

STATUS OF THE BROWN BEAR IN THE CANTABRIAN MOUNTAINS, SPAIN

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Abstract: During the 16th century, the European brown bear (*Ursus arctos*) inhabited most of the Iberian Peninsula. At present, its range in Spain is limited to 2 relict populations: the Pyrenees and the Cantabrian mountains. In 1973, the bear was declared a protected species; hunting was prohibited and compensation was paid for all livestock and agricultural damages by bears. The small Cantabrian bear population is distributed throughout 5 provinces covering approximately 5,000 km². This fragmented distribution leads to reduced interchange and genetic isolation between groups. Since 1954, 8 published population estimates have ranged from 54 to 142 individuals. Livestock grazing is the dominant activity in the mountains and has resulted in forests being converted to pastureland and being kept at seral stages. Livestock and agricultural damage by bears primarily affects young horses, sheep, and apiaries. Timber harvesting and the conversion of hardwood regeneration areas to exotic pine plantations also eliminate potential habitat. Coal-mining has a 3-fold influence: the operations themselves; the illegal hunting by miners in these areas; and the building of roads, which increase traffic. Principal threats are habitat loss and fragmentation, genetic isolation, illegal hunting, and use of strychnine. We encourage improved administrative coordination among provinces, timely compensation to affected livestock owners, and collection of ecological data to identify the species' requirements for survival.

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HISTORICAL REVIEW

Only a few centuries ago the numbers and densities of the European brown bear throughout Europe were much greater than at present. Brown bears were found on the Iberian Peninsula, from the evergreen oak woodlands of the south to the beech and oak forests along the Cantabrian coast in the north. As the human population increased, the effects of their activities on the landscape were incompatible with brown bears, and the bear population started to decline in numbers and distribution. Forested areas were cleared to put the land into agricultural production, create grazing land for livestock, provide fuel, and for construction materials. With the opening of the forests, bears became vulnerable to persecution. The techniques for hunting bears became more sophisticated through the years; with the advent of modern firearms and uncontrolled hunting, the bear population of the Iberian Peninsula was reduced to the remnant forested areas and unexploited mountain regions.

Without any control or regulation on bear hunting in Spain in the 1800s, bears continued to be killed each year at a high rate. Early records note that bounties were paid on bears in 1 province in the Cantabrian Mountains until the mid-1800s (Noval 1976). The bear population continued to diminish, and in the 1930s it became apparent that bears were becoming exceedingly rare and more difficult to find. Unregulated hunting persisted, and during the years

of the Spanish Civil War, 1936-39, the bear population increased slightly (Anonymous 1980). Following the war, impoverished conditions prevailed in all of Spain, including the mountains. All wildlife populations, including bears, were hunted for subsistence and many became locally extinct. In 1952, the Spanish government passed a law that ended bear hunting. This suspension of hunting activity lasted until 1957, when the government maintained that the population was stable and could again withstand hunting pressure. With fewer bears in the mountains, organized drives were formed to increase hunter success. This was a more effective means of hunting bears, but by now the population was at a low level and evidence of bears was not easily found. Twenty-eight bears were killed legally (more were killed illegally; see Notario 1970) between 1957 and 1965, all in the Cantabrian Mountains, the last 1 being killed on 27 October 1965. This indicated that the only alleged healthy population of bears in Spain was in the Cantabrian Mountains, and bears were killed only in the 2 provinces where the highest number of bears occurs today. Passage of a "temporary" law by the Spanish government in 1967 once again prohibited the hunting or molestation of bears. It was intended to curtail hunting until a decision could be made concerning the population status and the management action to be taken in the future with regard to the species' survival. On 5 October 1973, the Spanish government declared the brown bear a protected species; it prohibited hunting, trapping, possessing, and commercial exploitation of the animal. Violations of this law today result in a fine of 1,500,000 Spanish pesetas (\pm \$8,800 US). Spain's natural resource agency, the "Instituto para la Conservación de la Naturaleza"

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(ICONA), reimburses individuals affected by agricultural and livestock damages done by bears.

