

## Short Communication

### The ibex *Capra pyrenaica* returns to its former Portuguese range

Gisela Moço, Margarida Guerreiro, Ana Filipa Ferreira, António Rebelo, Armando Loureiro, Francisco Petrucci-Fonseca and Jesús M<sup>a</sup> Pérez

**Abstract** The ibex *Capra pyrenaica* has recently recolonized its former Portuguese range from a contiguous Spanish protected area. The first observations of ibex in Portugal were in Peneda-Gerês National Park in 1998. In 2001 we began a survey to confirm ibex presence in Portuguese territory, and to determine the current status of the species there. There are three ibex nuclei in the general area of the international border, and they are expanding their geographical range with two of the nuclei almost restricted to Portuguese territory. In 2003 the ibex population consisted of a minimum of 75 individuals. Different founder histories have led to distinct

age structures in each nucleus, but in general they exhibit the population dynamics typical of a recently reintroduced population with high reproductive potential. Priority conservation actions for this newly established population need to include increased monitoring, and reinforcement of the population with individuals from elsewhere. Effective conservation will require collaboration between staff of both Portuguese and Spanish protected areas and an integrated Spanish-Portuguese conservation plan.

**Keywords** *Capra pyrenaica*, ibex, Portugal, Red List, reintroduction, Spain.

The ibex *Capra pyrenaica* was once widely distributed throughout the Iberian Peninsula and the French Pyrenees but over the last 2 centuries its populations decreased greatly as a result of excessive hunting and habitat loss (Alados, 1985; Crampe, 1990; Pérez *et al.*, 2002). This mountain ungulate became extinct in Portugal and France in the 19th century but persisted in Spain. The ibex population that inhabited north-west Portugal and the Galicia region of Spain until the last decade of the 19th century belonged to the subspecies *C. p. lusitanica* (Cabrera, 1914) and the Gerês-Xurés massif of Portugal and Galicia was its last redoubt. The last known individuals were a female captured alive and another found dead, both in the Portuguese part of Gerês-Xurés in 1890 (Tude de Sousa, 1927).

The subspecies *C. p. pyrenaica* inhabited the Pyrenees and continued to occupy Spanish territory after its extinction in the French Pyrenees, but it became extinct in Spain in 2000 (Pérez *et al.*, 2002). There are now only

two extant subspecies: *C. p. hispanica* in central and Mediterranean Spanish mountain ranges, categorized as Lower Risk: conservation dependent on the IUCN Red List (IUCN, 2004), and *C. p. victoriae* in the north-west Iberian Peninsula, categorized as Vulnerable. Both subspecies are important hunting trophies in Spain. At the species level *C. pyrenaica* is categorized as Lower Risk: near threatened (IUCN, 2004). Generally, ibex populations in Spain have increased in both total numbers and range in the last 3 decades, and the total Spanish population was estimated at the end of the 1990s to be c. 50,000 in more than 50 nuclei (Pérez *et al.*, 2002; Fig. 1a).

In 1998 ibex were unexpectedly reported in Portugal. Here we describe the circumstances that led to this and present the first data on the founder population that recolonized the species' former Portuguese range.

The return of ibex to Portugal was the result of the translocation of the subspecies *C. p. victoriae* to Galicia (Fig. 1a). In 1992 four males and eight females were moved from Gredos National Reserve in Salamanca, Spain, to Invernadeiro Natural Park in Galicia. By 1997 this population had increased to 71 animals, and 18 were translocated to Baixa Limia-Serra do Xurés Natural Park. This protected area is adjacent to Portugal's Peneda-Gerês National Park. The two Parks were together named as Gerês-Xurés International Park in 1997.

In Baixa Limia-Serra do Xurés Natural Park five males and 11 females were kept in an enclosure at Salgueiros and one male and one female in an enclosure at Santa Eufémia (PNBLSX, 2001; Fig. 1b). By the end of 1998 the

