IBERIAN LYNX:
CONSERVATION THREATS AND MANAGEMENT SOLUTIONS

by

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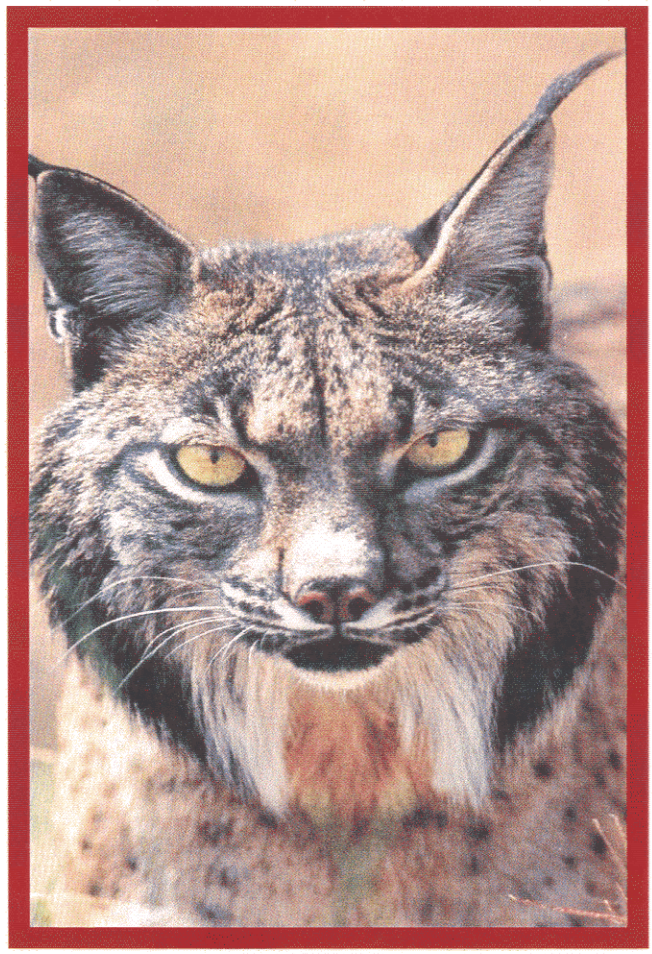

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1.0 INTRODUCTION

The Iberian lynx (*Lynx pardina*, Temmick 1824) is a wild felid that was once ubiquitous throughout the Iberian Peninsula of Europe. The humanisation of the European landscape suggests a problematic reality for this critically endangered wild beast. If co-existence with humans is not achieved and sustained, extinction is the imminent fate of the Iberian lynx. The urgency for intensive management is indisputable.

This paper will explore the situational factors surrounding the demise of the Iberian lynx population in Spain. First, the paper explores the physical and cultural characteristics of the study area that provides the geographical context for lynx conservation. Second, the biology of the Iberian lynx is examined since it is key to understanding the dynamics of lynx populations. Third, threats to the conservation of Iberian lynx are investigated due to the multitude of hazards confronting the lynx population, which effectively counter conservation efforts. Fourth, solutions are ascertained that may capacitate the timely address of the lynx decline. There are a multitude of strategies and approaches to managing the lynx decline that provides hope for the dwindling lynx population. Fifth, the role of humans is considered since people are critical to the political process called "wildlife management" and also since humans have an ethical/moral responsibility to secure the intrinsic value of living things. Finally, the future of the Iberian lynx in the face of unfolding adversity is contemplated. Will the Iberian lynx fall victim to its ill-fated destiny or is co-existence with humanity possible? In the realm of possibilities, can

the Iberian lynx survive the intensive cultural landscape and rural development encouraged within the political and historical European context?

2.0 A GEOGRAPHICAL CONTEXT

2.1 Europe

Europe is a mosaic of culture and language. Wildlife management strategies vary between the 55 countries of the European continent and there is no institution or authority at the Pan-European level to co-ordinate management (Schröder, 1998). The diversity among European communities has implicit implications for the conservation of wildlife as many wildlife populations transcend administrative boundaries.

Europe is devoid of true wilderness (Schröder, 1998). The cultural landscape dominant across the continent has long been cultivated through intensive land-use practices (Schröder, 1998). Biodiversity is largely concentrated in select mountain ranges such as the Caucasus Mountains on the eastern extremity, along the Mediterranean basin, and in the Carpathian Mountains of Romania. Throughout Europe, intensive agricultural practices, forestry, and fragmentation of habitat consistently threaten wildlife populations (Schröder, 1998,Litvaitis et al., 1996, Delibes et al., 2000).

The geographic position of people within Europe reflects lifestyles and attitudes. Europe is dominantly an urban society. The urban population appears more concerned with

globally recognised issues, furthermore, people are not only less concerned but also less interested in local wildlife (Schröder, 1998). The rural population is more concerned with economic opportunities since most are relatively poor as compared to the affluent urban dwellers.

Wildlife management is largely a political process. The emergence of a new political identity, the European Union (EU), also presents implications for wildlife management. The European Union may act as a Pan-European authority for the management of resources. This essentially means that political entities may lose governance over wildlife resources. The greatest potential set back for wildlife managers in Europe is the emphasis that the EU places on agricultural development (Schröder, 1998). Changes in agricultural policy are modifying landscapes that are detrimental to wildlife species. However, the EU has initiated Natura 2000, a network of protected areas across Europe. Unfortunately, the EU currently has no means to enforce this directive and many countries are reluctant to convert land to conservation areas in fear that they will be subject to land-use restrictions (Schröder, 1998).

Other wildlife directives have recognised and acted upon the need for interagency co-operation. Both the European and international community of wildlife researchers and managers have collaborated with the World Wide Fund for Nature (WWF) to form the Large Carnivore Initiative of Europe (LCIE). The agenda of both non-governmental organisations are further discussed in section 6.1, interest groups.

2.2 Spain

Spain's powerful world empire of the 16th and 17th centuries ultimately yielded command of power to England. Subsequent failure to embrace the industrial revolutions caused the country to fall behind the economic and political powerhouses of Britain, France and Germany (CIA, 2000). Spain remained neutral in World Wars I and II, but suffered through a devastating Civil War (1936-39) and in the second half of the 20th century has consequently played a catch-up role in the western international community.

Spain has a population of approximately 40 million persons whom are divided among 17 autonomous administrative divisions or provinces (CIA, 2000). The total area of Spain is 504,782 km^2 of which only 5,240 km^2 represents water. The climate is temperate with clear, hot summers in the interior and more moderate and cloudy conditions along the coast. Winters are cloudy and cold in the interior; partly cloudy and cool conditions mask the coast. The terrain is predominantly a flat dissected plateau surrounded by rugged hills. The Pyrenees Mountains form the eastern border between Spain and France. Spain is bordered by Portugal to the west, the Atlantic ocean to the north, and the Mediterranean Sea to the south.

Spain exhibits many of the characters present among European communities: a predominant urban population less concerned for local wildlife and a relatively poor rural society concerned with economic opportunity. Southern Spain is less densely populated but there are large areas of land owned by only a few people. This area is primarily

occupied by large privately owned estates, which function as hunting reserves and a primary source of income for the local landowners (Personal Communication with Juan Carlos Blanco and Christian Gortàzar).

