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DEMOGRAPHICS OF A WILD BOAR *Sus scrofa* LINNAEUS, 1758 POPULATION IN A METROPOLITAN PARK IN BARCELONA

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ABSTRACT

Collserola Park is situated within the greater metropolitan area of Barcelona, Spain, and, as such, is subject to important human pressure. The wild boar population in the park is almost completely isolated from populations in outlying natural areas because of a continuum of urban areas and major transportation infrastructures, which surround Collserola. Since 1995, we have studied the demography of wild boar in Collserola Park using the analysis of returns obtained from hunting battues, which occur each year between October and February. Since 1998, we have gathered additional information on aspects of population dynamics through regular monitoring of permanent sign-survey plots. That information was compared to hunting data from seasons between 1998-1999 and 2002-2003. Overall, there were significantly more females than males in the hunted population, although within seasons the sex ratio differed significantly from parity in the 2001-2002 season, only, when a higher proportion of females were killed. Hunting returns and field data show a decrease in the abundance of wild boar between 1998 and 1999, an increase in 2000 and 2001, and a decrease in 2002-2003. Pellet-group density was significantly correlated with independent indicators of population levels obtained from hunting data (mean number of wild boar seen and killed per battue). During the study, the population dynamics of wild boar in Collserola reflected fluctuations in the availability of oak mast (of *Quercus ilex* and *Quercus cerrioides*), in that population increases following years of moderate or high acorn availability, and decreases followed years with low or no oak mast. The weight of wild boar killed in hunting battues differed significantly between years and was correlated with oak mast availability between 1998 and 2001.

Keywords: Collserola Park, demography, hunting battue, mast, park, sign-survey, wild boar.

INTRODUCTION

Despite the generally negative effects of conurbations on most wildlife species, some wild mammals are capable of maintaining populations in certain peri-urban environments where their basic ecological requirements can sometimes be met (e.g., red fox *Vulpes vulpes* and badger *Meles meles* in the United Kingdom) (Harris and Cresswell 1987, Harris and Smith 1987). Several species of deer are found in suburban areas in North America, where their presence can sometimes be a source of conflict among interested parties and a challenge for wildlife managers (McAninch and Parker

1991, Conover et al. 1995, Whittaker et al. 2001). Free-living wild boar can be found close to large cities, such as Saragossa, Spain (Sanz 2000), Gdansk, Poland (Mikos 2002), and Geneva, Switzerland (Fischer et al. 2002).

There have been many studies of the demographic aspects of wild boar ecology in diverse environments, both within and beyond their native geographic distribution (Gaillard et al. 1987, Caley 1993, Boitani et al. 1995, Khokhar et al. 1995, Massei et al. 1997, Gabor et al. 1999). To date, however, little or no information is available on the ecology of wild boar in suburban environments (Gràcia et al. 2000, Cahill et al. 2003). Reduced direct human persecution might increase the value of peri-urban areas as refuge for this species, although other hazards, such as vehicle traffic, are generally more common. In metropolitan areas, greenspace is often highly fragmented, and natural, semi-natural, or agricultural habitats for wildlife are often present in the form of disconnected patches that vary in size (Marull and Mallarach 2002). Nevertheless, novel alternative food sources, such as domestic rubbish, gardens and allotments, or even direct feeding by people, might be a significant substitute for, or supplement to traditional foods encountered in more typical woodland or agricultural habitats, although, it is unknown to what extent such novel food resources influence wild boar population dynamics in peri-urban areas.

In more natural contexts, wild boar exhibit random demographic parameters, and long-term modelling of populations in Mediterranean areas shows that population levels can fluctuate between abundance and scarcity, even in the absence of hunting (Focardi et al. 1996). Other studies of wild boar in Mediterranean regions indicate the importance of variation in oak mast availability on wild boar reproduction and mortality (Massei et al. 1996, Massei et al. 1997). For wild boar occupying green space in metropolitan areas, population fluctuations can lead to specific management problems if high densities of individuals occur in suburban contexts (e.g., damage to gardens, traffic accidents, risk of disease).

