# REPRODUCTIVE RATES OF BROWN BEARS IN THE CANTABRIAN MOUNTAINS, SPAIN

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*Abstract:* We studied brown bear (*Ursus arctos*) reproductive rates by monitoring females with cubs in the 2 unconnected populations in the Cantabrian Mountains in northwest Spain. Annual average number of females with cubs, number of cubs, and litter size were 5.00, 11.20, and 2.24 respectively, for the western population (1986–90), and 1.67, 2.67, and 1.67, respectively, for the eastern population (1988–1990, except mean litter size, 1985–90). The significantly larger litter size for the western population ($P < 0.05$) may be related to greater food availability. At least 2 of the 6 females breeding in 1989 bred again in 1991 after an especially good hard-mast crop in 1989 and 1990.

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**Key Words:** Breeding females, breeding interval, brown bear, Cantabrian Mountains, cubs, litter size, reproduction, Spain, *Ursus arctos.*

The total number of brown bears in the Cantabrian Mountains is estimated at 70–90 (Palomero et al. 1993). They are in 2 apparently unconnected populations that separated in the first half of this century (Nores 1988). Each occupies an area of approximately 2,500 km$^2$ (Campo et al. 1984).

Until recently information on bear demography in the area, based on mail enquiries and interviews, was poor, and a more accurate monitoring program was needed. A complete census was rejected as being difficult and expensive. Instead we monitored females with cubs-of-the-year, a less expensive method that provides information on minimum population size, population trends, and breeding behavior (Knight and Eberhardt 1985, Harris 1986, Servheen 1989). In this paper, using data from the family group tracking program, we present the annual number of breeding females, litter size, and breeding interval in the 2 Cantabrian bear populations.

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## STUDY AREA

The Cantabrian Mountains run east to west between 4°–7° longitude west and 42°–43° latitude north. The highest peak, Torre Cerredo, at 2,648 m, is only 25.6 km from the coast, indicating how sharply they rise. The average altitudes and gradients of north-facing and south-facing slopes are 700 m and 34%, and 1,300 m and 21%, respectively.

Proximity to the ocean results in high rainfall and humidity, especially on the north-facing slopes where rainfall is normally between 900–1,900 mm annually and temperatures are mild. On the south-facing slopes, the maximum–minimum temperature difference is greater and rainfall (up to 400 mm annually) decreases inversely with altitude with the dry summer giving way to the Mediterranean-type climate of the rest of the Iberian Peninsula (Fig. 1).

The difference in gradients and climate on the 2 sides of the mountain range affects the vegetation. There are 2 main phytogeographic regions: the Eurosiberian covers all the north side and the Mediterranean faces south. In general, on the steep north-facing slopes forest cover is

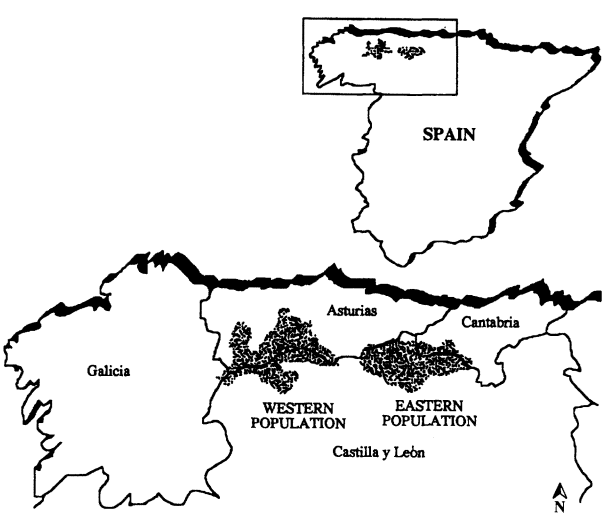


**Fig. 1. Cantabrian brown bear populations (dark area) in Northwest Spain, 1992.**

more varied with common, sessile, Pyrenean and evergreen oaks (*Quercus robur, Q. petraea, Q. pyrenaica, Q. rotundifolia*), beech (*Fagus sylvatica*), and chestnut (*Castanea sativa*) predominant. On the south-facing slopes there are mainly sessile and Pyrenean oak and beech forests. Over 1,700–2,300 m, climatic conditions prevent forest growth.

Livestock farming and agriculture have resulted in conversion of some of the forested area to grazing and brush. Currently total forest covers 20–50% of the area. Over the last few decades new human activities, especially mining and tourism, have been added to traditional ones.

Wild boar (*Sus scrofa*) red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), and chamois (*Rupicapra pyrenaica*) occur within the bears' range and may be prey, usually as carrion. Wolves (*Canis lupus*) are also present and cause damage to livestock; illegal trapping and poisoning of wolves sometimes affects bears.

