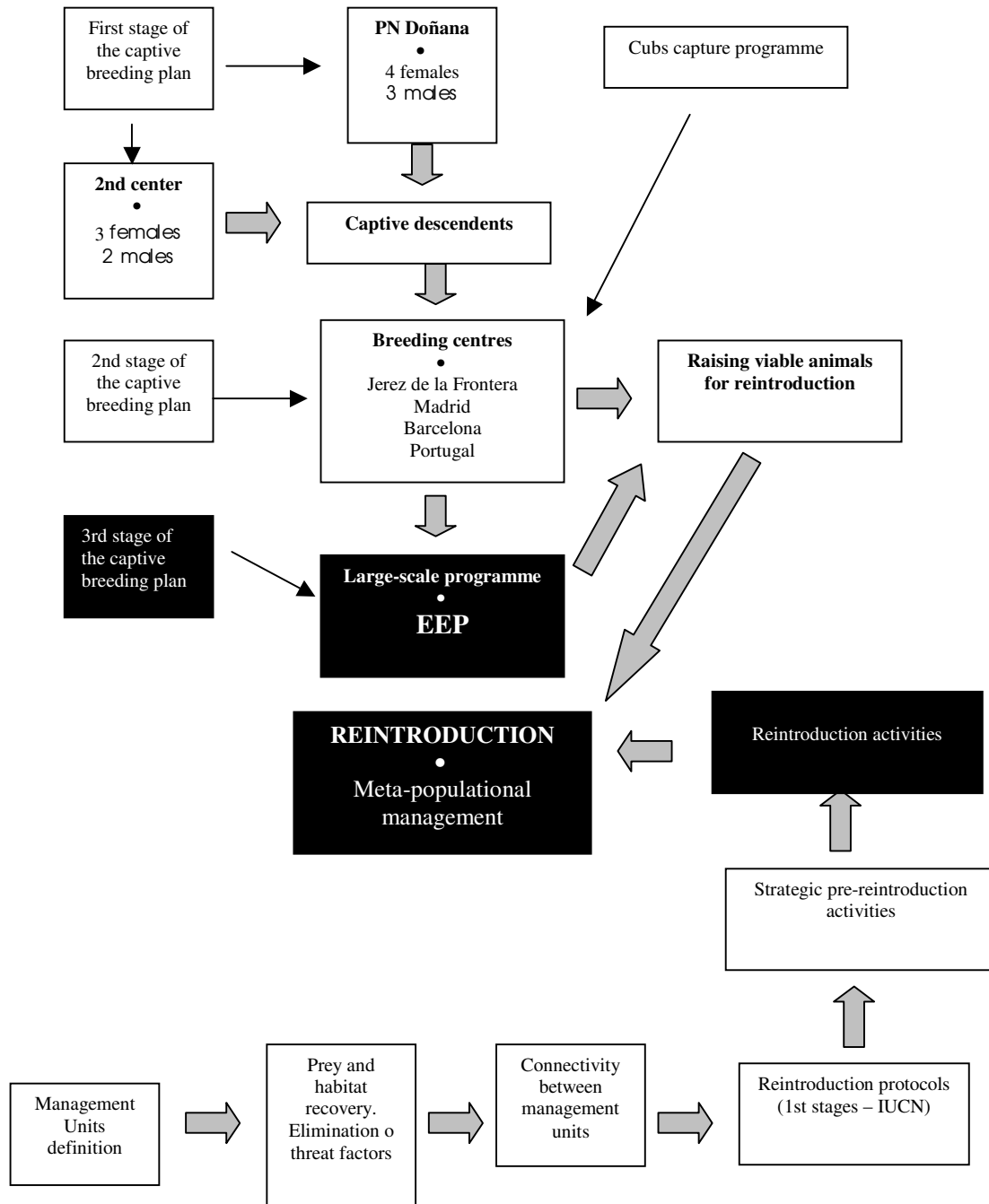


Geographic distribution of Iberian lynx in Spain according to the most recent data (Guzmán *et al.*, 2002). 1- Doñana; 2 – Cardena-Andujár.

**Annex II – Priority areas of the lynx historical range for the plan application.**



**Annex III – Action Plan application scheme.** Black boxes indicate actions that will be applied after the 5-years plan.



#### **Annex IV – Priorities, budget and involved agencies.**

In the following pages a description, for each action, of the priority level financial support and involved agencies is described. The following conventions are used:

**Priority 1** – Actions necessary to prevent the extirpation of the species in short-term.

**Priority 2** - Actions necessary to recovery or maintain natural conditions for the species survival.

**Priority 3** – All other actions necessary to meet recovery objectives.

ANM – National Association of Cities

ANPC – National Association of Game Producers and Landowners.