Data from hunting returns are regularly used to detect inter-annual changes in wild boar abundance (Sáez-Royuela and Tellería 1988, Vassant et al. 1987, Leránoz and Castién 1996, Rosell 1998). The various indices derived from such data are generally considered to be indicative of population levels (Sáez-Royuela and Tellería 1988), although independent field data is seldom available to test the reliability of these indices. In this study, we use both field data obtained from sign-survey plots, as well as hunting returns, to examine some basic demographic characteristics of a population of wild boar in a metropolitan park.

STUDY AREA

The study was carried out in Collserola Park, a large, protected peri-urban park covering about 8,000 ha in metropolitan Barcelona, Spain. The park has a typically Mediterranean climate, with an average annual rainfall of 672 mm, temperatures ranging between –4ºC and +35ºC, and an annual mean daily temperature of 14ºC. The terrain is quite mountainous and elevation ranges between 60 m and 512 m asl. Much (38%) of the Collserola area is covered by mixed woodlands of aleppo pine *Pinus halepensis* and holm oak *Quercus ilex*, although due to past human activity there is a diverse mosaic of vegetation types ranging from savanna-type grasslands (2%) of *Hyparrhenia hirta* to Mediterranean scrub (13%) and maquis (3%). In the more humid areas of the park, deciduous oak *Quercus cerrioides* (Willk et Costa, from the *Quercus humilis* group) is present, along with holm oak. Riparian woodland is present (<1%), although permanent watercourses are scarce within the park. Agricultural areas occupy about 8% of the area, but are rapidly declining.

Over 70% of metropolitan Barcelona has either low ecological connectivity, or none at all, due to the proliferation of urban areas and infrastructures (Marull and Mallarach 2002). As such, for all non-flying vertebrates, Collserola Park is effectively isolated from nearby natural and semi-natural areas (Figure 1). Within the limits of the park, there is an important road network that includes a motorway and railway axis, which crosses the park from southeast to northwest via a series of tunnels, and there are a considerable number of residential developments located in essentially wooded areas. Urban and suburban areas account for about 30% of the park. Since the beginning of the 1990s, wild boar numbers have increased in the park, in parallel

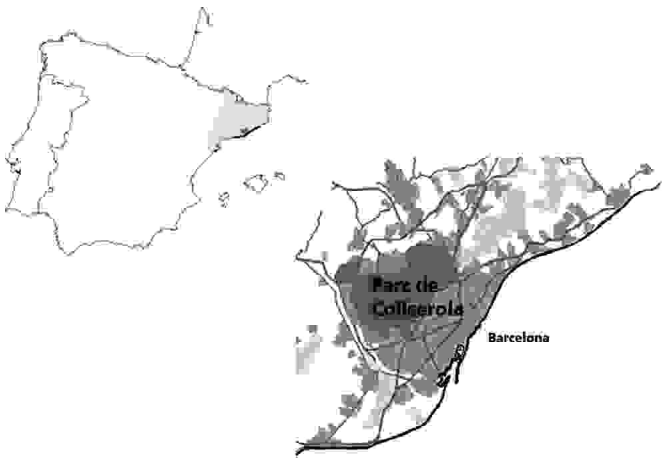

Figure 1. Location of Collserola Park, Northeast Spain. Urbanised ground is shown in medium grey, major roads are continuous lines, and other nature areas are light grey.

to a general increase in the province of Barcelona as a whole (Bonet-Arbolí et al. 2000), although, despite the broader upward trend, in recent years there were significant fluctuations in the number of wild boar captures in Collserola, which is not in keeping with the trends for the broader region (op. cit.). Wild boars in Collserola are free ranging and receive no supplementary feeding. The aim of our study was to evaluate possible factors underlying the species' population dynamics in this metropolitan park, given that it is a somewhat atypical environment for wild boar. This study is part of an ongoing monitoring program being carried out on wild boar in Collserola Park.