A member of the EU, Spain has met the increasing desire for the continued development of agricultural development, forestry, and infrastructure. As in the rest of Europe, environmental pressure has led to poor habitat quality and increased fragmentation.

3.0 BIOLOGY OF THE IBERIAN LYNX

3.1 Morphology

The Iberian lynx, *Lynx pardina*, is also known by its other common names: Spanish lynx and Pardel lynx (CSG, 1996). The Iberian lynx has more characteristic traits than the other lynx species. The Iberian lynx is comparable in size to the Canadian lynx (*Lynx canadensis*) or bobcat (*Lynx rufus*) but only half the size of the Eurasian lynx (*Lynx lynx*). Males weigh 11-15kg while females weigh 8-10 kg (Cobo, 2000, Delibes et al., 2000). They have a relatively small head, long legs, and a short tail with black tip. They have a short, flat face that is flanked by a characteristic beard in adults. Their coats are generally tawny coloured with many mottled dark spots.

3.2 Taxonomy

Lynx evolved about 4 million years ago, before families panthera and felis (small cats)(Big Cats Online, 2000), figure 3.2.1. The first lynx from which all extant forms emerged was the Issoire lynx (*Lynx issidorensis*). The Issoire lynx was larger than all current lynx species and said to bear more resemblance to the felids.

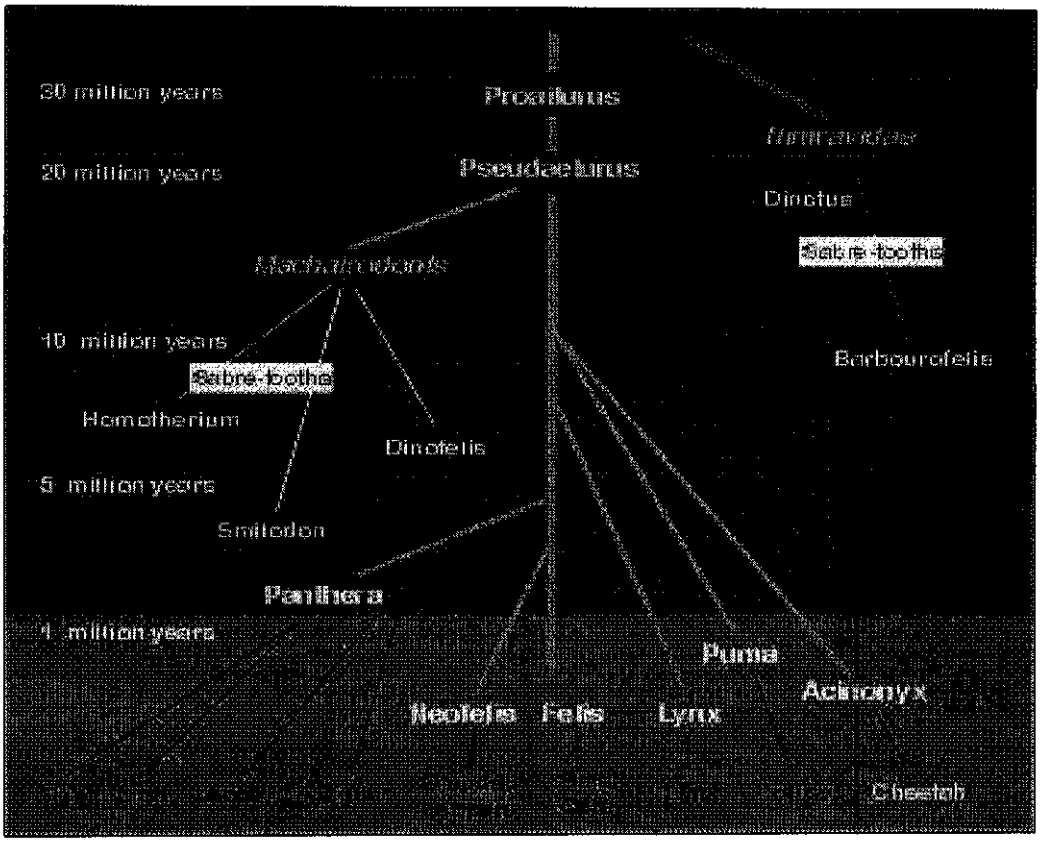

Figure 3.2.1. Phylogeny of cats

Debate still exists on the taxonomic status of the Iberian lynx. At first it was considered a subspecies of the Eurasian lynx but as early as 1824 was recognised as a distinct species by Temmick (Rodriguez & Delibes, 1992). Most current literature concurs with this

finding (Werdelin, 1990, Garcia-Perea, 1992). Figure 3.2.2 illustrates lynx phylogeny based on DNA evidence. This clearly shows that the Iberian lynx predates the Eurasian and Canadian varieties (Beltràn et al., 1996). It is in fact, most closely related to the Bobcat. The Iberian lynx is believed to have first appeared during the Late Pleistocene while the Eurasian lynx did not appear until the Holocene (Garcia-Perea, 2997, Big Cats Online, 2000).

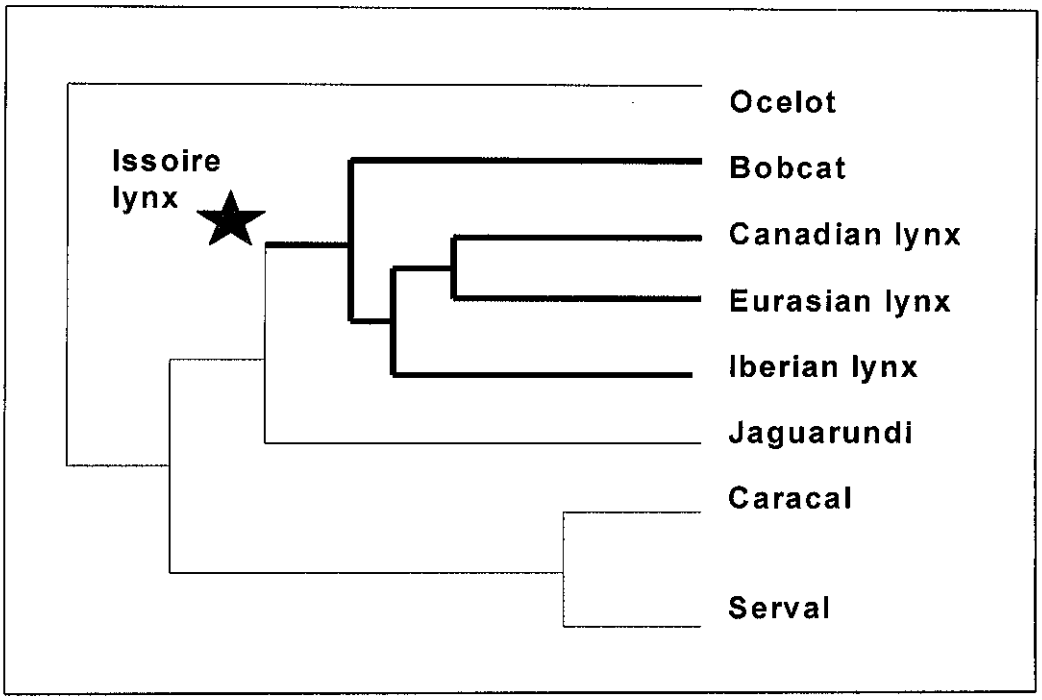

Figure 3.2.2. Phylogeny of lynxes.