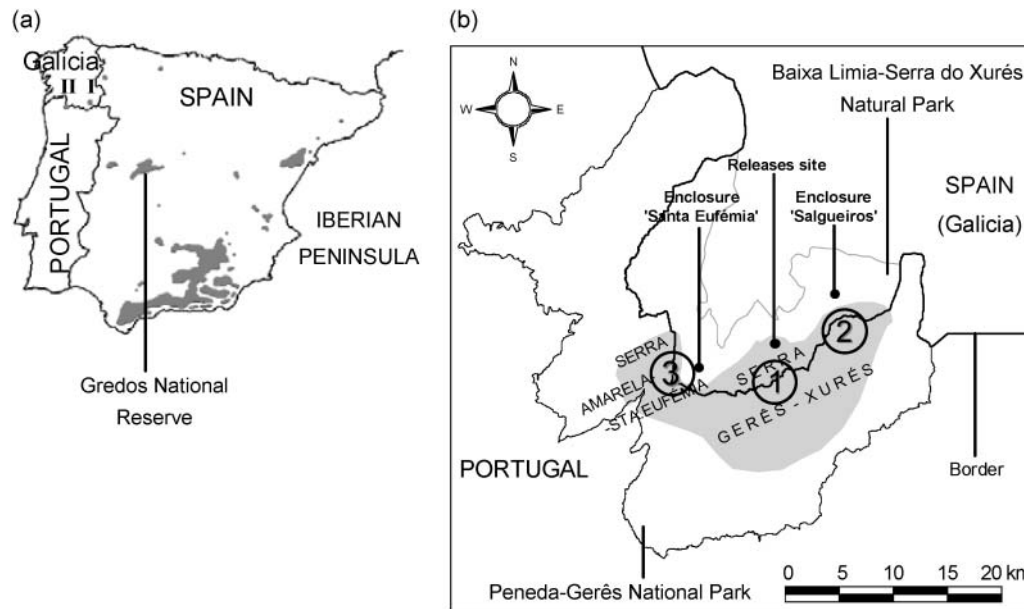
Gisela Moço (Corresponding author) and Jesús M<sup>a</sup> Pérez Departamento de Biología Animal, Biología Vegetal y Ecología, Universidad de Jaén, Paraje Las Lagunillas, s.n. E-23071 Jaén, Spain. E-mail gmoco@sapo.pt

Margarida Guerreiro, Ana Filipa Ferreira and Francisco Petrucci-Fonseca Centro de Biologia Ambiental, Faculdade de Ciências da Universidade de Lisboa - Campo Grande, 1749-016 Lisboa, Portugal.

António Rebelo and Armando Loureiro Parque Nacional da Peneda-Gerês/ Instituto da Conservação da Natureza - Quinta das Parretas, Rodovia, 4700 Braga, Portugal.

Received 9 December 2004. Revision requested 11 May 2005.

Accepted 4 January 2006.



**Fig. 1** (a) Ibex translocations to the north-western Iberian peninsula in 1992 (I, Invernadeiro Natural Park) and 1997 (II, Gerês-Xurés International Park); grey areas indicate the current distribution of ibex (from Pérez *et al.*, 2002). (b) The area surveyed (shaded grey) in Gerês-Xurés International Park on the Portuguese-Spanish border, with the locations of the two enclosures and the release site, and of ibex nuclei 1–3 (see text for details).

first ibex escapes from both enclosures were reported and these events led to the first observations of ibex in Portuguese territory: three ibex in Serra Amarela (3.4 km from the Santa Eufémia enclosure) and three in Serra do Gerês (3.0 km from Salgueiros). During 2000 and 2001 the Natural Park officially released a total of 25 ibex in Serra do Xurés.

In 2001 we started monitoring ibex presence and movements in Gerês-Xurés International Park. Our goals were to (1) investigate ibex presence in Portuguese territory, (2) determine the species' status, and (3) on the basis of such information, develop guidelines for population monitoring and management.

Monthly between September 2001 and December 2003 we surveyed the two massifs (with Portuguese and Spanish ranges) where ibex had been documented since 1998: Serra do Gerês-Xurés and Serra Amarela-de Santa Eufémia (Fig. 1b). We systematically searched on foot ( $n = 150$  transects) and from fixed observation points ( $n = 54$ ). The number of km walked per day was 1.9–25.8 km (mean  $\pm$  SD  $6.8 \pm 5.9$  km, total = 1,020.7 km) with 5–13 survey hours (mean  $\pm$  SD  $6.8 \pm 3.2$  hours, total = 1,185.3 hours) per day. In each encounter we recorded number, sex and age class, and location for inclusion in the geographical information system *ArcView* 3.1 (ESRI, 1996). Ibex nuclei were defined as localities where the same individuals were observed in consecutive surveys. Although we were only able to distinguish a few individuals, the social behaviour of the

species, the low number of ibex per nucleus and the distance between localities allowed us to identify these units. The geographical ranges of nuclei and the overall area of ibex occurrence were determined as the 100% Minimum Convex Polygon (MCP) of ibex locations (Dunham, 2001) using the Animal Movement extension to *ArcView* (Hooge *et al.*, 1999). The MCPs were calculated for 2001–2002 combined (because only a few locations were obtained for 2001) and for 2003. Once we were familiar with the study area the number of ibex in each nucleus was determined by direct total counts (Staines, 1978; Tellería, 1986; Alados & Escós, 1996) because ibex range was limited and numbers were low. If animals showed sedentary behaviour we assumed that we were able to detect all individuals. When this assumption was not possible the total number of individuals observed was considered to be the minimum number (Dunham, 2001). Age classes were defined as adult ( $\geq 2$  years), yearling (1–2 years) and kid ( $< 1$  year). The term juveniles was used when referring to both yearlings and kids. Sex ratio was calculated as number of adult females/adult males and a reproductive index as number of kids/number of adult females (Pereladova *et al.*, 1998). Causes of death and missing individuals were investigated by inquiries with local shepherds and staff from Peneda-Gerês National Park and Baixa Limia-Serra do Xurés Natural Park.