METHODS

Hunting battues

Hunting is permitted in approximately 50% of the park between October and February (Patronat Metropolità del Parc de Collserola 1990), although authorised battues for wild boar are only carried out in about 10% of the park (Bonet-Arbolí et al. 2000). Nevertheless, hunting pressure (battues per 100 ha) is similar to or greater than in other parts of Catalonia and Spain (Bonet-Arbolí et al. 2000). Standard data, such as sex and undressed weight (kg), were obtained by the authors, park rangers, or previous researchers (Bonet-Arbolí et al. 2000) from wild boar killed during all of the organised hunting battues between the 1995-1996 and 2002-2003 seasons. In that period, an average of 26 battues (range 23-30) were conducted per season. Animals were weighed to the nearest kilogram using standard weighing scales or Roman balances, and the total number of wild boar killed and seen (including killed individuals) during battues was recorded. To reduce the possible influence of variation in annual hunting effort on estimates of the number of wild boar killed or seen (all of the individuals encountered, including killed animals and escapees), the results were also expressed as the number of wild boar killed or seen per battue for comparisons with pellet-group density. For the analysis of sex ratios, animals were also classified as being either younger (<30 kg) or older (≥30 kg), which roughly correspond to individuals less than or greater than one year of age (Rosell 1998). Additional comparative data were available from annual hunting returns provided by the *Serveis Territorials de Medi Ambient* of the Catalan Autonomous Government. Those data, which were provided directly to the *Serveis Territorials* by hunters, include additional accounts of wild boar killed outside official organised battues in each hunting season, some of which would correspond to wild boar killed under special permits for the control of problem animals. Although no data are available on the sex and weight of

those wild boar, they were included in some analyses because in some years the number of wild boar killed outside official battues (declared annual returns) is greater than the number killed during authorised battues. Poaching can be a problem in Collserola Park, but its impact on the wild boar population is unknown.

Sign-survey plots

Forty plots (3m x 3m) were established at random in different habitat types in an area of the park where hunting does not occur. Plots were located in agricultural habitats (5 plots in crop fields and 8 plots in small terraced fields mixed with fruit trees), on wooded slopes (15 plots), in riparian woodland (7 plots) and in a thinly wooded firebreak (5 plots). Plots were surveyed seasonally between 1998 and 2003. During some surveys, it was not possible to inspect all of the established plots because of circumstances unrelated to the study (e.g., fields recently ploughed); thus, the total number of plots surveyed during each inspection varied between 31 and 38. The objective of plot surveys was to obtain an independent estimate of relative wild boar density based on pellet-group abundance. Since there was no intention to estimate absolute density using pellet-group counts, plots were not stratified according to habitat availability. During inspections, plots were examined in detail for the presence of wild boar pellet-groups and these were counted and removed from plots whenever found. As such, an index of pellet-group density (DI) was calculated for autumn and winter using the following equation:

$$DI = \frac{P/S}{D}$$

where P is the number of pellet-groups recorded, S is the area of the plot (9 m^2), and D is the number of days between consecutive seasonal inspections of the same plot.

Given its importance as a key factor in wild boar population dynamics, oak mast availability was assessed by counting acorns at woodland plots during each inspection. In the study area, holm oak and deciduous oak are present, although the former is the more abundant of the two species. Kermes oak (*Quercus coccifera*) and cork oak (*Quercus suber*) are also present in Collserola, but are generally much less widespread and are less abundant than the other two species. As such, only acorns from holm oak and deciduous oak were found at sign-survey plots. Acorns from deciduous oak tend to fall before those of holm oak, although, occasionally acorns of both species are found at the same time on the same plot. In this study, only total acorn abundance was assessed, and we did not differentiate between the oak species from which they came. To avoid influencing later use of the plots by wild boar, acorns were counted, but not removed from plots.