Presently the Iberian Peninsula brown bear population remains in 2 isolated regions. One very small, fragmented population, estimated to be fewer than 20 individuals, survives in several areas of the Pyrenees (Camarra 1983). A more abundant and widely distributed population, estimated to be 130 individuals, occurs in the Cantabrian Mountains of northern Spain (Campo et al. 1984) and occupies an area of approximately 5,000 km².

THE CANTABRIAN MOUNTAINS

The Cantabrian Mountains are in northern Spain and are situated on an east-west axis parallel and adjacent to the Cantabrian Sea (Fig. 1). They extend for 300 km, occupy an area of approximately 1,800,000 ha, and encompass portions of 5 provinces; Asturias, Cantabria, León, Palencia, and Lugo. The 5 provinces are governed as 4 separate political au-

tonomies; 2 being completely autonomous. The Spanish government established 9 National Hunting Reserves in the 5 Cantabrian Mountain provinces in 1966, and the present bear distribution encompasses these areas (Ortuño and Peña 1977). The areas of the Reserves range from 7,600 to 180,000 ha. Two National Preserves were created in 1943 and 1956 (Reres and Muniellos, respectively) and are also within the bear range. The forests and wildlife on these Reserves and Preserves are administered by ICONA; outside these boundaries, they are governed communally by inhabitants of these areas.

Elevations range from 1,000 m to over 2,600 m, although the mean elevation along the divide is 1,200–1,600 m. The north and south sides of the range differ greatly in physiography and climate and separate the Eurosiberian and Mediterranean biomes, respectively. The northern slope is precipitous, descending from 1,600 m to sea level in less than 25 km. It is characterized by narrow, steep valleys and fast-flowing streams and rivers. Situated near the sea,