## METHODS

Information on females with cubs-of-the-year was obtained through field work in favorable terrain conditions and interviews with government and private rangers, livestock farmers, hunters and other rural people. We had regular contact with the official and private wardens in the bears' range, especially those connected with hunting.

We mapped the data on females with cubs to a scale of 1:50,000 and analyzed them. Data on a group were accepted when either the group or its tracks were observed directly by us or when there was enough reliable information from other sources. All data not directly obtained by us in the field were personally confirmed with observers.

Individual identification of groups was not usually a problem due to their low numbers. We considered a minimum number of females with cubs, taking care not to count groups twice. The criteria used were observation dates, group composition and characteristics, measurements of tracks, existence of significant natural or artificial barriers, and spacing of observations. Knight and Eberhardt (1985) used natural marking, radiotracking, visible artificial marks, and location and date of observation as criteria. According to Servheen (1989), estimating females with cubs is facilitated by a small home range, restricted habitat use, and distinguishing characteristics of the family units (different sized cubs, individual markings).

Lack of information on home ranges of females with cubs in small Southern European populations is a problem as regards using distance between observations as a criterion. We used this criterion only in cases of large distances, taking into account information on other bear populations. Bjarvall et al. (1990) recorded a female staying 4 out of 5 study years within a 185 km$^2$ area, 1 year with 2 cubs. In different habitats of North America, average home range size was 8.5–239 km$^2$ for grizzly females with cubs-of-the-year and 46–546 km$^2$ for females with yearlings (LeFranc et al. 1987).

This research covers 1986–90 for the western population and 1988–90 for the eastern population. However, data on litter size in the eastern population covers 1985–87. Data for 1982–83 are from Campo et al. (1984).

## RESULTS AND DISCUSSION

For the western population we collected 100 observations of 25 females with cubs-of-the-year between 1986–90 ($\bar{x}$ = 4.00 observations/female, range = 1–10). For the eastern (1985–90), we selected 41 observations of 9 females ($\bar{x}$ = 4.56 observations/female, range = 1–12). First observations of females with cubs of both populations occurred in 21 cases (61.8%) from April to June, in 12 (35.3%) from July to September, and 1 (2.9%) in October.

These data provide minimum estimates due to possible cub death both in the den and during the first few weeks outside dens. Nagy et al. (in LeFranc et al. 1987) stated that greatest first-year cub mortality occurs in the den or in the first 4 weeks after emergence.

### Females with Cubs-of-the-Year

Females with cubs-of-the-year were located every year of this study in both populations. The average number of breeding females located in the western population was lower during 1986–90 ($\bar{x}$ = 5.00 per year, $n$ = 25, range = 3–6) than for 1982–83 ($\bar{x}$ = 10.50, $n$ = 21, Campo et al. 1984), the difference being significant (Mann-Whitney test, $P < 0.05$). In the Eastern population, results from 1988–90 ($\bar{x}$ = 1.67, $n$ = 5, range = 1–2) and those from 1982–83 ($\bar{x}$ = 2.50, $n$ = 5) did not differ significantly ($P > 0.20$) (Table 1).

The annual average number of cubs in the western (1986–90) and eastern (1988–90) populations were 11.20 (range 9–14) and 2.67 (range 2–3), respectively. For 1982–83, Campo et al. (1984) estimated an annual average of 22 and 4 cubs, respectively, for the western and eastern populations, the difference showing the same significance as in the previous analysis.

Although methodological variations may have contributed, the differences in the 2 periods in the Western popu-

**Table 1. Number of breeding females and cubs located in the 2 Cantabrian brown bear populations 1985–90.**

| Year | Western population | | Eastern population | |
|---|---|---|---|---|
| | Breeding females | No. cubs | Breeding females | No. cubs |
| 1985[a] | - | - | 2 | 4 |
| 1986[a] | 6 | 14 | 1 | 2 |
| 1987[a] | 6 | 11 | 1 | 1 |
| 1988 | 3 | 9 | 2 | 3 |
| 1989 | 4 | 9 | 2 | 3 |
| 1990 | 6 | 13 | 1 | 2 |

[a] Partial census of the eastern population.

lation can be attributed to a population decrease. In the Eastern population the scarce data do not allow definitive conclusions but suggest a stagnant population size.

Our data show that the western population is much bigger than the eastern, which agrees with estimates of Campo et al. (1984) and Palomero et al. (1993) that the former is about 3 times larger than the latter. Likewise Purroy (1991) found 4.4 times more signs of presence in the western than the eastern range.

## Litter Size

The average litter size was 2.24 cubs ($n = 25$, range 1–4) and 1.67 ($n = 9$, range 1–3) for the western (1986–90) and eastern (1985–90) populations respectively. The difference is significant ($F = 4.203$, df = 1.32, $P < 0.05$).