Statistical analyses

For parametric testing of means, we used Student t-tests and ANOVA, and the Tukey test was used for *post-hoc* multiple comparisons when significant results were obtained. Where appropriate, Chi-squared and Kruskal-Wallis tests were used for non-parametric tests of proportions and analysis of variance. When significant differences were obtained using the Kruskal-Wallis test, non-parametric *post-hoc* multiple comparisons were made following Zar (1984). Statistical testing was performed using SPSS for Windows, version 9.01 (SPSS, 1990). In the text, means are presented, along with corresponding standard deviations. Results were considered statistically significant when p values from statistical tests were < 0.05.

RESULTS

Sex ratio

Among the six individual hunting seasons between 1997-1998 and 2002-2003, the sex ratio (males:female) of wild boar differed significantly from parity during the 2001-2002 season, only, when there was a higher proportion of females among captured animals (Table 1). Nevertheless, no significant differences were detected between seasons, and when the data from the six seasons were combined, the overall sex ratio was significantly female-biased (Table 1). Overall, there was no significant difference between the sex ratio of younger (<30 kg, sex ratio = 0.72:1) and older (≥30 kg, sex ratio = 0.71:1) wild boar hunted ($\chi^2 = 0.001$, d.f. = 1, $p = 0.98$, $n = 163$). The sex ratio of older (≥30 kg, Table 2) wild boar varied among years, from 0.42:1 during the 2001-2002 hunting season to 1.29:1 in 1999-2000, which was the only season in which more males were killed, although the differences among years were not significant ($\chi^2 = 4.56$, d.f. = 5, $p = 0.47$, $n = 132$). Within-season sample sizes of younger wild boar (<30 kg) were too small in some seasons to permit comparisons of sex ratio between years in this age class. The sex ratio tended to be slightly biased toward females at the beginning of the hunting season, and shifted towards parity in the latter part of the season (monthly sex ratios: October – 0.54:1; November – 0.59:1; December – 0.74:1; January – 0.86:1; February – 0.80:1), but differences among months were not statistically significant ($\chi^2 = 1.13$, d.f. = 4, $p = 0.89$, $n = 163$).

Population dynamics

The various basic parameters obtained from hunting data (the number of wild boar declared killed in Collserola Park based on official returns, the number of wild boar killed in authorised battues, and the number of wild boar seen in battues) generally indicate a similar trend, especially over the last few years, despite an almost constant

number of battues per season (Figure 2). It is noteworthy that the general increase in population levels up to the 1998-1999 season was followed by a significant reduction in wild boar abundance in 1999-2000. There was a slight recovery in 2000-2001 and a more substantial increase in 2001-2002, which was followed by an important reduction in the 2002-2003 season. Although there was some inter-annual variation in the number of hunting battues that were authorised (permits given) each year in Collserola Park (mean = 33.6 ± 4.9 battues authorised, range = 28-43, n = 8 hunting seasons), in practise, the number of battues that were carried out in each hunting season was significantly lower ($t = 3.64$, d.f. = 14, $p<0.01$), and was quite constant throughout this study (mean = 26.4 ± 2.7 battues carried out, range = 22-30, n = 8 seasons; Figure 2).

TABLE 1
Summary of the comparisons of wild boar sex-ratio (males per female) in Collserola Park for the six hunting seasons between 1997 and 2002.

Hunting season	Number males	Number females	Sex ratio	Comparison	χ^2	*df*	*P*
1997-1998	15	20	0.75 : 1	1 : 1	0.71	1	0.398
1998-1999	15	23	0.65 : 1	1 : 1	1.68	1	0.194
1999-2000	9	9	1.00 : 1	1 : 1	0.00	1	1.000
2000-2001	10	9	1.11 : 1	1 : 1	0.05	1	0.819
2001-2002	10	25	0.40 : 1	1 : 1	6.43	1	0.011
2002-2003	9	9	1.00 : 1	1 : 1	0.00	1	1.000
Total	68	95	0.72 : 1	1 : 1	4.47	1	0.034
1997-2002	68	95	Comparison between the six seasons		4.53	5	0.476