The presence of three ibex nuclei in the study area was confirmed (Fig. 1b). Nucleus 1 occupies the central part

of the Gerês-Xurés mountain range, nucleus 2 the eastern limit of the same range and nucleus 3 the Amarela-Santa Eufémia range. Nuclei 2 and 3 correspond to the localities of the first ibex observations in 1998, and it therefore appears that they were the result of escapes from Salgueiros and Santa Eufémia enclosures, respectively. Nucleus 3 did not receive any immigrants during our study. There were immigrants to nucleus 2 during the survey period (Table 1) that could have come from nucleus 1 (we frequently observed ibex signs between the two locations) or were new escapees from Salgueiros enclosure. Nucleus 1 has formed of individuals from the official releases of Baixa Limia-Serra do Xurés Natural Park but it is possible it also receives escapees from Salgueiros. Nucleus 1 occupies the largest area (Table 1), with 75% of it located on the Spanish side of the border. The MCPs of nuclei 2 and 3 are smaller and predominantly located in Portugal (<1% of the MCP of nucleus 2 is in Baixa Limia-Serra do Xurés Natural Park in Spain and nucleus 3 is restricted to Peneda-Gerês National Park in Portugal). MCP areas of all nuclei, and in particular that of nucleus 3, increased from 2001–2002 to 2003.

In 2003 there was a minimum of 75 individuals (Table 1). Because most of the released and escaped ibex were adults there is a high proportion of adults in the population. As a result of the small population size and restricted range of the ibex in Peneda-Gerês National Park, it has been proposed that the species' Red List status in Portugal is changed from Extinct to Critically Endangered (Cabral *et al.*, in press). Sex ratios and reproductive indices of each nucleus (Table 1) were influenced in particular by the initial composition of the

founders. Information from local people suggested that there has been poaching of individuals from both nuclei 2 and 3.

Our results describe a population that is apparently increasing without resource limitation, and the geographical ranges of the nuclei are expanding, probably as a consequence of population growth. There are, however, some conservation concerns for individual nuclei. Nuclei 2 and 3, with lower numbers, are relatively near human habitation and their ranges are easily accessible to livestock, shepherds and tourists, and to poachers from both Portugal and Spain. Despite its higher reproductive potential, nucleus 3 may be affected by inbreeding, given its demographic history and geographic isolation. The range of nucleus 1 includes a hunting zone in Baixa Limia-Serra do Xurés Natural Park, and this nucleus could therefore become affected by hunting.

Priority conservation actions for this newly established population of *Capra pyrenaica* needs to include increased monitoring, and reinforcement of the population with individuals from elsewhere. Any hunting plans for ibex need to be considered cautiously, and there needs to be control of feral goats and dogs, domestic sheep and goats, and tourism in current and potential ibex range. Effective conservation will require collaboration between staff of both Portuguese and Spanish protected areas and an integrated Spanish-Portuguese conservation plan for the species.

Following our recommendations Peneda-Gerês National Park put into practice a surveillance plan for ibex and has continued to support studies of ibex diet and the monitoring of abundance, range and habitat use, and habitat modelling.

**Table 1** The number of ibex in three nuclei in Gerês-Xurés International Park during 2001–2003, with the sex ratio, reproductive index and home range areas calculated as the minimum convex polygon (MCP; see text for details).

Nucleus	Year	Number of ibex					Total	Sex ratio	Reproductive index	MCP(km <sup>2</sup> )
		Males	Females	Yearlings	Kids	Undetermined				
1 <sup>1</sup>	2001	6 <sup>2</sup>	14	0	4	5	29	2.3	0.3	5.29
	2002	10	13 <sup>3</sup>	3	7	1	34	1.3	0.5	–
	2003	12	14	3	9	5	43	1.2	0.6	7.04
2 <sup>1</sup>	2001	1	1	1	1	0	4	1.0	1.0	0.39
	2002	3 <sup>3</sup>	3 <sup>3</sup>	1	1	0	8	1.0	0.3	–
	2003	6 <sup>4</sup>	4 <sup>4</sup>	1	4 <sup>4</sup>	0	15	0.7	1.0	1.81
3	2001	2	2	1	3	0	8	1.0	1.5	0.09
	2002	2	3	3	4	0	12	1.5	1.3	–
	2003	2	5	3	6	1	17 <sup>5</sup>	2.5	1.2	0.92
Total	2003	20	23	7	19	6	75	1.2	0.8	9.77