3.3 Distribution & Population Status

The Iberian lynx population suffers from habitat fragmentation within Spain and Portugal, the only two countries in which it exists, Fig 3.3.1. The Iberian Lynx is

distributed on all four of the mountain ranges of southern Iberia and also on the flat plateau near the mouth of the "Guadalquivir" (Rodriguez & Delibes, 1992).

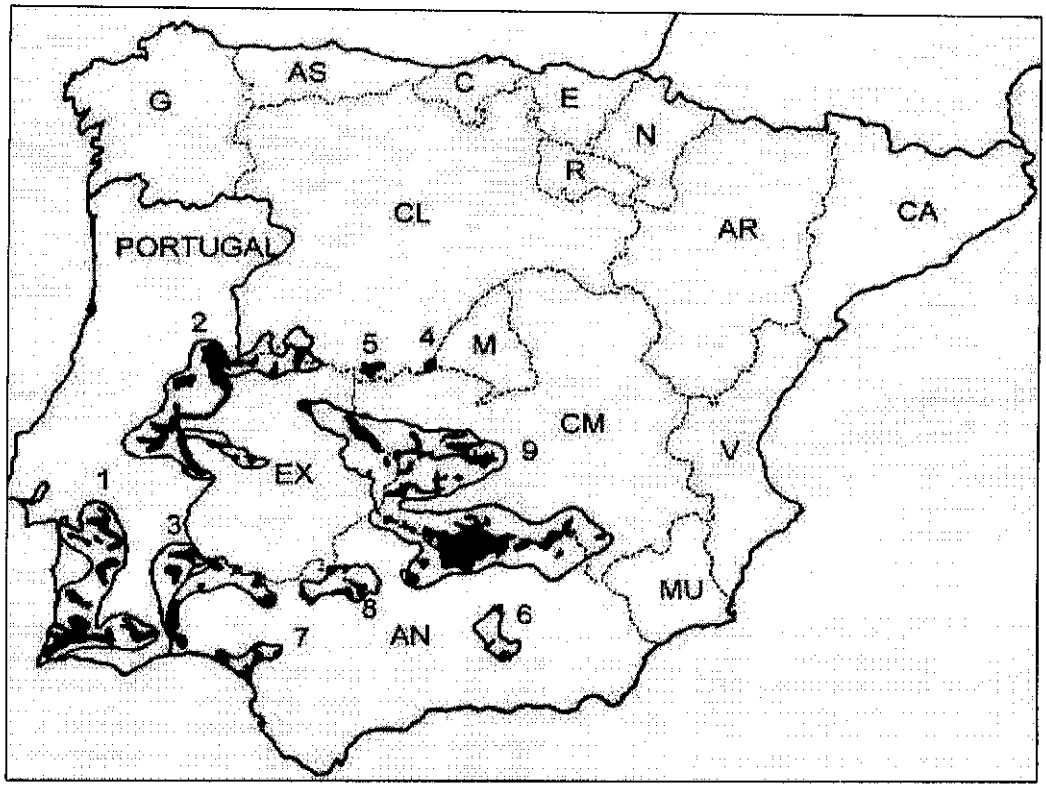

Figure 3.3.1. Lynx distribution in Spain and Portugal

The number of Iberian lynxes has significantly decreased in the past decade. It is believed that the lynx experienced an 80% range loss between 1960 and 1990 (Delibes, 1999). It is currently estimated that only 350-450 individuals exist (Delibes et al, 2000). The Iberian lynx is listed as endangered in the IUCN's red list of threatened animals and the Spanish Red Data Book (IUCN, 2000, Rodriguez & Delibes, 1992). The red list includes only a handful of the most critically endangered animals in the world (IUCN, 2000).

There are nine genetically isolated populations of which only two are viable in the short-term, none in the long-term (Rodriguez & Delibes, 1992). Figure 3.3.2 illustrates the breeding range (dark shaded), occasional presence (lightly shaded), distance between populations (numbers represent kilometres), and probability of dispersal among the nine populations (star = high, dark circle = low, empty circle = null). Each of these nine areas represents a metapopulation with little or no dispersal between them and many have less than 50 individuals. The largest of these populations, in Sienna Morena, has recently been divided in two (Delibes, 2000). The only population that is currently not in decline, is the Doñana population, which is intensively managed and monitored.

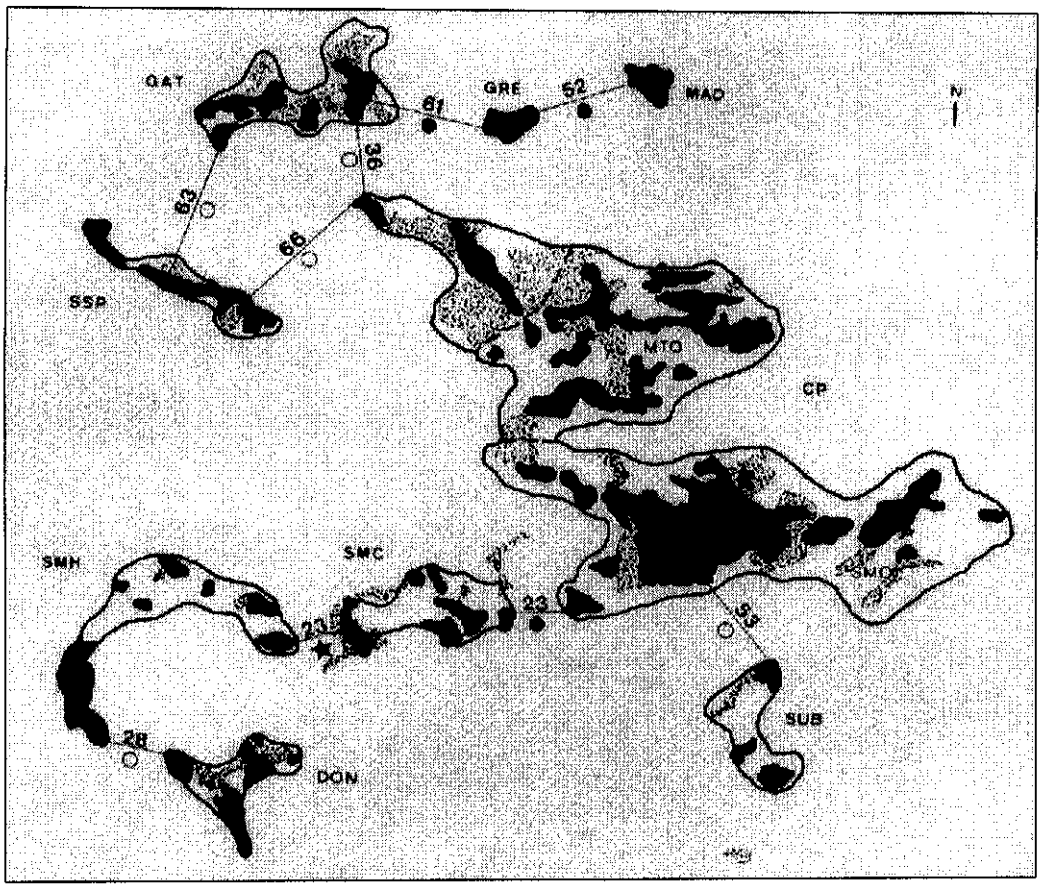

Figure 3.3.2. Breeding range, presence, dispersal, and distance between populations of Iberian Lynx