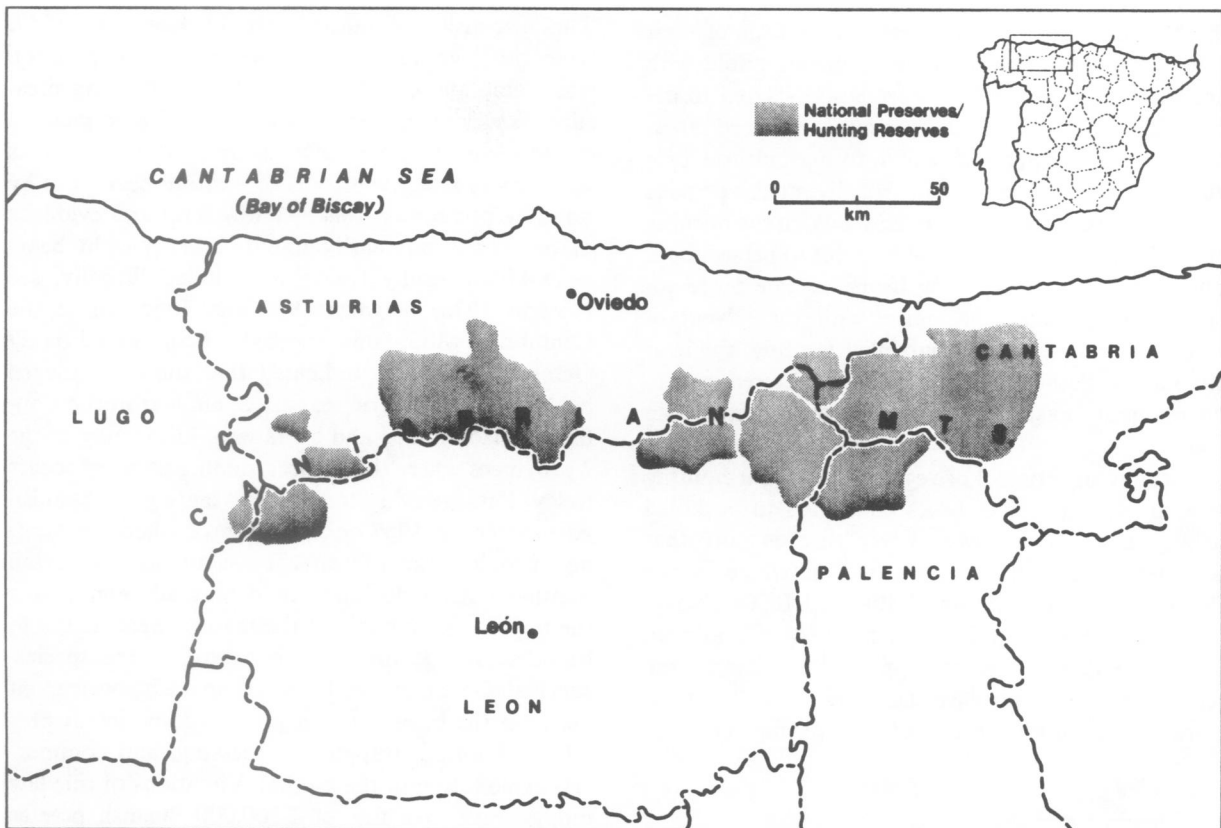


Fig. 1. Location of the Cantabrian Mountains in northern Spain.

the area's climate is Atlantic; seasonal temperature fluctuations are slight. Winters are generally mild at the mid-elevations, and mean temperatures decrease as elevation increases. Summers are cool, and precipitation is abundant year-round, ranging from 100 to 180 cm (Rivas-Martínez et al. 1984). Below 1,000 m the growing season is nearly 12 months long. The terrain of the south side is gentle and more open than that of the Atlantic side. It is characterized by wide valleys and weathered hills, which descend slowly south to a high plateau. The climate is continental, with heavy snowfall and below-freezing temperatures common in winter; summer is generally hot and dry with occasional rainfall. Precipitation predominantly occurs in winter and ranges annually from 90 to 130 cm. The growing season is only 5 months long.

Human modifications to the landscape over the last 4 centuries have drastically altered the forest species composition and distribution. It is predominantly mixed-hardwood, composed of oaks (*Quercus robur*, *Q. petraea*, *Q. pyrenaica*), beech (*Fagus sylvatica*), birch (*Betula celtiberica*), chestnut (*Castanea sativa*), hazel (*Corylus avellana*), holly (*Ilex aquifolium*), mountain ash (*Sorbus* spp.), and ash (*Fraxinus* spp.). The north slope is more lush, verdant, and floristically rich than the semiarid south side. Large mammals most commonly associated with the brown bear include European wild hog (*Sus scrofa*), Spanish wolf (*Canis lupus*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), chamoix (*Rupicapra rupicapra*), wild cat (*Felis sylvestris*), and fox (*Vulpes vulpes*). The road density in the Cantabrian Mountains is low (0.05 km/km²) in relation to the area of the mountains and the remainder of the country. This is a result primarily of rugged terrain and low human density of the area.

POPULATION DEMOGRAPHICS

The earliest demographic information on the brown bear population in the 5 provinces of the Cantabrian Mountains came from the work of Madoz (1843) between 1833 and 1843 and is used in the following discussion. Figure 2 plots the recorded presence of bears occurring within village districts during this period. The data are not complete, because some villages historically noted for being within traditional bear range are not represented. However, the data do provide a general outline of the historic range of the bear population. In the province of Asturias, 67 villages recorded the presence of bears between 1833

and 1843, predominantly in the Cantabrian Mountain region (Fig. 2). Asturias has historically had a large bear population, particularly in the southwestern areas of Degaña, Somiedo, and Muniellos. These areas contain some of the most extensive beech and oak forests (1,500–3,000 ha) of the entire province (García Dory 1973)—forests that were much larger in the past. The bear distribution in Asturias still encompasses these 3 areas, although little of the historic distribution in the eastern sector persists. The southeastern region of Asturias has extensive beech and oak forests and is believed to have been a corridor for movement and interchange of bear populations between Asturias and Leon. Within the last 100 years, 2 large highways and a railroad have been constructed between the cities of León and Oviedo in the zone between the 2 groups of bears and may have eliminated some east-west movements between the 2 provinces.

