

Short Communication

Inter-agency coordination fosters the recovery of the Pyrenean chamois *Rupicapra pyrenaica pyrenaica* at its western limit

JUAN HERRERO, INAZIO GARIN, CARLOS PRADA and ALICIA GARCÍA-SERRANO

Abstract Two political jurisdictions in northern Spain, Navarre, where the Pyrenean chamois *Rupicapra pyrenaica pyrenaica* is categorized as Vulnerable, and Aragon, where it is huntable, coordinated management for the recovery of this subspecies at the western limit of its range. After an estimate of only a small population in 1992–1993 hunting was banned in Aragon and, in 1995–1996, monitoring of both populations began. In the two massifs where the subspecies lives, which lie across the border of the two jurisdictions, chamois populations increased from 33 to 136 and from 144 to 455 by 2007 (average annual increases were 15 and 11%, respectively). The subspecies was also located on a third massif, in 2002. After the recovery the ban against hunting was lifted in Aragon, in 2006, with a sustainable hunting quota based on 5% of the estimated minimum population size. We conclude that coordinated management between agencies in two jurisdictions has fostered the recovery of the Pyrenean chamois.

Keywords Chamois, population size, Pyrenees, *Rupicapra pyrenaica pyrenaica*, Spain, transboundary coordination, trend

Coordination across administrative units can be an imperative for the management and, especially, the monitoring, of shared wildlife populations. In many cases such coordination does not occur and jurisdictional differences in management practices affect adjacent or shared populations. For example, national parks, where hunting is usually forbidden, are typically surrounded by hunting areas where the harvest can be significant. In contrast, when populations of threatened large carnivores or raptors

overlap jurisdictions, coordinated management is relatively common (Proctor et al., 2004; Antor et al., 2007).

Ungulates have life histories that are conducive to sustainable harvests (Caughley & Sinclair, 1994) and, for a variety of reasons (population control, meat production, and recreational and trophy hunting), are intensively exploited. In addition, threatened populations have recovered (e.g. Arabian oryx *Oryx leucoryx*, IUCN SSC Antelope Specialist Group, 2008) and conservation efforts can have a positive effect (e.g. bison *Bison bonasus*, Pucek, 2004; Apennine chamois *Rupicapra pyrenaica ornata*, Dupré et al., 2001) although, in some cases, conservation efforts have been initiated too late (e.g. Pyrenean wild goat *Capra pyrenaica*; García-González & Herrero, 1999). In some instances ungulate species have spread in response to socio-economic changes (Gortázar et al., 2000) or unintentional escapes (Goulding et al., 2003). In the case of mountain ungulates populations have been created ex novo (e.g. Apennine chamois and Alpine ibex *Capra ibex*; Mari & Lovari, 2006; Aulagnier et al., 2009), and the size and distributions of populations have increased through reintroductions or re-enforcements (Berduco, 1990; Moço et al., 2006). Legislation has ensured that appropriate hunting quotas are set and that thereby the standards for the sustainable use of the species are met.

The Pyrenean chamois *Rupicapra pyrenaica pyrenaica* is a small, slightly dimorphic mountain-dwelling ungulate endemic to the Pyrenees. It is subject to intense hunting pressure, although hunting is banned in several national parks and nature reserves. In 2004 the population was at least 55,000 animals (Herrero et al., 2004). In the three Pyrenean countries (Andorra, France and Spain) the Pyrenean chamois is a game species and is an important economic and social resource in rural communities in Spain and a significant non-profit recreational activity in France.

At the western limit of its current distribution the chamois occupies an area that is managed independently by the autonomous governments of Navarre and Aragon, Spain, whose management goals differ significantly. The subspecies is categorized as Vulnerable on the Red List for Navarre but not threatened, and huntable, in neighbouring Aragon. Most of the area inhabited by chamois in this area lies within a nature reserve in Navarre and a game reserve in Aragon.

JUAN HERRERO* (Corresponding author) Ecology Department, University of Alcalá, E-22718 Alcalá de Henares, Spain. E-mail egasl@arrakis.es

INAZIO GARIN Zoology Department, University of the Basque Country, Bilbao, Spain

CARLOS PRADA and ALICIA GARCÍA-SERRANO Ega Wildlife Consultants, Zaragoza, Spain

*Current address: Area of Ecology, Department of Agriculture and Agrarian Economy, High Politechnic School of Huesca, University of Zaragoza, E-22001, Spain

Received 22 July 2009. Revision requested 28 August 2009.
Accepted 5 October 2009.

