Consequences of the Bovine Spongiform Encephalopathy (BSE) on breeding success and food availability in Spanish Vulture populations.

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ABSTRACT

The establishment of vulture restaurants has been considered a useful conservation tool for preserving vulture populations. Since the Bovine Spongiform Encephalopathy or "mad-cow" disease (BSE hereafter) appeared in Spain (to date 277 cattle affected and increasing) leaving carcasses in the fields for vultures was strictly banned. During 2001-2002, the Spanish Government removed around 305,000 carcasses per year from the fields/farms (0.58% of the National Livestock census). Results of the *Surveillance Plan against BSE* on removing carcasses have been unequal by region. Only La Rioja Province has managed a good carcass removal program that destroyed 48,025 and 31,277 carcasses in 2001 and 2002 respectively. Anyway, since BSE appeared vulture species in Spain have enough food available. The effect of the corpse removal programme on the breeding success of vulture populations inhabiting large areas of Spain has been analysed. The study area accounted for 84% of Griffon, 50% of Cinereous, 51% of Egyptian and 100% of Bearded Vulture populations. The Bearded Vulture is the only species having a well-established - protection and managed - feeding program. For the rest of species, although there are protected breeding areas, there is not enough protection of feeding places. The National Royal Decree approved in November 2002 and subsequent European regulations do not take into account the extensive grazing management nor the use of ruminant species for feeding vultures. Agreement between biologists and veterinarians is urgent needed in order to balance livestock rearing techniques and carcass availability for vultures.

Introduction

The four vulture species inhabiting Spain have experienced different population trends in the last three decades: The Eurasian Griffon *Gyps fulvus* has greatly recovered (SEO, 1981; Arroyo *et al*. 1991 and Del Moral & Martí, 2001) while Cinereous *Aegypius monachus* and Bearded *Gypaetus barbatus* Vultures had slight increases (Sánchez, 2003; R. Heredia, 2001 and pers. comm.); finally, the Egyptian Vulture *Neophron percnopterus* has suffered a 25% decline since the last First National Census in 1990

(Perea et al. 1991; Del Moral & Martí, 2002). Causes of these are clearly protection of breeding areas and in some instances (e.g. the Eurasian Griffon) a food superabundance and/ or lack of human prosecution by means of shooting or poisoning (Donázar & Fernández, 1990; Camiña 2000). However, it must be noticed the growth of poisoning incidents in recent years especially for the Egyptian and Cinereous Vultures in certain areas (Antor, 2003; Hernández, 2000, 2003; Sánchez, 2003).

Supplementary feeding has been widely employed as a conservation tool for managing carrion-eating birds for a long time (Iribarren, 1977; Terrasse, 1985; Fernández, 1988; Butchart, 1988; Mundy et al. 1992 and references therein; Vlachos et al. 1999). However in the 70´s and 80´s only a few true feeding stations for griffons operated in Spain, mostly managed by Non-Governmental Organizations (NGO´s) and probably no more than ten (Iribarren, 1977). In extensive grazing areas, carcasses remained in the field, and vultures regularly fed on them. For many years only a few feeding points were used in the Pyrenees. There, mainly sheep hooves and spinal columns were dropped in order to increase the survival of immature Bearded Vultures (Heredia & Heredia, 1999). Furthermore, other vulture restaurants were employed in the recovery of the Cinereous Vulture population, as is the case of Mallorca (Tewes et al. 1998). However, to date, all the remaining named "feeding stations" were places where people from villages left livestock carcasses for vultures. They are known in Spanish as "*muladares*" (There is no translation into English but it could means "the place where carcasses are left for vultures") and they are run illegally. According to very old Spanish regulations all carcasses must be destroyed (buried or burnt) in order to prevent any effect on human health. However, both shepherds and authorities overlooked the problem of corpse disposal and left carcasses for vultures at these sites. From now on a clear distinction will be used between feeding stations and vulture restaurants. In Spain, the latter term is employed for legal feeding sites in accordance with the new regulations.