Overall, between 1995 and 2002, there was significant variation among hunting seasons in the number of wild boar killed per battue (Kruskal-Wallis: $H = 25.3$, d.f. = 7, n = 209 battues, $p<0.001$), although significant between-year differences were only observed between the 1996-1997 and 1998-1999 hunting seasons ($Q = 3.45$, d.f. = 8, n = 209 battues, $p<0.05$), when the mean numbers of wild boar killed per battue were 0.47 ± 0.90 (n = 30 battues) and 1.41 ± 1.08 (n = 27 battues), respectively (the remaining comparisons between hunting seasons were non-significant). There was significant (Kruskal-Wallis: $H = 47.7$, d.f. = 7, n = 207 battues, $p<0.001$) variation among seasons in the number of wild boar seen per battue in the same period. Multiple comparisons among individual hunting seasons revealed that the number of wild

boar seen per battue was significantly higher in the 1998-1999 season (mean 7.4 ± 5.5, n = 27 battues) than during 1995-1996 (mean 2.0 ± 1.9, n=23 battues) (Q = 4.53, d.f. = 8, n = 207 battues, $p<0.01$), and significantly lower in 1996-1997 (mean 2.1 ± 3.8, n = 30) than in 1997-1998 (mean 4.4 ± 3.3, n = 27) (Q = 3.51, d.f. = 8, n = 207 battues, $p<0.02$), 1998-1999 (mean 7.4 ± 5.5, n = 27) (Q = 5.50, d.f. = 8, n = 207 battues, $p<0.01$) and 2001-2002 (mean 6.2 ± 6.9, n = 25) (Q = 3.43, d.f. = 8, n = 207 battues, $p<0.02$). The remaining comparisons between seasons were non-significant.

TABLE 2
Population structure of hunted wild boar in Collserola Park by weight class and sex for the six hunting seasons between 1997 and 2002.

	< 30 kg				≥ 30 kg			
Hunting season	M	F	Sex ratio	Percent of population	M	F	Sex ratio	Percent of population
1997-1998	3	4	0.75 : 1	20.0	12	16	0.75	80.0
1998-1999	5	4	1.25 : 1	23.7	10	19	0.53	76.3
1999-2000	0	2	-	11.1	9	7	1.29	88.9
2000-2001	1	0	-	5.3	9	9	1.00	94.7
2001-2002	2	6	0.33 : 1	22.9	8	19	0.42	77.1
2002-2003	2	2	1.00 : 1	22.2	7	7	1.00	77.8
Total	13	18	0.72 : 1	19.0	55	77	0.71	81.0

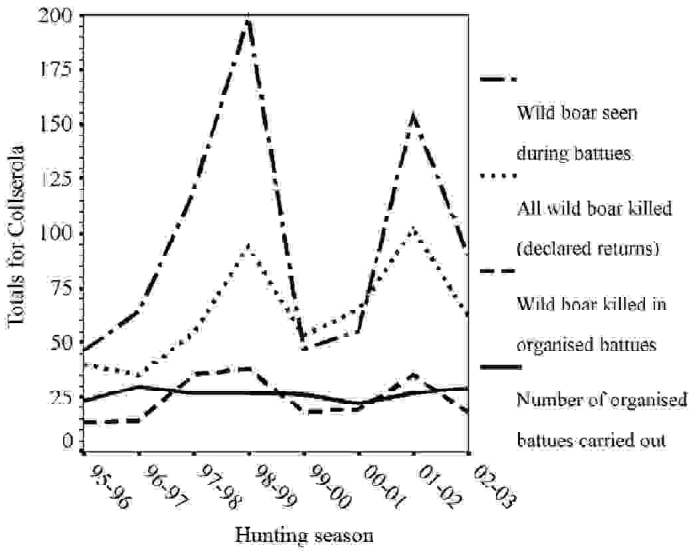

Figure 2. Number of hunting battues, sightings, and captures of wild boar in Collserola Park between the 1995-1996 and 2002-2003 hunting seasons.