The province of Cantabria had 26 villages that recorded the presence of bears in their vicinity, all located in the western half. The historic distribution was extensive, even though the area of the Cantabrian Mountains in the province is small; many of the peripheral points of the bears' range are in the low mountainous region, which previously contained extensive areas of beech and oak forests. The bear distribution has dwindled and exists precariously in the 180,000 ha National Hunting Reserve of Saja.

In Palencia, bears were reported in 8 areas of the northern tip of the province. The portion of the Cantabrian Mountains in this area encompasses the historic distribution. The present distribution includes this mountainous terrain and is within the National Hunting Reserve of Fuentes Carrionas.

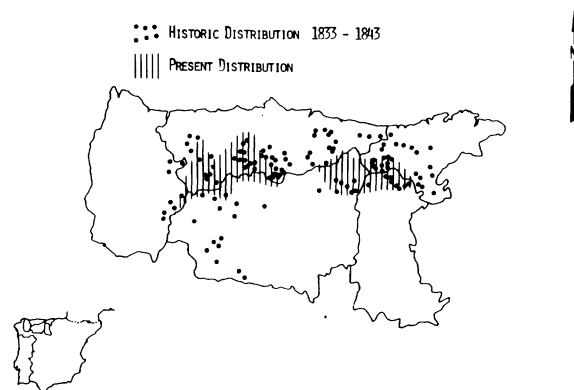


Fig. 2. Historic and present distribution of the brown bear in 5 Cantabrian Mountain provinces.

Twenty-three villages were in historic bear range in León. The distribution was expansive, covering a large part of the total area of the province except for the agriculturally developed central and southeast sections. Bears occupied the Cantabrian Mountains along the northern border, the insular Montes de León area in the west-central region, and the Cabrera region in the southwest. Adjoining the southern border and the Cabrera region, Madoz noted "some bears" in the northern section of the province of Zamora (Reguera 1985). The last bear observed in Zamora was killed in 1920. The present distribution ranges through the Cantabrian Mountains, with occasional reports of bears in the Montes de León area. Although the brown bear is widely distributed in León, the mean density is low; bears of the western sector are part of a larger nucleus in Asturias that occasionally use this area of León. The eastern sector has the largest number of bears in León and possibly the entire eastern nucleus; the majority are located in the National Hunting Reserve of Riaño.

The historical distribution in Lugo is derived from only 8 records of bear occupation in the Sierra de Ancares and Fonsagrada area. In the last 150 years, bears have not ranged far into Lugo and only have been reported in or near the Cantabrian Mountains. The present distribution in Lugo remains small. Bears probably do not reside there, and observations of bears are likely of those from Asturias and León.

Various sources of information from the 1700s and 1800s indicate that bears were undoubtedly much more numerous then. For example, the following information is taken from the province of Asturias: between 1769 and 1860, 5 men killed 224 bears (Notario 1970, Noval 1976). The Asturian government paid bounties in 1816 for 45 bears killed, in 1817 for 62 bears, and in 1843 for 47 bears (Noval 1976). In 1872 alone, 1 man killed 71 bears (Anonymous 1980) and another killed 92, although there was no reference to the year or time frame (Noval 1976). The accuracy of these data is not known. Nonetheless, for any given year during the 1800s, more bears were apparently killed in Asturias than exist in Asturias today.