BRISA – Portuguese Highways, SA

CAP – Portuguese Confederation of Agricultures

CPADA – Portuguese Confederation of Environment Protection Non-governmental Organizations

DGRF – National Forest resources Agency;

DGT – National Tourism Agency

DGV – National Veterinary Agency;

EDIA – Alqueva Dam Agency, SA

FENCAÇA – National Federation of Associative Game Areas

FPFP – National Federation of Forest Producers

GNR – National Republican Guard

ICN – Institute of Nature Conservation

LNIV – National Laboratory of Veterinary Research

MAI – Interior Ministry

MF- Finances Ministry

MHOP – Public Infrastructures Ministry

MNE – Foreign affairs Ministry

UICN/SSC – International Union of Nature Conservation/Species Survival Committee

UID – Scientific and Research Agencies



	Priority	Duration	Agencies	Estimated cost (euros)
<b>I. Ex-situ conservation</b>				
Establishing na agreement with Spain	1	2003	ICN, MNE	
Reintroduction centre	1	2004	ICN, UID, UICN/SSC	977 394
Work team	1	Concluded	ICN, UID	-
Genomic Resource Bank	1	On-going	ICN, UID	1000
<b>II. In-situ conservation</b>				
<b>Habitat and prey recovery</b>				
Land acquisition	1	2003-2007	ICN, DGP; ONGs	Av
Management plans for private lands	1	2003-2007	ICN, DGF, CPADA	Av
Recovery of Mediterranean woodland	2	2003-2007	ICN, ANPC, CAP, DGF, DRA's, FENCAÇA; ONGs	850.230
Installation of crop fields for rabbits	1	2003-2007	ICN, ANPC, CAP, DGF, DRA's, FENCAÇA; ONGs	1.275.000
Rabbit artificial warrens	1	On-going (2003-2007)	ICN, ANPC, CAP, DGF, DRA's, FENCAÇA; ONGs	425.000
Creation of water points	2	On-going (2003-2007)	ICN, ANPC, CAP, DGF, DRA's, FENCAÇA; ONGs	215 000
Rabbit restocking and reintroduction	1	On-going (2003-2007)	ICN, ANPC, CAP, DGF, DRA's, FENCAÇA; ONGs	1 300 000
Control of free-ranging cats and dogs	2	2003-2007	ICN, ANM, DGF, DGV, FENCAÇA,OV	Av
Survey of rabbit diseases	1	On-going (2003-2007)	ICN, ANM, DGF, DGV, FENCAÇA,OV;	30 000
Evaluation of forest projects	2	On-going (2003-2007)	ICN, DGF, FFPF	Av
Management agreements	2	2003-2007	ICN, DGF, FFPF, ANPC	Av
Socio-economic incentives	2	2003-2007	ICN, MF, FFPF	Av
<b>Measures related with the reduction of non-natural mortality causes</b>				
Establishing an effective surveillance system	2	On-going (2003-2007)	ICN, DGF, DRA, FENCAÇA, GNR	Av
Establishing management agreement with hunting associations	2	On-going (2003-2007)	ICN, DGF, FENCAÇA, DRA	Av
Supporting hunting guards formation	3	2003-2007	ICN, DGF, FENCAÇA, DRA	Av
Educational actions	3	2003-2007	ICN, IA, CPADA	
Application of the Game practices evaluation	2	2003-2007	ICN, DGF, FENCAÇA, DRA	Av
Minimizing the effect of infrastructures	2	2003-2007	ICN, MOP, UID, BRISA	Av

	Priority	Duration	Agencies	Estimated cost (euros)
<b>Measures related with environmental education</b>	3	2003-2007	ICN, ONGs	71 258
Measures related with research and monitorization				
Lynx Management Units definition	2	2003-2004	ICN, UID	125 000
Lynx Survey Network	2	On-going (2003-2007)	ICN, UID	Av
Characterization of ecological corridors	2	2003-2004	ICN,UID	20 000
Habitat suitability studies	2	On-going (2003-2007)	ICN, UID	20 000
Carnivores ecological studies	3	On-going (2003-2007)	ICN,UID	20 000
Genetic studies	2	On-going (2003-2007)	ICN,UID	20 000
Rabbit ecological studies	2	On-going (2003-2007)	ICN, UID	Av
Captive breeding studies	3	2003-2007	ICN, UID	Av
<b>Measures related with reintroduction</b>				
Preparatory phase studies	3	2003-2007	ICN, UID, UICN/SSC	Av <sup>a</sup>
Management plans for MALs	3	2003-2004	ICN, UID, DGF, DRAs	25 000 <sup>a</sup>

AV – In evaluation

a –On-going projects

Annex V- Elaboration and implementation of Management and Reintroduction Plans for MALs