Pellet-group density

Between 1998 and 2002, autumn and winter pellet-group density indices showed trends similar to both the mean number of wild boar seen and killed per battue during the corresponding hunting season, with maximum values in 1998 and minimum values in 1999 (Figure 3). Bivariate correlations between those parameters revealed significant relationships between the mean number of wild boar seen per battue and both the mean autumn and mean winter pellet-group density indices (autumn: $r = 0.92$, $p<0.05$; winter: $r = 0.96$, $p<0.01$, $N = 5$ yr, from 1998-2002; Figure 4). The mean number of wild boar killed per battue was significantly correlated with the mean autumn pellet-group density index ($r = 0.89$, $p<0.05$), and the corresponding correlation with the winter pellet-group density index was marginally non-significant ($r = 0.85$, $p=0.07$) ($N = 5$ yr, from 1998-2002).

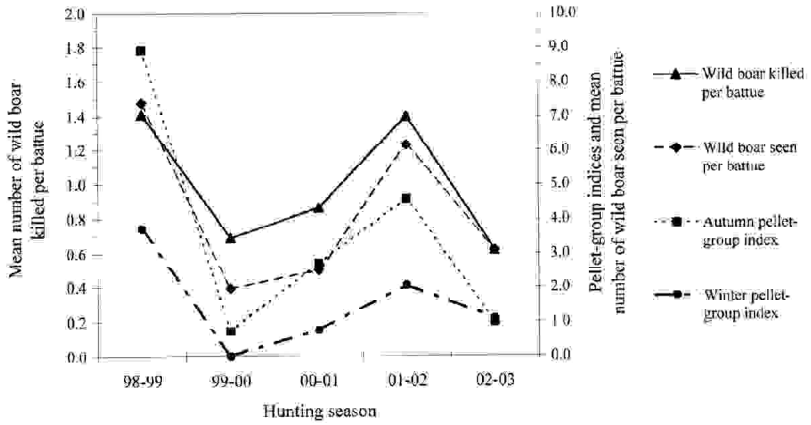

Figure 3. Comparison of the mean number of wild boar seen and killed per battue, with the mean pellet-group density indices for autumn and winter during 1998-2002.

Oak mast availability and wild boar body weight

Autumn and winter oak mast availability varied significantly among years (autumn availability - Kruskal-Wallis: $H = 65.3$, d.f. = 4, $n = 135$ plots, $p<0.001$; winter availability - Kruskal-Wallis: $H= 67.5$, d.f. = 4, $n = 135$ plots, $p<0.001$). Oak mast abundance was significantly higher ($p<0.01$) in the autumn of 2002 and in the winter of 2002-2003 (Figure 5) than in all of the other years (from 1998 to 2001). Apart from 2002, which was a year of exceptional acorn (basically *Q. ilex*) productivity in Collserola, the highest levels of oak mast availability were recorded in 1999, both in autumn and winter, followed by 2000, whereas acorns were very scarce in 1998 and almost nonexistent in 2001 (Figure 5). Nevertheless, the differences in autumn and winter oak mast abundance between years in the 1998-2001 period were not

statistically significant. Inter-annual variation in wild boar abundance, as indicated by the percentage change between hunting seasons in the mean number of wild boar killed per battue, appears to reflect oak mast availability because population increases followed years of moderate to high acorn abundance, and years of very low or no availability led to subsequent decreases in wild boar numbers (Figure 5).

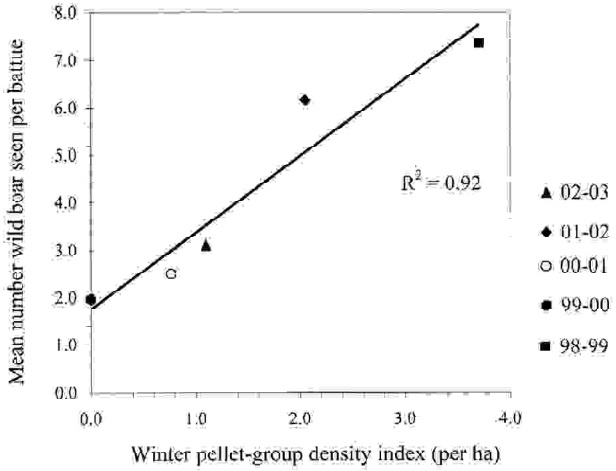

Figure 4. Relationship between the mean winter pellet-group density index and the mean number of wild boar seen per battue in the same hunting season in Collserola Park.