<sup>1</sup>Minimum number of individuals (see text for details)

<sup>2</sup>One male died due to bad winter conditions (Parque Natural Baixa Límia – Serra do Xurés, pers. comm.) and one female due to unknown causes

<sup>3</sup>One male missing; 3 males and 1 female immigrated

<sup>4</sup>One female with kid, and two males immigrated

<sup>5</sup>One undetermined individual missing during summer

## Acknowledgements

This work was funded by the Environment Operational Programme, sponsored by Leica, and its continuation is supported by the Foundation for Science and Technology of Portugal through a PhD fellowship (Ref.: SFRH/BD/10546/2002). We wish to thank Miguel D. Gama, Francisco Álvares, José Carlos Brito, Lúcia Jorge, Daniel Santana, Susana Silva, Dinis Peixeiro, Peneda-Gerês National Park technicians and rangers, Carlos Silva, Fernando Machado, Daniel Manso, Jesus Martínez, Sara Roque and Pablo Guerrero.

## References

- Alados, C.L. (1985) Distribution and status of the Spanish Ibex (*Capra pyrenaica*). In *The Biology and Management of Mountain Ungulates* (ed. S. Lovary), 204–211, Croom-Helm, Beckenham, UK.
- Alados, C.L. & Escós, J. (1996) *Ecología y comportamiento de la cabra montés. Consideraciones para su gestión*. Museo Nacional de Ciencias Naturales. Consejo Superior de Investigaciones Científicas, Madrid, Spain.
- Cabral, M<sup>a</sup> J. (Coordinator) (in press) *Livro Vermelho dos Vertebrados de Portugal*. Instituto da Conservação da Natureza, Lisboa, Portugal.
- Cabrera, A. (1914) *Fauna Ibérica: Mamíferos*. Museo Nacional de Ciencias Naturales, Madrid, Spain.
- Crampe, J.-P. (1990) *Projet de réintroduction du bouquetin ibérique au versant nord des Pyrénées Occidentales*. Tarbes, Parc National des Pyrénées, France.
- Dunham, K. (2001) Status of a reintroduced population of mountain gazelles *Gazella gazella* in central Arabia: management lessons from an arid land reintroduction. *Oryx*, **35**, 111–118.
- ESRI (1996) *ArcView GIS – User's guide version 3.1*. Environmental Systems Research Institute, Redlands, USA.
- Hooge, P.N., Eichenlaub, W. & Solomon, E. (1999) *The Animal Movement Program*. USGS, Alaska Biological Science Center, Anchorage, USA.
- IUCN (2004) *IUCN Red List of Threatened Species*. IUCN, Gland, Switzerland [http://www.redlist.org, accessed 10 April 2004].
- Pereladova, O.B., Bahloul, K., Sempere, A.J., Soldatova, N.V., Schadilov, U.M. & Prisiadznuk, V.E. (1998) Influence of environmental factors on a population of goitred gazelles (*Gazella subgutturosa subgutturosa* Guldenstaedt, 1780) in semi-wild conditions in an arid environment: a preliminary study. *Journal of Arid Environments*, **39**, 577–591.
- Pérez, J.M., Granados, J.E., Soriguer, R.C., Fandos, P., Márquez, F.J. & Crampe, J.P. (2002) Distribution, status and conservation problems of the Spanish Ibex, *Capra pyrenaica* (Mammalia: Artiodactyla). *Mammal Review*, **32**, 26–39.
- PNBLSX (Parque Natural Baixa Límia - Serra do Xurés) (2001) *Informe sobre a reintroducción da cabra montês (Capra pyrenaica) en Galicia*. Consellería de Medio Ambiente, Xunta de Galicia.
- Staines, B.W. (1978) The dynamics and performance of a declining population of Red Deer (*Cervus elaphus*). *Journal of Zoology*, **184**, 403–419.
- Tellería, J.L. (1986) *Manual para el censo de los vertebrados terrestres*. Editorial Raíces, Madrid, Spain.
- Tude de Sousa (1927) *Gerez (Notas Etnográficas, Arqueológicas e Históricas)*. Imprensa da Universidade, Coimbra, Portugal.

## Biographical sketches

Gisela Moço is carrying out research on ibex population dynamics in Peneda-Gerês National Park. Jesús M<sup>a</sup> Pérez focuses his research on populations of mountain ungulates. Ana Filipa Ferreira and Margarida Guerreiro carry out research on ibex habitat suitability and diet. Francisco Petrucci-Fonseca is interested in the conservation of wolves and their prey. Armando Loureiro is a biologist in Peneda-Gerês National Park, where he is responsible for game management. António Rebelo is a collector at Peneda-Gerês National Park, collaborating in several mammal monitoring and distribution studies.