There have been numerous legislative attempts to protect the Iberian lynx population. The Convention on International Trade in Endangered Species of Wild Fauna and Flora listed the Iberian lynx in Appendix I: Species threatened with extinction which are or may be affected by trade (CITES, Washington, 1973). The Convention on the Conservation of European Wildlife and Natural Habitats listed the Iberian lynx in Appendix II: Strictly protected fauna species (Bern, 1979). The Bern Convention outlined three main objectives: (1) to conserve wild flora and fauna and their natural habitats, (2) to promote co-operation between states, and (3) to give particular emphasis to endangered and vulnerable species. The Portuguese Game Law removed the Iberian lynx from the game species list in 1974 and forbid captures. The Council Directive 92/43/EEC of the European Commission, The Conservation of Natural and Wild Fauna and Flora, listed the Iberian lynx in Appendix II: Priority species among those requiring special measures of habitat protection and also in Appendix VI: Strictly protected. The Portuguese Ministers Council Resolution n 142/97 in 1997 concerning the National List (First phase to submit to EU) included some lynx areas. Despite legislation at international, national, and regional levels, populations of Iberian lynx continue to decline.

3.4 Habitat requirements

As most felids, except the lion, cheetah, and domestic cat, the lynx is a solitary animal. The lynx is also territorial with territories ranging from 4 to 20 km^2 (Delibes, 1999). Lynx conservation will require large expanses of land to be conserved or restored for

lynx habitat. Lynx are shown to exhibit marking behaviours and defend their territory aggressively at times (Ferreras et al., 1997). These actions are intensified by the lack of suitable habitat.

The Iberian lynx is a habitat specialist, preferring the Mediterranean forests and scrublands of southwest Spain (Rodriguez & Delibes, 1992). Factors that influence habitat selection include, high vegetation cover, abundance of rabbits, and low human influence. Scrublands can be divided into two types, dry and wet (Moreno & Villafuerte, 1995). Wet scrublands are characterised by their proximity to marshes, medium vegetation cover (~54%), and a diverse grass understorey that is high in protein and water content. Dry scrublands are characterised by their location away from marshes, lower water table, and xerophytic vegetative cover (~67%) that are less diverse with lower protein and moisture content. Lynx are most consistently found in the wet variety but can tolerate dry scrubland habitat. Habitat ranges in altitude from 400 to 1300m, except in Doñana, which is at sea level (Rodriguez & Delibes, 1992).

3.5 Feeding habits

The predominantly nocturnal Iberian lynx are feeding specialists, dependent upon the European rabbit (*Oryctologalus cuniculus*) LCIE, 2000). Rabbits account for 80-100% of biomass consumed by Iberian lynx. Each lynx needs approximately 1 rabbit per day to survive. Lynx are rarely a threat to livestock and there are no documented attacks on humans (Delibes et al. 2000).

3.6 Reproductive capacity

The reproductive biology of the Iberian lynx is not well documented and the mating system varies between and among populations (Delibes et al., 2000, LCIE, 2000). Peak mating season is January through February but mating may occur year round. Most litters are born between March and April with a mean reproductive rate of 0.8 litters per female per year. Gestation is approximately 2 months and litter size ranges from 2 to 4 kittens per birth. Usually, only two survive weaning. At 10 to 11 months kittens become independent but remain in their natal territory, they disperse at 20 months. The age at which a female can first reproduce is debated and appears to be dependent on demographic and environmental factors, usually between the first and second year. They are able to reproduce until 10 years of age. Only females that hold a territory breed. Males do not help raise kittens and only meet females during the mating season. Breeding occurs in hollow trees and high understorey grasses of the scrubland; In the mountains, rocky outcropping are selected for breeding that usually coincide with hunting reserves or natural parks (Rodriguez & Delibes, 1992)

4.0 CONSERVATION THREATS

Threats are divided into three subgroups (Delibes et al., 2000). First, deterministic threats are factors that have caused and continue to cause a strong numerical decrease in the lynx population. Second, stochastic threats are factors that have effects that have

been amplified in small populations. Third, obstacles to conservation include factors imposed by political, administrative, social, and economic realities.

4.1 Deterministic

Deterministic factors include habitat alteration, habitat removal, prey scarcity and human induced mortality (Delibes et al., 2000). The decline in the lynx population, as well as, the recent extinction of individual lynx populations are both primarily a result of habitat destruction (Rodriguez & Delibes, 1992). Large developments in coastal tourism and intensively cultivated and irrigated lands have increased human pressures. For example, the harvesting of cork combined with overgrazing by ungulates has modified this habitat to make it unattractive to the lynx. Hydroelectric dams have converted some lynx habitat into aquatic freshwater reservoirs (Delibes et al., 2000). Also, the removal of buffers between agricultural plots and the development of roads has significantly altered habitat (Delibes, 1999). Several roads that have been constructed to connect villages traverse habitats historically occupied by lynx (Ferreras et al., 1992). This habitat fragmentation increases the number and length of edges and is associated with increased mortality risks to lynxes (Ferreras et al., 1992). More often, lynx are finding their way onto privately owned estates used as hunting reserves because of the higher quality of habitat and prey (Personal communication with Christian Gortázar).

In the 1950's European rabbits were nearly eradicated from the Iberian Peninsula by myxomatosis. In the 1980's, rabbit haemorraghic disease (RHD) had devastating

cumulative effects on the previously reduced rabbit population, particularly in northern Spain (Calvete et al., 1997). Rabbit populations were reduced by 80% in Doñana and by 90% in the Toledo Mountains. Prey scarcity is compounded by other generalist carnivores such as the red fox (*Vulpes vulpes*)(Palomares et al., 1996). Rabbits are intensively exploited by hunters, further threatening the extinction of the lynx's main prey base (Delibes et al. 2000).

Human activities are the main cause of lynx mortality (Ferreras, 1992). In Doñana park, 33.3% of lynx deaths result from illegal trapping, 20.8% from road traffic, and 12.5% from falling in artesian wells. Only 8.3% of lynx mortality result from natural processes. Until the 1950's the Spanish government paid a bounty for the killing of lynxes. Although hunting of the Iberian Lynx was banned in 1973 and an 8,000US dollar fine was implemented for the wilful killing of a lynx, significant numbers are killed in traps set for small game (Delibes, 1999, CSG, 1996). In 1998, a massive toxic spill inflicted immense damage to the Doñana ecosystem (CSG, 1998). The spill, originated from a Swedish-Canadian open-pit mine site and released 4 million cubic metres of acidic water, equivalent to the Exxon Valdez oil spill of the Alaskan coast. This illustrates the pressures and unforeseeable influence of human activity on wildlife populations such as the Iberian lynx.

4.2 Stochastic

Stochastic threats include demographic viability, genetic viability, and disease and catastrophe (Delibes et al., 2000). The smaller the population the more susceptible to extinction based on low numbers of breeding females and low rates of replacement. Genetic viability is lost quickly in small populations. The Iberian lynx is vulnerable to genetic drift, where alleles with low frequency are likely to disappear from the population gene pool (CSG, 1996). For example, when Doñana National Park was established in 1959, three pelage patterns were present; currently no animals exhibit the rarer fine spotted pattern (Delibes, 1999, Delibes et al., 2000). Reduced genetic variability in small populations also makes them more exposed to diseases. Such outbreaks may rapidly extirpate small, isolated lynx populations.