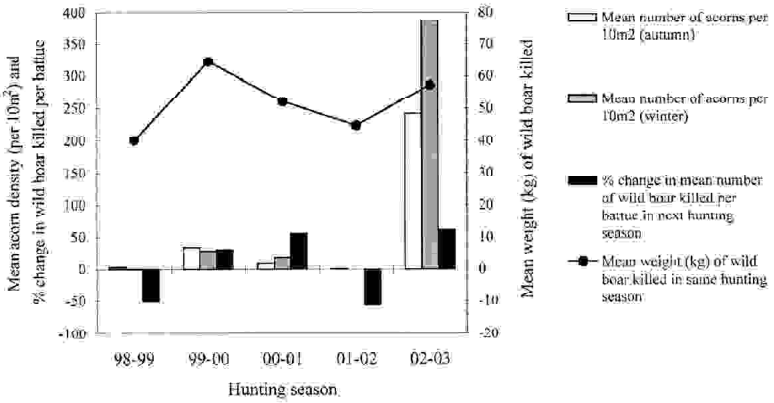

Figure 5. Oak mast availability (acorns per 10 m^2), wild boar body weight (kg) and subsequent changes in the abundance of wild boar in Collserola Park. Note: change in abundance is indicated as the percentage variation in the mean number of wild boar killed per battue between a given hunting season and the following season.

There was significant variation in mean body weight among years (One-way ANOVA: $F_{4.123} = 7.31$, $p<0.001$). Post-hoc comparisons showed that weight was significantly higher in the 1999-2000 hunting season (64.4 ± 18.7 kg, n = 18) than in 1998-1999 (40.1 ± 16.1 kg, n = 38) and 2001-2002 (44.7 ± 19.5 kg, n = 35) (Tukey tests: $p<0.001$), and significantly higher in 2002-2003 (57.6 ± 21.1 kg, n = 18) than in 1998-1999 (Tukey test: $p<0.01$). In 2000-2001, mean body weight (52.1 ± 14.3 kg, n = 19) was not significantly different from those in other years (Tukey test: $p>0.05$). Wild boar body weight tended to be higher in years that had a greater abundance of acorns (Figure 5), although, overall, in the five years from 1998 to 2002, mean body weight of wild boar killed during battues was not significantly correlated with oak mast availability ($r = 0.40$, $p=0.5$, n = 5 years, winter and autumn combined). When the data from 2002-2003, an exceptional period for acorn abundance in Collserola, were removed from the analysis, the correlation between mean body weight of wild boar and oak mast availability was significant ($r = 0.97$, $p<0.03$, n = 4 years, from 1998-2001).

DISCUSSION

Observations of captive bred wild boar have shown no difference from parity in the sex ratio of newborn litters (Eguchi et al. 2001), whilst differences have been observed at the foetal stage (Carranza et al. 1994), although not in other studies of hunted populations (Herrero 2003, Rosell 1998). A population sex ratio of 1:1 has also been observed in previous field studies (Baber and Coblentz 1986, Saunders 1993, Massei et al. 1997, Rosell 1998), although others have found a predominance of either males (Milkowski and Wojcik 1984) or females (Garzón 1991). Herrero (2003) generally found no differences in sex ratio of hunted wild boar in two extensively studied populations in Aragon, Spain, except among individuals of the oldest age class (>3 years old) in one population, in which there was a higher proportion of females. Massei et al. (1997) observed differential rates of natural mortality between distinct age and sex classes in a non-hunted population, where adult females had higher death rates than did males, and juvenile males had higher death rates than females during particular periods of food scarcity. In other hunted populations, males were killed at a lower rate than females, despite the sex ratio of trapped individuals among the same population being biased towards males (Gabor et al. 1999). It has been suggested that mortality rates can be higher in females when food resources are scarce because of their higher energetic requirements for reproduction (Massei et al. 1997), and adult females accompanied by piglets are considered to be more vulnerable during hunting battues (Rosell 1998). In Collserola Park, the highest proportions of females among hunted wild boar were observed in 2001-2002 (0.4:1) and in 1998-1999 (0.65:1), both being

the worst years for oak mast availability. In our study, however, there was no evidence of increased vulnerability of females at the end of the hunting season, when adults are most likely to be in the latter stages of gestation.