The data for 1982–83 given by Campo et al. (1984) for average litter size in both western ($\bar{x} = 2.09$ cubs, $n = 21$) and eastern populations ($\bar{x} = 1.60$ cubs, $n = 5$) show no significant difference compared with our data ($F = 0.642$, df = 1.44, $P > 0.05$, and $F = 0.033$, df = 1.12, $P > 0.05$).

Average litter size in North America (31 studies reviewed in LeFranc et al. 1987) ranged from 1.6 cubs in Arctic Alaska to 2.8 cubs in southcentral Alaska with only 8 cases of less than 2. In each of 4 Canadian populations average litter size was 2 (Nagy and Haroldson 1990).

Most authors relate litter size to food availability. Knight and Eberhardt (1984) associated difference in litter size in Yellowstone (average 2.1 cubs between 1959–70, 1.9 cubs between 1974–82) with the closure of rubbish dumps around 1970. Bunnell and Tait (1981) attributed litter size differences between interior (1.88 cubs) and coastal (2.22 cubs) grizzlies to the high availability of spawning salmon (*Oncorhynchus* spp.) to the latter. Rogers (1987) associated average litter size of black bears (*Ursus americanus*) in Minnesota with supplementary rubbish dump feeding. For first litters, figures varied from 2.1 cubs with a natural diet only to 2.5 cubs with supplementary feeding. For subsequent litters variation was 2.5 cubs to 3.4 cubs, respectively.

In some eastern European countries where supplementary food is available, litters of 3 are usual and litters of 4 have been recorded. The average without supplementary food was 2 cubs (Berducou and Camarra 1990). In other south European populations litter size is low. Camarra (1990) studied litters aged 5–9 months in the Pyrenees and found the average litter size of 1.44 cubs ($n = 9$). In the Trentino (Italian Alps) litter size is usually 1, rarely 2, with the last record of 3 in 1910 (Osti 1991). In addition to trophic factors, small litter size in Alpine and Pyrenean populations may be due to genetic problems or increasing age of the mothers as there are <15 bears in each population.

Greater food resources in the western Cantabrian bear range is probably the main cause of larger litter size of this population. Good autumn and winter feeding may be a key factor in breeding success. The eastern Cantabrian bears depend on fruit crops of beech and oaks, which in some years yield little. In addition to these fruits, the Western bears have evergreen oaks and chestnuts, occurring at different altitudes with several hundred meters between each. Greater diversity and guaranteed chestnut crops ensure weight increase prior to hibernation for the western population.

## Interval between Litters

At least 2 of the 6 females that gave birth in 1989 did so again in 1991. One in the western population was easily identifiable because she was missing part of a hind leg. She had 3 cubs both years.

The eastern female had 2 cubs both years. She received special attention (12 observations for the litter of 1989–90 and 44 of the litter of 1991–92). Her characteristics and particularly small track size were well known and, in both periods, she was located on the same dates in the same areas.

In the North American review by LeFranc et al. (1987), the average intervals between litters were mostly 3 to 4 years with a few of 2 years between litters. According to Craighead et al. (1976), the average for 15 females in Yellowstone was 3 years with 4 cases of 2 years between litters. Stringham (1990) reviewed this parameter in several North American populations and found only 1 case of a 2-year breeding interval in a salmon-rich area of Alaska.

In general, as with litter size, this parameter is related to food availability in bear territory. Rogers (in Berducou and Camarra 1990) stated that the interval for 8 black bear females that fed regularly at a dump was 2 years.

Others that fed naturally ranged from 2–4 years. Rogers (in Bunnell and Tait 1981) quoted repeated examples of 2-year intervals in food-rich, deciduous forest habitats. In conifer areas, intervals generally exceeded 3 years.

We have no quantified data on fruit crops in 1989 and 1990, but field observations indicate crops were generally good, especially for acorns. This could explain the 2-year breeding interval of the 2 Cantabrian females.

## MANAGEMENT IMPLICATIONS

The 4 regional governments responsible for bears and their habitat are currently developing joint recovery plans. To evaluate the efficiency of the measures taken within the framework of the plans up-to-date information on demographic parameters and trends of the 2 populations are necessary. Family group tracking provides part of this information economically and with minimum disturbance. Its continuation will provide long-term data allowing future analysis of population trends.

Regular breeding in both populations and a relatively high average litter size in the western population are reasons for optimism regarding recovery. The latter parameter, although not conclusive, suggests good general health and genetic condition. The agencies responsible for bear conservation should pay special attention to the small eastern population which breeds regularly but produces a low number of cubs.

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