Since the Bovine Spongiform Encepahlopathy (BSE hereafter) and other diseases such as foot and mouth disease, appeared in Europe both the livestock rearing techniques and movements within the European Union territory have been peer supervised by authorities. In Spain the first cases of BSE appeared in November 2000 and, up to May 2003, 277 cattle had been affected (Ministerio de Agricultura Pesca y Alimentación,

2003). Just after that, measures against BSE included carcass removal from the field and farms to be destroyed by means of incineration. Nevertheless, carrion eating birds directly affected by these measures were not taken into account (Camiña 2001a). Since then, some local regulations were published for preserving vulture populations (Boletín Oficial de La Rioja, 2001; Boletín Oficial de la Comunidad Foral de Navarra 2001; Diario Oficial de la Generalitat Valenciana 2001). Finally, on 1st November 2002 the Spanish Government published a Royal Decree (Boletín Oficial del Estado, 2002) that permits the disposal of carcasses for carrion eating birds. Only very recently the European Union approved a regulation concerning the use of carcasses for vultures in those countries where these species breed (Diario Oficial de la Unión Europea, 2003). The aims of this paper are as follows. 1) Assess the efficiency of the carcass removal programme in terms of the extent of BSE in Spain. As soon as BSE appeared an immediate change in food availability was supposed. 2) Review the breeding successes of the four vulture species breeding in Spain before 2000 and after BSE appeared (2001 breeding seasons). 3) Evaluate the application of the 1098/2002 Spanish National Royal Decree, the previous local regulations above mentioned and the EU 322/2003 Decision (Diario Oficial de la Unión Europea, 2003) together with the current situation of existing "*muladares*" or legal vulture restaurants in Spain.

Material and Methods

The study was carried out in a vast area of Spain accounting for the 72.4% of Eurasian Griffon, 96% of Cinereous, 80% of Egyptian and 100% of Bearded Vulture populations of Spain (Del Moral & Martí 2001 and 2002; Sánchez, 2003 and R. Heredia, 2001 and pers. com.). The area includes the Local Governments of Aragon (three provinces: Zaragoza, Huesca and Teruel accountig for 47,682 km^2), Navarra (one province and 10,421 km^2), La Rioja (one province and 5,033 km^2), Castilla la Mancha (five provinces: Guadalajara, Albacete, Ciudad Real, Cuenca and Toledo; 79,255km^2), Castilla-León (eight provinces: Burgos, Palencia, León, Zamora, Salamanca, Avila, Segovia and Valladolid; 94,010 km^2), Extremadura (two provinces: Cáceres and Badajoz; 41,602 km^2) and Andalusia (eight provinces: Huelva, Sevilla, Cádiz, Córdoba, Jaén, Málaga, Granada and Almería; 87,267 km^2), all together accounting for 365,270 km^2. See Figure 1 for details.

FIGURE 1

The numbers of carcasses yearly removed from the fields or farms were taken from the Agriculture and Livestock Ministry for 2001 and from Consejería de Agricultura Gobierno de La Rioja for 2001 and 2002 (all were unpublished data from the Action Plan Against BSE). Thus, clear data on number of carcasses of different types removed in the latter region are being collected (F. J. Puértolas, pers. comm.). In addition, a special surveillance program regarding the impact of the "Plan against the BSE" on carrion eating birds was started in 2001 (Camiña, 2001b, 2003a and 2003b; Camiña & Luján 2002). Livestock censuses were taken from Local Governments statistics (Junta de Extremadura, 1998; Junta de Castilla León, 1999; Gobierno de La Rioja, 2001; Comunidad Foral de Navarra, 2002; Gobierno de Aragón, 2002; Junta de Andalucía, 2003 and Junta de Comunidades de Castilla La Mancha, 2003). With this information it was possible to estimate minimum mortality rates for the different types of livestock in 2001.