4.3 Obstacles

There are several obstacles to conservation. The first is lack of co-ordination between administrations. The conservation of most lynx populations is managed by at least two regional administrations. Other populations straddle the boundary between Spain and Portugal. Management programs of such frontier lynx populations are rarely co-ordinated (Delibes et al., 2000). Furthermore, mechanisms of co-ordination are sometimes lacking within administrative units. Different government departments often make contradictory decisions affecting lynx populations. Second is the lack of incentives for the conservation of lynx habitat. Big game hunting and recreation offers a higher

profitability use of the Mediterranean forests as opposed to traditional land-use that is linked to optimal lynx habitat (Delibes et al., 2000). There is no current economic or social incentive program for the conservation of optimal rabbit and lynx habitat. The third obstacle is human attitudes toward small game predators and their control. Predator control is extensively applied on the small game hunting estates since hunters perceive red fox and other generalist predators to be harmful for business. Unfortunately, non-selective methods are widely used, which has serious implications for lynx conservation. The final obstacle is limited knowledge. Important conservation decisions are often based on limited biological, ecological, behavioural, and social information (Delibes et al., 2000). Doñana is the only population that has been intensively studied. This is a limiting factor in the design of a comprehensive management plan.

5.0 MANAGEMENT SOLUTIONS

The Council of Europe published an Action plan for the conservation of the Iberian lynx in 2000. The plan outlines three specific objectives. First, increase the size of the extant lynx population to genetically viable levels and maximise connection between isolated populations. Second, favour natural or assisted re-colonisation in areas where lynx have disappeared, potential recuperation areas, or other areas where successful introduction would be feasible. Third, develop alternatives to make profitable the preservation of all elements of the Mediterranean forest. There are numerous approaches to the management of the Iberian lynx that have been assigned specific actions.

5.1 Co-ordination and planning

A number of actions have been formulated to achieve co-ordination of lynx management (Delibes et al., 2000). First, the Bern Convention must adopt the action plan and propose it to the Portuguese and Spanish authorities. Second, the governments of Portugal and Spain must set up an interdisciplinary team to draw-up, co-ordinate, implement, and supervise the Portuguese Plan and the Spainish Strategy for Iberian lynx conservation. Third, specific formulas for trans-regional and trans-national co-ordination in lynx management must be developed. Fourth, specific conservation measures must be integrated into existing laws and regulations or provide new legal coverage. Finally, the Iberian lynx conservation plan and strategies must be published in official gazettes. There are numerous cases where multiple agency co-operation has been successful in the management of endangered species. Community conservation of tigers in Nepal illustrates the social profitability of co-operation among interest groups (Long, 1999). This project was a joint effort between the local community, WWF, and the Nepalese Department of National Parks and Wildlife Conservation. The focus of the project was to promote guardianship of tiger habitat through economic incentive.

5.2 Habitat protection and restoration

Researchers emphasise the need for an ecosystem/land-use approach to conservation since it is difficult to establish reserves that are large enough to ensure the survival of the threatened lynx (Rodriguez & Delibes, 1992). Also, conservation of the Mediterranean

ecosystem must harmonise "the development of rural areas with the maintenance of habitats and traditional land uses (Rodriguez & Delibes, 1992, p. 195). Land-uses conducive to the preservation of scrubland must be established and road construction must be banned in key lynx habitat (Delibes, 1999). There must be an incentive program for landowners to encourage lynxes on privately owned land.

An illustration of a successful conservation initiative is the Cabañeros reserve. In 1985, the Spanish Air force sought to acquire the Cabañeros estate, a large area in Toledo Mountains (CSG, 1985). This area was considered key lynx habitat. In 1989, the government denied the air force proposal and established a 267km^2 natural park at Cabañeros, the largest wild Mediterranean forest in the world (CSG, 1989). This area now represents one of the largest populations of lynx.

The European Commission's Action Plan outlines several other key actions (Delibes et al., 2000). This plan calls for the revision of European policy and the development of criteria to convert abandoned agricultural lands, and to improve forestry lands, into suitable lynx habitat. Also, the physical removal of scrubland vegetation must cease and economic incentives and tax exemption aimed at conservation of Mediterranean scrubland and proper management must be implemented. Areas for ecological corridors must be identified to increase dispersal.

5.3 Rabbit recovery

There are several approaches to instigating rabbit recovery. Since myxomatosis, more than 500,000 rabbits have been released annually in Spain (Calvete et al., 1997). This appeared successful until the RHD epidemic in the 1980's that further devastated rabbit populations. Unfortunately, rabbit restocking is not an effective method of increasing prey. Calvete et al. (1997) found that the survival rate of restocked rabbits (mostly relocated wild rabbits) was less the 3%. Causes of mortality included injuries, disease, and predation. The effectiveness of this management approach can be increased by control for wildlife diseases, short captivity period, and disturbance of carnivores during the release by fencing the restocking area. In economic terms, these methods may not be cost-efficient considering modest dispersal rates of restocked rabbits (Calvete et al., 1997).

Another approach to rabbit recovery is the restoration of traditional management of scrubland. Traditional land-uses have been eliminated from many areas designated for nature conservation and is suspected to have contributed to the declining rabbit population (Moreno & Villafuerte, 1995). In Doñana National Park, it was demonstrated that rabbit activity was found to be significantly greater in burned areas of scrubland than non-burned areas. It is further postulated that "the increased use of the burned areas may also indicate an improvement in rabbit condition that could lead to improved survival and reproduction (Moreno & Villafuerte, 1995, p. 83)."

5.4 Reduction of mortality causes

There are numerous methods of reducing mortality. The use of snares and trapping must be banned in lynx areas and bans must be enforced (Delibes, 1999). Mortality by non-selective predator control can be eliminated by the development of alternative, selective methods of predator control. Artesian wells must be covered and poaching must be stopped through awareness campaigns. Decision-making must be co-ordinated with the construction of new roads and lynx conservation that avoid high-risk crossing sites (Delibes et al., 2000).

5.5 Public information and education

The Action Plan also outlines actions that promote public awareness and education (Delibes et al., 2000). Managers must identify key interest groups that require different messages in relation to the conservation of Iberian lynx and the Mediterranean scrubland. Awareness campaigns must be designed and directed towards various interest groups. Managers must promote the conservation of lynx as a symbol of pride and the responsibility of preserving them. Education must be improved both at public and institutional levels. The incentives and advantages derived from lynx conservation must be disseminated.

5.6 Protection of areas of presence and promotion of connections

Natura 2000 proposed the declaration of "sites of community importance (SCI's) of enough areas to ensure the long-term viability of lynx populations. Delibes et al. (2000) also suggests special protection to all areas suitable as corridors between isolated populations. It is necessary to promote incentives and public awareness in the SCI's and longitudinal research regarding the construction or recovery of corridors across areas isolated by impermeable barriers.

5.7 Reduction of inbreeding

To reduce inbreeding research must be conducted on the composition and structure of the various lynx populations and their genetic characteristics. Natural communication must be promoted through dispersal by preserving and restoring natural corridors connecting populations. Translocation projects can minimise the loss of genetic variability in the short-term.