If coordinated management decisions can help achieve the objectives set for wildlife populations that encompass multiple jurisdictions and if the benefits of cooperation can be greatest for populations near their distributional limit, chamois at the western limit of their range in the Pyrenees provide a suitable evaluation of the efficacy of this approach. Here, we assess whether the recovery of the Pyrenean chamois population (the management goal) was correlated with management decisions: the temporary ban on hunting in Aragon and an increase in coercive force (the number of rangers) in Navarre.

The study area includes three mountain massifs above 1,600 m (Ezkaurre, 745 ha; Larra–Lapaquiza, 10,588 ha; Lakartxela, 666 ha; Fig. 1), with mixed forests of beech *Fagus sylvatica*, fir *Abies alba* and Scots pine *Pinus sylvestris*, and mountain pine *Pinus uncinata* woodlands and cliffs and meadows. The maximum elevation is 2,500 m. In Navarre the study area includes Larra–Belagoa Nature Reserve, and in Aragon the entire study area is contained within Los Valles Game Reserve. In these areas chamois coexist with domestic livestock (cattle, horses and sheep) and other wild ungulates (wild boar *Sus scrofa*, and roe *Capreolus capreolus* and red deer *Cervus elaphus*).

The first estimate of the chamois population in this area was in 1992 (Garin & Herrero, 1997). This indicated the small size of the population and led to a ban on hunting in western Los Valles Game Reserve in 1993. In Navarre, after

the number of rangers increased from one to six, coordinated long-term monitoring of the chamois population began, in 1996. New rangers attended a course on chamois biology and survey methods. In Aragon the number of experienced rangers was not a limiting factor and monitoring began in 1995. Rangers from Navarre and Aragon, technicians, volunteers and ourselves participated in surveys, which were conducted from dawn until midday in June and November, to 2007, under a common, coordinated plan based on an agreement between the two jurisdictions. Monitoring involved simultaneous annual counts of individuals in both Navarre and Aragon by observation along 10 itineraries. In addition, we surveyed one itinerary in the Lakartxela massif, also in June and November, an area where chamois had existed historically (Fig 1). Since 2002, when chamois appeared there for the first time, two new itineraries were added to this area. Pairs of observers equipped with binoculars, spotting scopes, local maps and radio receivers walked each itinerary. The location of each group of chamois was plotted on a map and the sex and age (adult males, adult females, yearlings and kids) of individuals noted. A group was any animal aggregation that occupied the same parcel of land, had sensorial contact and was more or less coordinated in its movements (Schaller, 1977). The number of individuals recorded was an estimate of the minimum population size but provided a basis for an analysis of any population trend.

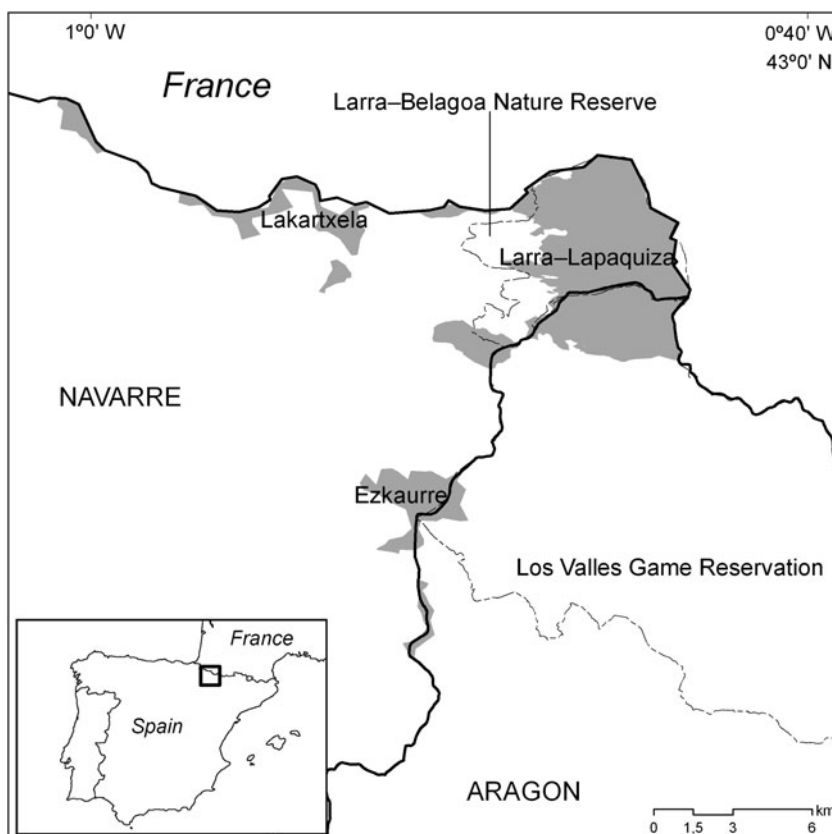


FIG. 1 The study area, showing the three massifs of Lakartxela, Larra–Lapaquiza and Ezkaurre inhabited by the Pyrenean chamois *Rupicapra pyrenaica pyrenaica* in the westernmost part of its distribution.