Estimates of breeding success of the four species of vultures breeding in Spain have been collated at a regional level from published material and from many scientists regularly monitoring regional vulture populations. Data from Local Governments were provided by authorities as well (pers. comm. of unpub. data). All the people/institutions involved are mentioned in acknowledgements. Juan José Sánchez Artés from the Black Vulture Conservation Fund (BVCF) and Rafael Heredia, National Advisor for the Bearded Vulture from the Spanish Government, provided us with the last National censuses for both Cinereous and Bearded Vultures respectively. After the BSE appeared a yearly monitoring programme was suggested to assess the evolution of breeding parameters. At least for colonial species (Eurasian Griffon and Cinereous Vulture), censuses should be made at most of the breeding colonies and not in single sites as sometimes was previously done (Arroyo et al. 1991; Del Moral & Martí, 2001). The intention was to avoid focusing on colonies with specific threats because this could bias the results. The breeding season for the four species of vultures in Spain starts as soon as December (Eurasian Griffon and Bearded Vulture) and lasts until August, i.e. Egyptian Vulture (Cramp & Simmons, 1978; Del Hoyo et al. 1994). Thus, the effect of measures against BSE was tested in 2001 breeding season. Only for La Rioja data on 2001 and 2002 breeding seasons were largely available. Data of breeding success and productivity were gathered and are used here as in Cheylan (1981): Breeding success:

Number of fledglings/ Number of pairs that laid eggs. Productivity: Number of fledglings/ Total number of breeding pairs.

Finally, on 1st of November 2002 the Spanish Government approved the National regulation on disposal of carcasses for carrion eating birds (Boletín Oficial del Estado, 2002). Previously, in March, April and June 2001, La Rioja, Navarra and Valencia Local Governments established specific regulations for their territories (Boletín Oficial de La Rioja, 2001; Boletín Oficial de la Comunidad Foral de Navarra, 2001; Boletín Oficial de la Generalitat Valenciana, 2001). In La Rioja three feeding stations were legally established and the number of carcasses dropped there were regularly monitored. Firstly, requirements of carcass disposal regulations in Spain are compared and, secondly, food requirements of vultures assessed. Finally, the most recently approved regulations from the EU are considered.

Results

1) Removal of carcasses:

Table 1 shows the Livestock Censuses (1998-2001) for the regions included in this study together with the percentage they account in Spain, as a whole. A total of at least 52,172,715 horses, goats, pigs, sheep and cattle were recorded in 2000 (Ministerio de Agricultura Pesca y Alimentación, 2003). The data for horses are too imprecise for further consideration.

TABLE 1

Table 2 shows the number of carcasses removed on each region during 2001. Results are also expressed as a percentage of their respective total livestock regional censuses.

TABLE 2

From these data it can be calculated that the average annual removal rate (carcasses removed/livestock census) for the whole of Spain is on average only 0.58% (range 0.03-10.97%). Clearly, the highest value is for La Rioja (i.e. 10.97%), the remainder are all less than 2% (Table 2). Table also reveals that all regions collected cattle and, to some

extent, sheep carcasses with no pigs and horses at all. Now we will examine in detail the results for La Rioja, where data for 2002 are also available. Table 3 shows total numbers of carcasses removed, carcasses per day and % they represent over the regional livestock census.

TABLE 3

From 2001 to 2002 total number of sheep collected diminished while pigs increased, while the remaining categories were little changed. Average removal rate for 2001-2002 in La Rioja is higher as compared with the average removal rate for the rest of Spain in 2001: average ($\pm$ standard error) for La Rioja 9.01% $\pm$ 1.95 and n = 2 and average of 0.52% $\pm$ 0.19 for "Spain" and n = 6 (t –Test, t = -7.77 and $p<0.001$). However, there is a decrease of carcass removal rate in La Rioja in 2002 (7.05% of the regional census as compared with 10.97% the previous year) probably caused by a "relaxation" in the sheep removal process that results in less carcasses collected. The high potential availability of carcasses in the region is noteworthy as compared with the estimated Eurasian Griffon population and the food requirements for the species there (Camiña, 2000). Results does not revealed great seasonal changes on mortality, probably due to they are gross numbers for six month periods.