5.8 Captive & semi-captive breeding

The Iberian Lynx captive breeding centre was inaugurated in 1992 in Doñana National Park (CSG, 1993). This provides a starting point for a captive-breeding program. Scientists must also create a bank of lynx genetic material to be used in the prevention of

further genetic impoverishment (Delibes et al., 2000). The viability of breeding Iberian lynx may be assessed under semi-natural conditions at the breeding centre.

5.9 Monitoring and research

There is a fundamental lack of research on and knowledge of the Iberian Lynx. "Little effort has been devoted to understand its biology, ecology and behaviour, perhaps due to the species scarcity and limited distribution" (Delibes et al., 2000). p. 13). Monitoring and research must encompass population estimates, population dynamics, habitat requirements, inter and intra-population genetic variation, landscape ecology, population ecology of rabbits, parasites and diseases, and the identification of public values and attitudes.

6.0 HUMAN DIMENSIONS

Wildlife management is often referred to as a political decision-making process or the science of manipulating habitat, wildlife, and people to achieve human defined goals through the management of wildlife species (Anderson et al., 1987). Human dimensions in wildlife management "focuses on public knowledge levels, expectations, attitudes and activities concerning fish and wildlife resources and associated habitats. There is a close tie between human dimensions and conservation education research" (Adams, 1988). Human dimensions research investigates human wildlife interactions as well as the

attitudes and beliefs of various interest groups. It is implicit that human interactions and wildlife biology must be balanced in order to conserve endangered species.

6.1 Interest Groups

Interest groups were identified through personal communication with several experts in lynx ecology and management. Each was asked six key questions:

1. Who are the key interest groups?
2. For each group, what is their main concern/issue?
3. For each group, what is their preferred management option?
4. How do the local people perceive the Iberian Lynx? Are their any local or community-based initiatives?
5. As a key researcher in this area, what do you personally believe to the greatest threat to conservation? What must be done to reverse the declining trend in the Iberian Lynx population?
6. For the following list of threats, rate the relative importance of each (from 1(most important) to 11(least important).

a) Habitat alteration
b) Habitat removal
c) Prey scarcity
d) Human induced mortality
e) Demographic viability
f) Genetic viability
g) Disease and catastrophe
h) Lack of co-ordination between administrations
i) Lack of incentives for conservation of lynx habitat
j) Human attitudes towards small game predators and their control
k) Limited knowledge

Respondents identified six main interest groups, fig 6.1.1.

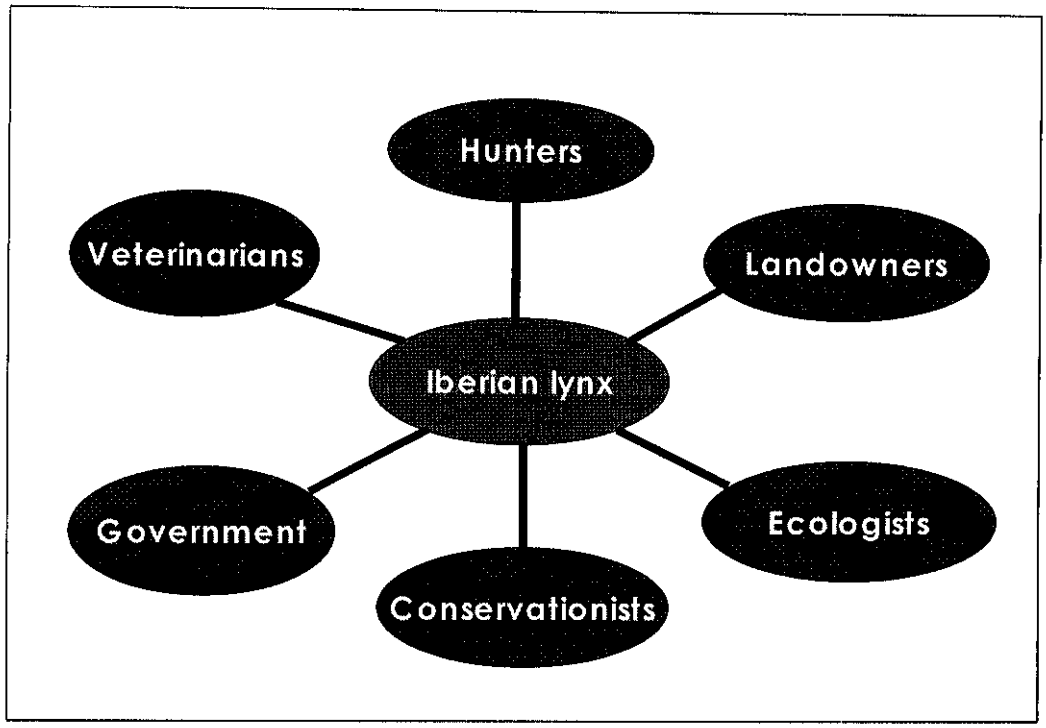

Figure 6.1.1. Stakeholder map of key interest groups

The world's leading ecologists, including veterinarians are fighting for the survival of the Iberian lynx, as well as, various conservation-minded regional and international organisations. WWF and WWF Adena are primarily concerned with the conservation of nature and ecological processes (WWF, 1998). Their fundamental aim is to preserve the world's biodiversity. The World Conservation Union (IUCN) has a similar platform, to encourage the world community to conserve the integrity and diversity of nature and to ensure the ecological sustainability of natural resources (IUCN, 2000). The Cat Specialist Group, under the directive of the IUCN, "is pledged to do all in its power to achieve the conservation of all cat species, and appeals for the co-operation of all people to ensure that these magnificent animals continue to co-exist with humans as they have through the ages" (CSG, 1996). The Species Survival Commission (SSC) also under the

directive of the IUCN aims to encourage action by the conservation community particularly for threatened or endangered species (SSC, 2000). The Large Carnivore Initiative for Europe (LCIE), a network of representatives from governmental and non-governmental organisations, aims to maintain and restore viable populations of large carnivores as an integral part of the European landscape and to promote co-existence among humans and carnivores (LCIE, 2000). The Iberian Lynx is one of five large carnivores upon which the initiative focuses.

The Government of Spain has dedicated many resources to lynx conservation. The *Ministerio de Medio Ambiente* (Ministry of Environment) has implemented a lynx study group and the *Conservacion de la Naturaleza* (Nature Conservatory) has established 12 national parks plus several reserves. The Institute for the Conservation of Nature (ICONA) and the Spanish Council for Research also play an active role in lynx conservation and research.

Wildlife managers are primarily concerned that current conservation measures have had little success and that limited knowledge inhibits the management of lynx. Generally, landowners and hunters have negative attitudes towards the endangered lynx. They view the lynx as a serious economic threat since restrictions to land-use are magnified as serious economic losses. The general public have less vested interest than landowners but it has been shown that urban dwellers are more likely to view the Iberian lynx as an appealing symbol for the conservation of Mediterranean ecosystems and a source of pride (Delibes et al., 2000).

Each interest group perceives different key issues and management strategies for the conservation of Iberian lynx, Table 1 and 2. The results of question six illustrate the unanimous agreement of experts on the top three threats to the Iberian lynx population: (1) Prey scarcity, (2) Disease, and (3) Habitat alteration.