Since 1954, 7 authors have made 8 estimates for the Cantabrian brown bear population (Table 1). The earliest estimate (Couturier 1954) indicated that as few as 40 bears survived. Rafael Notario conducted the earliest Spanish investigation in 1964. He estimated that 90 bears existed in the Cantabrian Mountains; 74 in the western nucleus and 16 in the eastern

Table 1. Brown bear population estimates in the Cantabrian Mountains, Spain.

Source	Population	Western nucleus	Eastern nucleus
Courturier (1954)	40	—	—
Notario (1964)	90	74	16
Notario (1970)	60	50	10
Braña et al. (1979)	± 54	42	12
Garzon et al. (1980)	54	38	16
Notario (1980)	79	62	17
Campo et al. (1984)			
1982	128 ^a	93 ^b	35 ^b
1983	142 ^a	103 ^b	39 ^b

^a Total of 2 nuclei estimates.

^b Mean of the range of population estimates cited.

nucleus (Notario 1964). Only 6 years later, he reported no more than 60 individuals survived (Notario 1970). From work conducted between 1974 and 1977, Garzon et al. (1980) estimated the presence of 54 bears, including 38 in the west and 16 in the east. In 1977 Braña et al. (1979) published the same population estimate, which differed only in the subpopulation calculations. Notario (1980) again published population estimates of 79 individuals, 62 in the western nucleus and 17 in the eastern. The most recent data present population estimates for 2 consecutive years (Campo et al. 1984). During 1982, a population of 128 individuals was estimated, consisting of 93 in the west and 35 in the east. The 1983 estimates increased to 142 bears, comprised of 103 and 39 in the 2 regions, respectively.

The research methodology consisted of inquiries among National Hunting Reserve game wardens and people living in the mountains as to the number of bears living within their respective areas. Because brown bears are shy, secretive, forest-dwelling, and possibly nocturnal, population studies are difficult and estimates are questionable. The limited road and trail mileage in the Cantabrian Mountains, its high density of livestock, and the lack of government financial support to conduct demographic research complicate efforts to attain reliable bear population estimates.

The estimates made in the last 10 years have ranged from 54 to 142 bears for the entire population, which raises doubt about the reliability of the estimates. After spending 8 months exclusively in the lesser eastern nucleus during 1985, we believe that the latest population estimates (Campo et al. 1984) for this nucleus are high and that the nucleus more likely

consists of 17 individuals, as estimated by Notario in 1980.

HUMAN IMPACTS

Brown bears and humans have coexisted in the Cantabrian Mountains for many centuries, but not until the 20th century have the cumulated effects of human activities seriously affected the bear population. For centuries the forest and other natural resources were used without comprehensive planning or foresight. Today the bear population is threatened because of its fragmented distribution and the continuing alteration of its habitat. Human activities have steadily increased during this century. With the induction of Spain into the European Community, there will be added pressure to increase the productivity of the mountain region. This would undoubtedly put the bear population in an even more vulnerable position.

Livestock Production

Humans have had a long and prosperous history with livestock in Spain. During the 16th century, when Spain was a world power, its wealth was based fundamentally on its millions of sheep (Balgañón 1985), which led to subsequent environmental disturbances. In the Cantabrian Mountains today, the livestock raised is cattle and sheep primarily and goats secondarily. In some areas, horses are raised. Because most of the mountainous terrain is unsuitable for commercial agriculture, livestock production is the most important source of income for the people. Many isolated villages are nearly self-sufficient and rely on livestock for food, transportation, work production, and other everyday needs. In the mountains of Asturias and Cantabria, 1 person typically owns 5 cows but may own as many as 15 (Ortuño and Peña 1977). During May–October, nearly all livestock graze on higher slopes away from villages. In León and Palencia, livestock production is occasionally augmented by several transhumant herds of sheep, some as large as 2,000, that seasonally move north from southern Spain. Although transhumance was once more common, few shepherds practice it today.