Population density was based on the amount of area above 1,600 m. To identify population trends we used a Poisson regression to fit the data to an exponential growth model and calculated the annual growth rate.

In 1995 the Ezkaurre massif had at least 33 chamois and in 2007 at least 136 (5.1 chamois km⁻²; Fig. 2). In the 13 years of surveys the number of chamois observed in the two census periods of any given year sometimes differed significantly and therefore the estimated rate of exponential growth was based on the higher of the numbers observed in June and November. The exponential growth rate was $0.1386 \pm \text{SE } 0.01$ (likelihood test $P < 0.0001$), i.e. an average annual increase of 15% (seven chamois year⁻¹). In 1996 the Larra–Lapaquiza massif had at least 144 chamois and in 2007 at least 455 (12.2 chamois km⁻²; Fig. 2). In the 12 years of surveys the exponential growth rate was $0.1044 \pm \text{SE } 0.0056$ (likelihood test $P < 0.0001$), i.e. an average annual increase of 11% (23 chamois year⁻¹). In 2002 eight chamois were observed in the Lakartxela massif, indicating an extension of the western limit of the subspecies. Since then reproduction has occurred annually and the estimate of the minimum population has increased slightly: 2003 (5 chamois), 2004 (8), 2005 (7), 2006 (10) and 2007 (11).

Inter-agency coordination to foster the recovery of Pyrenean chamois at the western limit of its range resulted in a significant recovery of the population and an increase in its area of distribution. The protected area of Larra–Belagoa Nature Reserve, which does not permit hunting, and the neighbouring area of Los Valles Game Reserve, where hunting is strictly controlled, along with the decision to ban hunting for a prolonged period in the Game Reserve,

provided the basis for the recovery of the chamois populations at Ezkaurre and Larra–Lapaquiza and the establishment of a new population in Lakartxela. Throughout the Pyrenees these types of areas have been vital for the recovery, maintenance and expansion of chamois populations, as well as for populations of wild boar, and roe and red deer (Gortázar et al., 2000).

In 2006, based on the size of the chamois population, the Government of Aragon permitted hunting in the massifs that are shared with Navarre. The hunting quotas were based on 5% of the estimated minimum population size and the proportions of the total area in each of the two massifs. The coordinated management described here can be of value for the conservation of other mountain ungulates that have distributions spanning regional administration bodies.

Acknowledgements

The rangers of Aragon and Navarre participated enthusiastically in the fieldwork and maintained spirit and commitment, sometimes under difficult conditions. Both autonomous communities financed the surveys. We thank the technicians from both jurisdictions, who were responsible for the consultancy projects that supported the surveys.

References

- ANTOR, R., MARGALIDA, A., FREY, H., HEREDIA, R., LORENTE, L. & SESÉ, J.A. (2007) First breeding age in captive and wild bearded vultures *Gypaetus barbatus*. *Acta Ornithologica*, 42, 114–118.
- AULAGNIER, S., KRANZ, A., LOVARI, S., JDEIDI, T., MASSETI, M., NADER, I. et al. (2009) *Capra ibex*. In *IUCN Red List of Threatened Species v. 2010.1*. IUCN, Gland, Switzerland. [Http://www.iucnredlist.org](http://www.iucnredlist.org) [accessed 17 June 2010].
- BERDUCOU, C. (1990) Chamois and Isards: balance of translocations in France (1956–1988). *Revue d'écologie: la terre et la vie* (Suppl. 5), 121–130. [In French with English abstract]
- CAUGHLEY, G. & SINCLAIR, A.R.E. (1994) *Wildlife Ecology and Management*. Blackwell Science, Oxford, UK.
- DUPRÉ, E., MONACO, A. & PEDROTTI, L. (2001) Action Plan for the Apennine chamois (*Rupicapra pyrenaica ornata*). *Quaderni di Conservazione della Natura*, 10, 1–138, Ministero dell'Ambiente—Istituto Nazionale per la Fauna Selvatica. [In Italian]
- GARCÍA-GONZÁLEZ, R. & HERRERO, J. (1999) The bucardo of the Pyrenees: story of an extinction. *Galemys*, 11, 17–26. [In Spanish]
- GARIN, I. & HERRERO, J. (1997) Distribution, abundance and demographic parameters of the Pyrenean chamois (*Rupicapra pyrenaica pyrenaica*) in Navarre, Western Pyrenees. *Mammalia*, 61, 55–63.
- GORTÁZAR, C., HERRERO, J., VILLAFUERTE, R. & MARCO, J. (2000) Historical examination of the status of large mammals in Aragon, Spain. *Mammalia*, 64, 411–422.
- GOULDING, M.J., ROPER, T.J., SMITH, G.C. & BAKER, S.J. (2003) Presence of free-living wild boar *Sus scrofa* in southern England. *Wildlife Biology*, 9(Suppl. 1), 15–20.
- HERRERO, J., ESCUDERO, E., FERNÁNDEZ DE LUCO, D. & GARCÍA-GONZÁLEZ, R. (2004) *The Pyrenean Chamois Rupicapra p.*