Table 1. Common Ground Matrix: Key issues

Key issues	Ecologists	Conservationists	Veterinarians	Land owners	Hunters	Government	Managers	**Total**
Diversity		X						**1**
Fragmentation	X	X						**2**
Game production				X	X			**2**
Genetic viability	X		X					**2**
Habitat alteration	X	X						**2**
Habitat corridors		X				X		**2**
Habitat protection						X	X	**2**
Illegal trapping	X	X			X		X	**4**
Lack of knowledge	X							**1**
Legislation		X				X		**2**
Pollution		X						**1**
Population Decline	X	X	X					**3**
Prey Scarcity	X	X		X	X		X	**5**
Tourism				X		X		**2**
Wildlife diseases	X		X					**2**
Extinction	X	X					X	**3**
Uncertainty	X						X	**2**
Legal restrictions				X	X			**2**
Land converted to parks/reserves				X				**1**
Total	**10**	**10**	**3**	**5**	**4**	**4**	**5**	

Table 2. Common Ground Matrix: Management Strategy

Management strategy	Ecologists	Conservationists	Veterinarians	Land owners	Hunters	Government	Managers	**Total**
Habitat management	X						X	**2**
Research	X						X	**2**
Translocation	X						X	**2**
Habitat protection	X	X						**2**
Prohibit hunting		X						**1**
Predator control		X						**1**
Captive breeding	X		X				X	**3**
Sanitary management of ungulates			X					**1**
Rabbit recovery	X		X		X		X	**4**
Lynx re-introduction	X						X	**2**
Traditional land use	X			X				**2**
Total	**8**	**3**	**2**	**1**	**1**		**6**	

6.2 Models of felid conservation in human landscapes

Populations of wild felids have declined and been fragmented by contemporary land uses. Furthermore, it is likely that local efforts to protected endangered felids such as the Iberian lynx will be unsuccessful due to the area requirements of wide-ranging carnivores (Litvaitis et al., 1996). Management efforts may take decades to implement; in the case of lynx, the population may be annihilated before initiatives are completed. Litvaitis et al. (1996) illustrates the human component of felid conservation through several interpretative models that are eminently applicable to human-lynx relations. Each model emphasises a multifaceted approach to felid-human interactions both on a spatial and

temporal continuum. In addition, Litvaitis et al. notes that "persistence of disjunct populations of felids in human-dominated habitats will likely be dependent on management efforts at several spatial and temporal scales.

Figure 6.2.1 illustrates human forces and their effects on felid populations. Human-lynx relationships deviate in space and time. At the local, short-term scale, human pressures lead to a reduction in lynx density. For example, overgrazing in one hunting reserve reduced the density of lynx in that area. At the landscape, intermediate scale, human land use practices such as deforestation, intensive agriculture, and urbanisation has resulted in sink/source habitats (ie. low quality habitat that surrounds suitable habitat that supports small groups of breeding individuals). For example, in south west Spain the landscape consisted of large hunting estates that modified the quality of habitat in many areas. Pockets of suitable land were preserved as *Parques Nationales* (National Parks) amid the low quality habitat on the estates. The spatial concept of landscape does not adhere to political boundaries and therefore this landscape extends into southern Portugal. At the regional, long-term scale, population fragmentation decreases genetic viability thus making individuals vulnerable to stochastic extinction. For example, fragmentation of the lynx population as a result of human-lynx interactions at previous spatial and temporal scales led to nonviable, inbreed metapopulations.

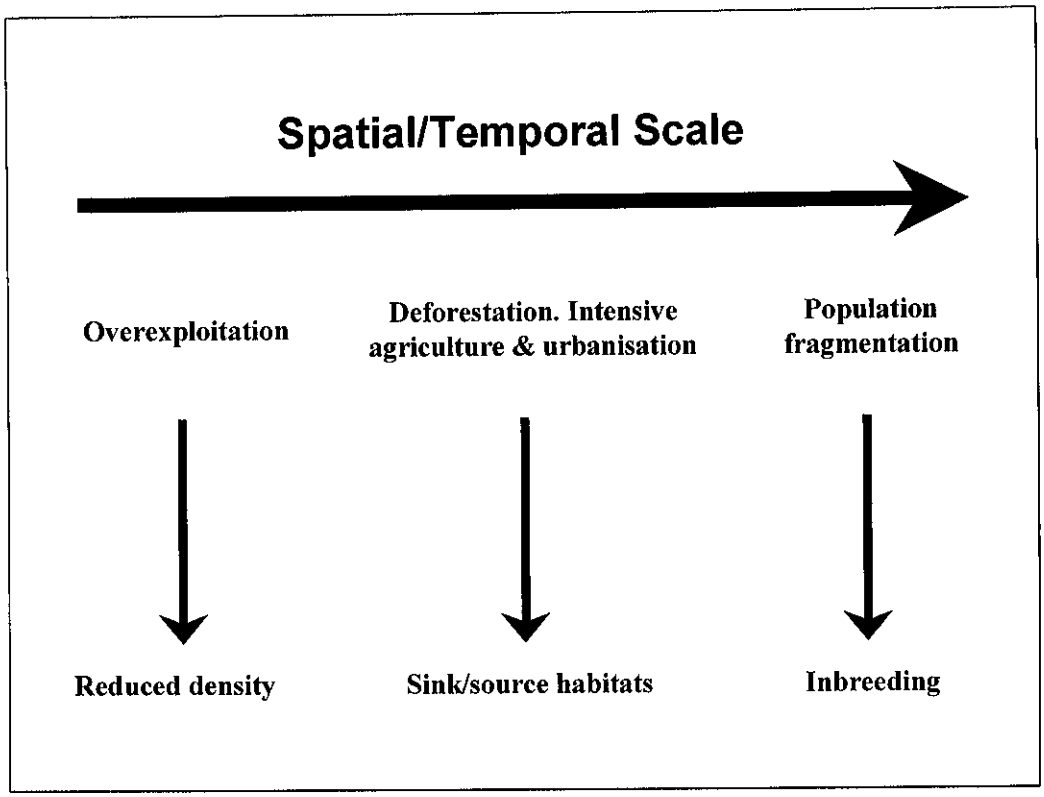

Figure 6.2.1. Human forces and their effects on felid populations
*** adapted from Litvasitis et al., 1996**

Figure 6.2.2 depicts actions that may reverse the decline of felid populations in humanised landscapes. Actions differ at spatial and temporal scales. At the local, short-term scale, flexible legislation to eliminate hunting and trapping must be enacted immediately and combined with public awareness programs. At the landscape, intermediate scale, efforts are best focused on habitat manipulation that will enhance prey and subsequently increase the carrying capacity for lynx. Moreno and Villafuerte (1994) concur with Litvaitis' et al. model; they demonstrated that habitat restoration has increased the abundance of European rabbits. At the regional, long-term scale, the development of habitat corridors is expected to lead to long-term viability of lynx

populations. Habitat corridors are critical to dispersal among populations. WWF Adena in co-operation with the Natura 2000 initiative of the EU, are currently focusing efforts on a series of corridors between the most viable lynx populations in Spain and Portugal (Cobo & Beaufoy, 2000).