Livestock production has had a great impact on Spain's bear population. The beech and oak forests that once dominated the Cantabrian Mountains have been drastically reduced to provide grazing land for

livestock. Although the rate of conversion has decreased in the last 30 years, the practice continues. To keep these areas free of shrub species and more productive for grazing, landowners burn them frequently, which halts the regeneration process. The combined effects of overgrazing and routine burning in many areas of the mountains, specifically the south side, have eroded the soil and exhausted its nutrients. These factors, added to the short growing season of the south side, create a fragile environment that requires substantial time to recover from such disturbances.

Livestock and Agricultural Damages

Given the high density of livestock and the distribution of cultivated crops and orchards in brown bear range, damage by bears is bound to occur. In the National Hunting Reserve of Riano between October 1974 and September 1984, ICONA paid 964,700 pesetas (\pm \$5,600 US) for 100 incidents of livestock and agricultural damage (C. Romero, ICONA, pers. commun.). The incidents were destruction of sheep ($N = 52$), apiaries ($N = 30$), goats ($N = 11$), cattle ($N = 6$), and horses ($N = 1$). The annual compensation payments in Asturias between 1973 and 1977 ranged from slightly less than 1 million pesetas (\pm \$5,800 US) to 1.5 million pesetas (\pm \$8,800 US) (Braña et al 1979). Most bear depredations were on horses, even though they are the least numerous of all livestock in the mountains; 65% of the horses killed were ≤ 3 years old. Cattle were the 2nd most frequently attacked livestock, followed by sheep and goats. Together, these 3 groups comprised 23% of the incidents. Bears regularly visited apiaries, even though they were within villages. The only agricultural crops in the Cantabrian Mountain region grow in Asturias and Cantabria; bears frequently invade corn crops and apple orchards in the fall. They may also damage chestnut and hazel trees.

Deforestation

Centuries ago, Spain was covered with forests. According to a popular legend, a squirrel could travel jumping from tree to tree from Gibraltar to the Pyrenees. Today only 8.4 million ha, or 32%, of the entire country is covered with forest (Bauer 1980). The principal causes of deforestation are the increased use of lands as pasture for livestock, the lack of a forest protection policy, the long series of battles in

Spain that used fires as a war tactic, the construction of boats for the Spanish Armada, and the use of timber for many personal uses over the centuries.

The Cantabrian Mountain region was spared much of the deforestation in the past because of its remoteness and low human density. The naval timber harvested during the height of Spain's maritime power in the 16th century and thereafter was predominantly in the Basque provinces rather than the Cantabrian provinces because access was greater there (T. Díaz, pers. commun.). Despite its expansive forested area, the Cantabrian region is rapidly losing its hardwood forest to lumber and paper production. Information on the rate of deforestation of native hardwoods between 1946 and 1974, specifically oak and beech, in Asturias (García Dory 1973, Bauer 1980) indicates that between 1946 and 1968, the area of oak-forested habitat decreased 37% and beech habitat decreased 45%. From 1968 to 1974, oak habitat decreased another 18%; the cumulative decrease since 1946 is 48%. Beech forest area decreased even more: 45% between 1968 and 1974 and a cumulative 69% since 1946.

ICONA controls the timber resources and is responsible for the high deforestation rate in Asturias and Cantabrian Mountain provinces; little responsibility for this process can be attributed to the local people (ICONA 1980). The increase in the number of paper mills in northern Spain has increased the harvest of oak and beech as well as other species, native and introduced (García Dory 1973). Presently there is no policy of native hardwood regeneration in the Cantabrian Mountains.

The welfare of the brown bear population is threatened by this loss of habitat. Bears rely heavily on the oak and beech forests for food and cover. The availability of fall foods, which include acorns and beechnuts (Braña et al. 1979, Garzon and Palacios 1979, Garzon et al. 1980) have been shown in North America to affect black bear (*U. americanus*) litter size and reproductive success (Rogers 1976). Suitable areas for cover and protection are critical to bears in the Cantabrian Mountains. The patchy distribution of forest cover increases the vulnerability of bears when traveling between areas. The hardwood forest may also be used for denning or other critical needs that are not yet known. The bears' survival depends upon the hardwood forest. Their destiny will be affected by how well the forest is managed and conserved in the future.