2) Breeding success before and after BSE:

Bearded Vulture: The total number of occupied territories for 2002 was 93; being the highest value ever recorded. The population was comprised of 80 pairs that bred and 30 fledgings, (Heredia, pers. comm.). However, the breeding success is still decreasing. Causes of this will be mentioned later.

Eurasian Griffon: Breeding success data from La Rioja, Navarra, Castilla-León and certain colonies from Extremadura have been collated (Donázar et al. 1998; Camiña 2001b, 2003a and 2003b; A. Senosiaín pers. comm..; ADENA/WWF pers. comm.).

TABLE 4

Table 4 compares the average breeding success before and after BSE and no differences were found. Colonies "after" included the same colonies controlled for breeding success "before" plus more colonies within their respective areas. All breeding pairs in the same cliff were considered as "colony" (not as Arroyo et al. 1991 and Del Moral & Martí, 2001 precluded; they considered as "colony" all the cliffs within a radius of 1,000

metres of distance). Furthermore, some data referred to Cáceres Province in Extremadura (Prieta 2003 and pers. comm.) revealed a 17% increase in 2001 as compared with the III National Census (Del Moral & Martí, 2001). Then, breeding success was reported to be 0.68. Data on productivity are quite similar than those for breeding success but are not so abundant from before BSE. Thus, no information on this subject it has been included here.

Cinereous Vulture: Only breeding success for two colonies from Extremadura region (Monfragüe and Sierra de San Pedro, both in Cáceres Province) can be compared. The Spanish Cinereous Vulture population is monitored each year, and it is steadily increasing, however, many human induced threats others than food availability (mainly poisoning or timbering) are affecting many colonies (Sánchez, 2003). Thus, values of breeding success are highly biased by those threats for comparisons on the impact only of BSE. Monfragüe Natural Park, the largest colony in Spain, had 228 breeding pairs in 2001 and breeding success was 0.76 in both 1998 and in 2001). At Sierra de San Pedro colony there were 220 pairs and breeding success was on average 0.70± 0.14 for the period 1998-2000 as compared with 0.76 in 2001. Other data for Castilla La Mancha region showed that for the period 1989-2000 the number of breeding pairs increased from 196 to 243, and breeding success from 0.80 to higher than 0.90. In 2001 there were 267 breeding pairs with a breeding success similar to the previous period. In addition, outside of the regions considered in the present study, another colony in central Spain has also increased and reached a higher breeding success in 2002 as compared for the last four years (SEO, 1999; Del Moral, pers. comm.). Breeding success before was on average 0.71± 0.02 for 1997-1999.

Egyptian Vulture: The only information available for this species (Table 5) is from Andalusia (Benítez et al. 2003). Estimates of productivity and fledging success were made with different sample sizes. Anyway, not clear trend on breeding parameters were found between years.

TABLE 5

3) Management of feeding stations before and after BSE disease:

As it has been previously mentioned, *"muladares"* for vultures have been illegal for many decades. To date, there are four specific regulations governing the establishment of feeding stations in Spain. At the National level the Royal Decree 1098/2002 has been in force since 1st November 2002 (Boletín Oficial del Estado, 2002). Previously, La Rioja, Navarra and Valencia Local Governments in March, April and October 2001 respectively, established local laws to regulate the disposal of carcasses in their territories (Boletín Oficial de La Rioja, 2001; Boletín Oficial de la Comunidad Foral de Navarra, 2001; Boletín Oficial de la Generalitat Valenciana, 2001). Table 6 summarises the main comparisons for regional and national regulations. The main problems related to their applications have been underlined. It is also shown that requirements for dropping carcasses also differs within regions and with the national regulation. Six months before the Spanish Decree, on 1st May 2002, both the European Parliament and Commission, published the 1774/2002 Regulation for all animal remains that are not used for human consumption (Diario Oficial de las Comunidades Europeas, 2002) and it was put into practice on 1st May 2003. This regulation was finally reinforced by means of the 322/2003 Decision from the Commission published on 12th May 2003 (Diario Oficial de la Unión Europea, 2003). Both documents try to balance BSE control with the preservation of carrion eating birds within the European Union for four countries - Portugal, Spain, France, Italy and Greece- that host breeding populations of vultures and certain species of eagles and kites. Apart of recognising the different species breeding on each the above mentioned countries, the Decision accepts all type of carcasses put out for vultures. Nevertheless, cattle and sheep and goats older than 24 and 18 months respectively must test negative for encephalopathies before being placed at a vulture restaurant.