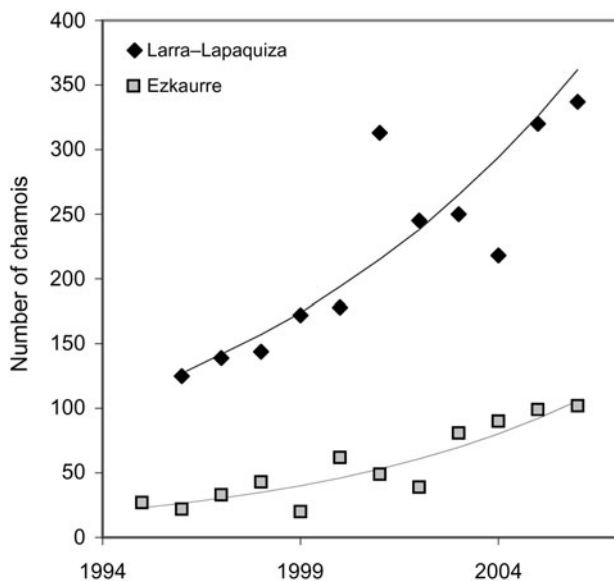


Fig. 2 Number of chamois observed in the massifs of Ezkaurre (1995–2006) and Larra–Lapaquiza (1996–2006), with the population trend fitted by Poisson regression (lines).

- pyrenaica: *Biology, Pathology and Management*. Publications of the Council for the Protection of Nature, Government of Aragon, Saragossa, Spain. [In French and Spanish with English abstracts]
- IUCN/SSC ANTELOPE SPECIALIST GROUP (2008) *Oryx leucoryx*. In 2008 *IUCN Red List of Threatened Species*. IUCN, Gland, Switzerland. [Http://www.iucnredlist.org](http://www.iucnredlist.org) [accessed 2008].
- MARI, F. & LOVARI, S. (2006) The release of Apennine chamois in Central Italy: 20 years later. *Reintroduction News*, 25, 21–22.
- MOÇO, G., GUERREIRO, M., FERREIRA, A.F., REBELO, A., LOUREIRO, A., PETRUCCI-FONSECA, F. & PÉREZ, J.M. (2006) The ibex *Capra pyrenaica* returns to its former Portuguese range. *Oryx*, 40, 351–354.
- PROCTOR, M.F., SERVHEEN, C., MILLER, S.D., KASWORM, W.F. & WAKKINEN, W.L. (2004) A comparative analysis of management options for grizzly bear conservation in the US–Canada trans-border area. *Ursus*, 15, 145–160.
- PUCEK, Z. (2004) *European Bison: Status Survey and Conservation Action Plan*. IUCN/SSC Bison Specialist Group, IUCN, Gland, Switzerland, and Cambridge, UK.
- SCHALLER, G.B. (1977) *Mountain Monarchs: Wild Sheep and Goats of the Himalaya*. The University of Chicago Press, Chicago, USA, and London, UK.

Biographical sketches

JUAN HERRERO focuses on the management and conservation of large mammals and carries out long-term monitoring of the brown bear, Pyrenean chamois, roe deer, wild boar and Iberian wild goat. He dedicates much of his time to the organization and coordination of surveys for Pyrenean chamois. INAZIO GARIN is currently working on the ecology of bats and has been involved in the monitoring of Pyrenean chamois since 1992. CARLOS PRADA is a protected area specialist with a particular interest in geographical information systems and protected area planning. ALICIA GARCÍA-SERRANO is interested in animal behaviour and in statistics and their application to the conservation and management of large mammals.