Mining

Mining activities in the Cantabrian Mountains occur predominantly in Asturias and León, and to a lesser extent in Palencia and Cantabria (Ministerio de Industria 1977). Coal is the most frequently mined substance, with 83 mines operating in Leon, 32 in Asturias, and 14 in Palencia. The western region of Leon and west and central regions of Asturias are the most active, all being within or near brown bear range. Few bears reside in or near the principal coal-mining areas of León or Asturias; however, in the western areas of Degaña and Cangas de Narcea, bears inhabit heavily mined areas, although their numbers appear to be decreasing.

Mining operations may affect the bear population because the construction of new roads and the upgrading of existing roads increases the amount of traffic in the area. Many of the operations are "open pit," resulting in extensive areas being disturbed and an additional loss of habitat. Lastly and most importantly, the socioeconomic conditions of mining areas differ from those of other settlements in the mountains. Miners are well paid, have ample free time, and generally are not local residents. Many own expensive "all terrain" vehicles and hunt and fish without abiding by ICONA's regulations. The fine for killing a bear in Spain is high, but it may not be high enough to deter people who can afford to pay it. The opportunity of obtaining a legendary trophy animal may outweigh the risk involved. Evidence of illegal hunting in mining areas is available; 5 bears were killed between 1980 and 1981 in the area of Cangas de Narcea and 4 bears (1 female and 3 cubs) were killed between Degaña and Cangas de Narcea during spring 1980 (Braña et al. 1982).

Other Impacts

Wolves inhabiting the bear range consistently damage livestock; therefore, affected livestock owners occasionally place strychnine in killed livestock or in baits. Bears then become potential victims. In June 1984, a young male bear was found poisoned by strychnine in the National Hunting Reserve of Riaño, an area in which wolf attacks on livestock commonly occur.

Within the last 50 years, 2 reservoirs have been constructed within brown bear habitat in the Cantabrian Mountains of León. Two additional reservoirs are under construction; 1 is nearly complete in the

National Hunting Reserve in Riaño which contains the last extensive oak forest in the eastern nucleus and 1 of 2 remaining core areas for this population. Once inundated, vital habitat will be lost and human activity will increase, ultimately displacing the few surviving bears.

The fragmented distribution of the population today has reduced genetic interchange between the 2 nucleus groups to the point that such interchange is low or nonexistent. The eastern group is seriously threatened (fewer than 30 individuals), and if no measures are taken to halt fragmentation of the population, the species in the Cantabrian Mountains will be threatened with extinction.

CONCLUSIONS

The principal threats to this population can be summarized as follows:

1. The fragmentation and deterioration of habitat by the decline in total area of the native hardwood forests as a result of deforestation caused by fires, logging by wood products industries, mining, and conversion to grazing lands. New dams and reservoirs will inundate bear habitat and the number of roads and human activity in the mountains will increase.
2. Illegal hunting, as shown in the period between 1979 and 1981, when at least 17 bears were shot or snared (Braña et al. 1982).
3. The illegal placement of strychnine in baits to control wolves within brown bear range.
4. Genetic isolation owing to the fragmented distribution of the population and reduced interchange between groups.

Conserving the brown bear population of the Cantabrian Mountains will require the following measures:

1. Improving the administrative coordination of ICONA among autonomous provinces.
2. Controlling illegal hunting and the use of strychnine in the Cantabrian Mountains.
3. Accelerating ICONA's compensation process for livestock or agricultural damages incurred by bears in the provinces of Leon, Palencia, and Lugo.
4. Investigating the ecological requirements of the brown bear and its needs for survival. This work must be combined with a conservation education program aimed at people living in or near brown

bear range, who now compete with the bear for the region's resources.