TABLE 6

Referring to the current management of feeding sites in the different regions in Spain, all the vulture species will be considered together, except for the Bearded Vulture because of its specialised food habits and restricted distribution. The number of vulture restaurants operating in Spain in 2002 for this species are shown in Table 7. They are the only feeding stations with a true legal framework. Twenty eight are based and other regions out from the Pyrenees area, as is the case La Rioja, sometimes provide with

food at suitable areas for the species where some vagrant individuals have been recorded (Antor et al. 2000).

TABLE 7

Food provision is made mainly with sheep hooves and pork spinal columns in order that Bearded Vulture can obtain enough bones. This also tries to avoid competition with griffons. All food comes from slaughterhouses so it has been supervised by veterinarians. As an example, the monthly average use of vulture restaurants by Bearded Vultures is shown in Figure 2. The abundance index (zero means lack of use of vulture restaurants, 3 maximum use) was calculated by counting the number of days that birds were seen attending three feeding sites during food provisioning activities (once per week since mid 80´s): 0= no birds registered; 1= Bearded Vultures present on less than the half of the provisioning days, 2= vultures present on half of the days and 3: birds present on more than the half of the days (Fondo de Amigos del Buitre, 2001).

FIGURE 2

In addition to the existing vulture restaurants for the Bearded Vulture the following ones are working or planned in the Pyrenees regions: Navarra established nine and seven additional ones are planned. Previously, research was undertaken (Fernández, 1988) to assess the importance of existing feeding sites (*muladares*). Thereafter, additional surveys on illegal sites were undertaken. Aragón has made two regional surveys (Sampietro and Pelayo, 1995; Fundación para la Conservación del Quebrantahuesos, 2003). There were around 232 illegal feeding sites (*muladares*) in 1995. The second survey revealed a clear reduction in numbers of these places and many of them had been closed. Despite the difficulty of finding illegal feeding sites there is a clear reduction in number of these places in Aragón region between 1995 and 2002 (only 116 recorded), see Table 8. This reduction was related with other European regulations referred with wastes. The BSE has increased the lack of such feeding areas.

TABLE 8

Feeding sites were places where only carcasses and meat and bone remains are dropped, at feeding sites/ rubbish dumps also wastes were disposed. The use first of feeding site or rubbish dump words refers to the main food source provided at that places.

On the other side, La Rioja built up three vulture restaurants in 2001, being one still on work. A second one suffered from ceasing of food provisioning because food superabundance in its vicinity and the third is starting dropping carcasses just now. Figure 3 shows the amount of food provided at two feeding stations since November 2001. Fourteen farms coming from five neighbouring villages provided with the food there by themselves. Average distance from farms to the vulture restaurants was less than 10 kilometres. A monthly sheet must be given to authorities with the numbers and kilograms of carcasses disposed. Castilla León region planned 27 vulture restaurants and one province of Castilla la Mancha (Ciudad Real) a minimum of three. Extremadura has one feeding station for a long time but, till now, there is no plans for setting up more vulture restaurants. Finally, in Andalusia 25 are currently setting up and another 12, specific for Cinereous Vultures were considered. The latter are mobile feeding stations for avoiding competition with griffons. They are baited with rabbits and it is planned to change the location as soon as interespecific competition could be noticed. In Andalusia the Local Government officers will be in charge of carrying and dropping carcasses at vulture restaurants (V. Talavera, pers. comm.).