In Collserola Park, oak mast availability seems to be a factor determining fluctuations in wild boar population size, as was found in other studies (Okarma et al. 1995, Massei et al. 1997). It is of particular significance that the two years in which oak mast availability was very low or nil (1998 and 2001) were followed by years in which wild boar abundance decreased, possibly because of the negative effects of low oak mast on reproduction (Matschke 1964, Massei et al. 1996) or survival rates (Massei et al. 1997). The 1998-1999 and 2001-2002 hunting seasons were also years in which a higher proportion of females were recorded among the hunted population, which possibly further reduced the reproductive capacity of the population in the following year. On the other hand, wild boar population levels increased in the years following autumns and winters that had moderate or high availability of acorns. Nevertheless, the degree to which oak mast influences changes in the numbers of wild boar in Mediterranean habitats will also depend on other limiting environmental factors, such as drought (Massei et al. 1996, 1997) and disease (Gortázar et al. 2002, Vicente et al. 2002).

The relatively low number of authorised battues carried out in Collserola each year might, *a priori*, cast doubt on the usefulness of the hunting data they provide as an indicator of wild boar population levels. Nevertheless, the population trends they indicate are generally corroborated by field data of pellet-group abundance. Also, the hunting effort in Collserola Park is comparable to that in other areas of Spain (Bonet-Arbolí et al. 2000). Given the relative stability in the number of battues carried out each season in Collserola, variation in hunting pressure, per se, probably has not had an important influence on the number of wild boar killed in each season or the observed fluctuations in overall population levels. Indeed, some suggest that hunting, per se, is not a key factor influencing wild boar population levels (Boitani et al. 1995). Although the number of wild boar killed in authorised battues in Collserola is relatively low (mean = 26, range = 18-38, period = 1998-2002), in some years, the total number of declared returns can reach about 100 animals (Figure 2), and might influence population trends. Nevertheless, the number of wild boar killed in a given year, whether from authorised battues or total declared returns, does not appear to be a good predictor of population levels in the following year.

Our results indicate that, despite its apparently atypical context, the wild boar population in Collserola Park in metropolitan Barcelona displays underlying natural demographic characteristics that are typical of this species. For several reasons, however, population fluctuations in Collserola Park might be more marked than in nearby areas (Bonet-Arbolí et al. 2000). In an ever more isolated population, sharp increases and

decreases might not be compensated for by emigration-immigration fluxes, and urban sprawl and transportation infrastructures can limit access to alternative food resources in outlying areas beyond the Collserola mountains during periods of food scarcity. Also, in other situations, the presence of agricultural crops can have significant effects on wild boar population density (Caley 1993, Khokhar et al. 1995, Krueger 1998) and probably act to buffer the effects of variation in food availability in natural Mediterranean habitats (Fournier-Chambrillon et al. 1996). In Collserola Park, the loss of agricultural areas and activity has accelerated in recent years.

Finally it should be emphasized that acorn production is highly variable between years and does not follow regular, predictable cycles (Koenig et al. 1994). In our study, only one of five years could really be considered a true 'mast' year (2002-2003), with an exceptionally high abundance of acorns in comparison to other years, in some of which acorns were virtually absent during autumn and winter. There is a lack of knowledge about this issue in Mediterranean ecosystems, where acorns can form an important component of the wild boar's diet. In that regard, the monitoring of oak mast availability might prove useful in identifying periods of food scarcity for wild boar, during which they might be increasingly forced to exploit alternative food sources of anthropogenic origin, as well as in predicting proximate population trends.

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