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LITERATURE CITED

- ANONYMOUS. 1980. Proteger al oso. *Caza y Pesca* 456:811. (In Spanish.)
- BAUER, E. 1980. Los montes de España en la historia. Ministerio de Agricultura, Madrid. 610pp. (In Spanish.)
- BALGAÑÓN, M. 1985. Los bosques: evolución histórica, situación actual. *El Campo* 98:25–30. (In Spanish.)
- BRAÑA, F., J. C. DEL CAMPO, AND C. LASTRA. 1979. Sobre el oso pardo en la cordillera Cantábrica. *Acta Biol. Mont.* 1:91–101. (In Spanish.)
- , B. HEREDIA, AND G. PALOMERO. 1982. Situación del oso pardo en la cordillera Cantábrica. *Quercus* 2:38–40. (In Spanish.)
- CAMARRA, J. 1983. Habitat utilization of brown bears in the western Pyrenees. *Acta Zool. Fenn.* 174:157–158.
- CAMPO, J. C. DEL, J. MARQUINEZ, J. NAVES, AND G. PALOMERO. 1984. Distribución y aspectos poblacionales del oso pardo en la cordillera Cantábrica. *Acta Biol. Mont.* 4:371–381. (In Spanish.)
- COUTURIER, M. 1959. *L'ours brun*. Grenoble, France. 905pp. (In French.)
- GARCÍA DORY, M. 1973. Evolución del bosque natural de Asturias. *Asturnatura* 1:7–17. (In Spanish.)
- GARZON, P., AND F. PALACIOS. 1979. Datos preliminares sobre la alimentación del oso pardo en la cordillera Cantábrica. *Bol. Est. Cent. Ecol.* 8:61–68. (In Spanish.)
- , F. PALACIOS, AND J. GARZON. 1980. Situación actual del oso pardo en España y datos sobre su alimentación en la cordillera Cantábrica. *Actas I Reunion Iberoamer. Zool. Vert., La Rabida 1977*:681–683. (In Spanish.)
- Instituto para la Conservación de la Naturaleza (ICONA). 1980. Las frondosas en el primer inventario forestal nacional. Ministerio de Agricultura, Madrid. 132pp. (In Spanish.)
- MADOZ, P. 1843. *Diccionario geográfico-estadístico-histórico de España*. Madrid. 267pp. (In Spanish.)
- Ministerio de Industria. 1977. *Estadística minera de España*. Madrid. 113pp. (In Spanish.)
- NOTARIO, R. 1964. El oso pardo en España. Ministerio de Agricultura, Madrid. 162pp. (In Spanish.)
- . 1970. El oso pardo en España. 2nd edición. Ministerio de Agricultura, Madrid. 162pp. (In Spanish.)
- . 1980. Informe de la situación actual en España del oso pardo. *Caza y Pesca* 445:26–39. (In Spanish.)
- NOVAL, A. 1976. *La fauna salvaje asturiana*. Ayalga Ediciones, Salinas, Asturias. 459pp. (In Spanish.)

ORTUÑO, F., AND J. DE LA PEÑA. 1977. Reservas y cotos nacionales de caza: region Cantabrica. Incafo. Madrid. 253pp. (In Spanish.)

REGUERA, J. 1985. Gran fauna extinguida en la provincia de Zamora. Bol. Inform. Diput. de Zamora 24:29-30. (In Spanish.)

RIVAS-MARTÍNEZ, S., T. DÍAZ, J. PRIETO, J. LOIDI, AND

A. PEÑAS. 1984. Los Picos de Europa: la vegetación de la alta montaña Cantábrica. Ediciones Leonesas, León. 295pp. (In Spanish.)

ROGERS, L. L. 1976. Effects of mast and berry crop failures on survival, growth, and reproductive success of black bears. Trans. North Am. Wildl. and Nat. Resour. Conf. 41:431-438.