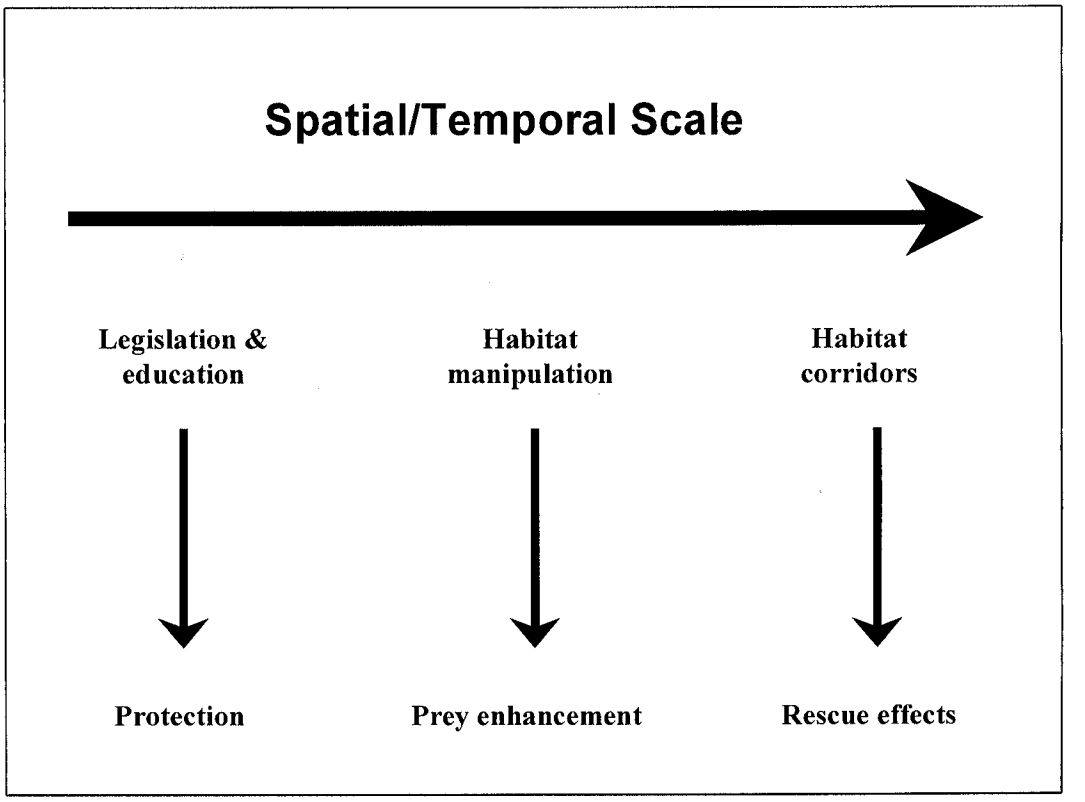

Fig 6.2.2. **Actions to reverse declining felid populations in humanised landscapes**
*** adapted from Litvasitis et al., 1996**

Figure 6.2.3 illustrates the relative influence of conservation efforts to restore endangered felid populations. The letters represent various temporal and spatial locations. Point A indicates local/immediate efforts, Point B indicates landscape/interim efforts, and Point C indicates Regional/long term efforts. Population viability is greatest when efforts are

occurring at cumulative spatial and temporal scales. Efforts may occur in either direction, A to C (bottom-up), or from C to A (Top-down).

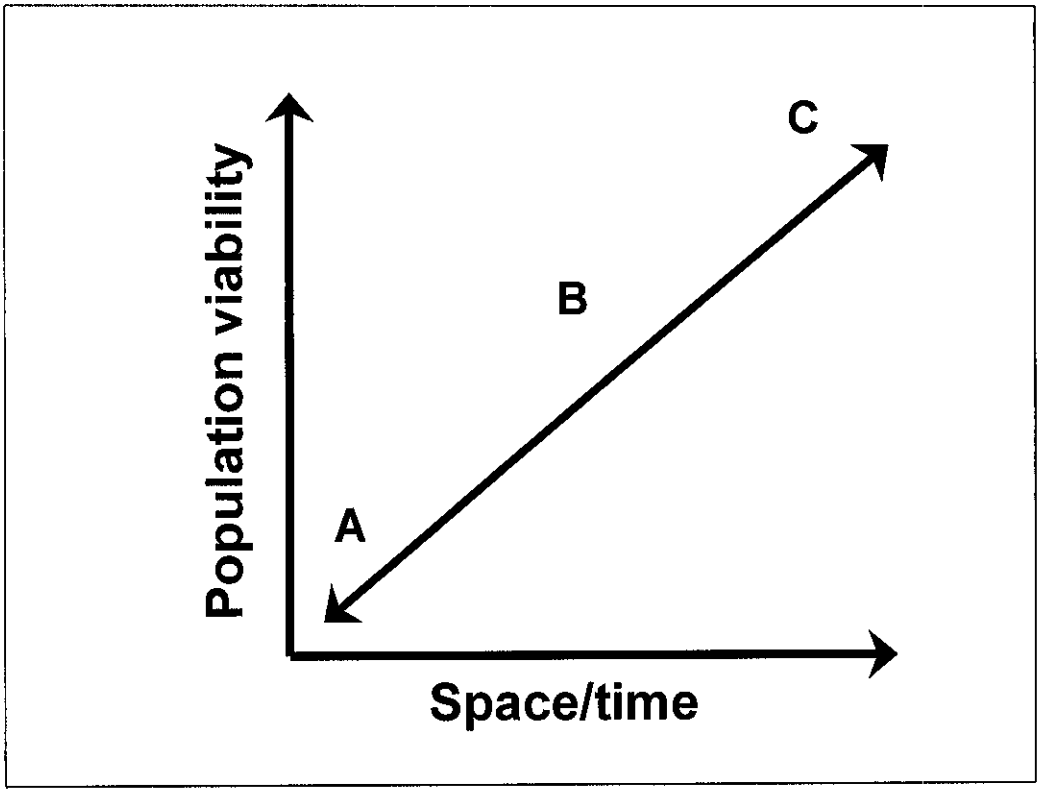

Fig 6.2.3. **Spatial/temporal influence of conservation efforts on population viability**
*** adapted from Litvasitis et al., 1996**

7.0 THE FUTURE OF THE IBERIAN LYNX

According to leading researcher Miguel Delibes, "If current trends continue, the Iberian lynx will probably disappear in the first half of the 21st century. This would be a huge embarrassment for Europe, as it would represent the first well-documented extinction of a wild felid. However, an increasing number of people are working to change current

trends and we can only hope they are successful" (LCIE, 2000). "Areas designated for nature conservation...may be inadequate to provide for the survival of the species originally contained within them" (Ferreras et al., 1992). The future seems pessimistic since the number of individuals lost in unfavourable years exceeds the potential increase in optimal years.

"Only saving the Iberian lynx will grant Europe the moral authority to call for the conservation of biodiversity in other parts of the world" (Delibes et al., 2000, p 28). Co-existence of humans and lynx is only possible as long as all interested parties join forces in the management of lynx populations. The threats may be insurmountable for the vanishing Iberian lynx. A management program that utilises a variety of approaches at multiple temporal and spatial scale provides the only hope for conservation. If Europe cannot co-exist with the Iberian lynx, the future for other large carnivores may also become problematic in the future.

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