Discussion

Removal of carcasses has provided for the first time in Spain with reasonable estimates of the amount of carrion generated annually. Results have also revealed that the success of the "Surveillance Plan against BSE" has varied regionally. Only La Rioja has reached the highest rates of removal with an annual budget of 1,82 Millions Euros for this purpose. A different situation exist in Extremadura and Castilla la Mancha. There, the use of extensive rearing practices the whole year round make the shepherds rely on vultures to locate died livestock. Under extensive grazing they cannot monitor the whole herd all the time. All the carcasses taken into account in this paper came from both intensive and extensive farming activities. Only remains from slaughterhouses were not considered in these calculations. If the results from La Rioja are applied to the whole Spain, then it can be firstly estimated that number of carcasses available is much higher. The removal program should have to remove around 3,725,132-5,723,347 carcasses annually, however, only 305,249 were collated in 2001. Secondly, percentages from Table 3 could be considered as *"minimal annual mortality rates"* for

each type of carcasses. Even for La Rioja, carcasses dropped at existing vulture restaurants were not included. Annual mortality rates here (Table 4) are slightly higher that those supported by De Juana & De Juana (1984), Fernández (1988) and Donázar and Fernández (1990) where annual mortalities for sheep (6.4%) and cattle /horses (2%) were reported.

Results support the idea that, to date, vulture populations have not been affected as a whole by measures against the presence of BSE disease. Furthermore, many of the traditional illegal feeding sites ("*muladares*") remain operative with carcass provision other than ruminant species and one feeding station in La Rioja has to cease food provisioning. The regulations have done very little to remove carcasses and the existing vulture restaurants were insignificant in terms of food supply; see Figure 3 for La Rioja where the Eurasian Griffon population it is comprised of 819 breeding pairs (Del Moral & Martí, 2001, Camiña, 2000). If we estimate a daily food requirements for a Griffon Vulture of 500 grams of meat (Donázar 1993), and only for the breeding population there, then the monthly food required (819 birds X 2 birds/pair X 30 days/month X 0,5 kgr./day) reached 24,570 kgr. As an example, if the 7,442 kgr. Of carcasses provided in January 2002 are considered, and assuming that the entire carcass could be consumed (skeleton and skins were not discounted); then, only the 30,29% of the breeding population could feed there that month. For the Bearded Vulture, despite the significant population increase since 1986, lower breeding success seems to be related to causes other than food shortages (Heredia & Margalida, 2001). The number of vulture restaurants has also increased since 1990 (Heredia & Heredia, 1999, data gathered for this paper) and food has been provided on a regular basis. In accordance with the Royal Decree 1098/2002 and old regulations food provisioning it is ensured and is enhanced by legality. Nevertheless, Hernández (2003), as revealed from radio-tracked birds, found that poisoning is the main threat for the species on both sides of the Pyrenees. Vulture restaurants for the Bearded Vulture have provided with free poisoned food for the non reproductive population (juveniles and immatures) during adverse weather conditions (Heredia & Heredia, 1999). Providing with safe food for the non-reproductive populations of vultures it should be one of the main reason for establishing feeding stations. The Eurasian Griffon is the species that exclusively relies on carcasses for feeding (Camiña 2000; 2001a) and breeding parameters remain at the same level as

recorded before 2000. Changes in breeding success for the Cinereous Vulture have been associated with poisoning incidents of breeding adults in many of the Spanish colonies (Sánchez, 2003). Then, immature birds mated and made breeding attempts that usually failed (Costillo et al 2001; E. Costillo and A. Godino pers. comm.). Furthermore, sheep carcasses range from 43-83% of the diet of the Cinereous Vulture (Corbacho et al. 2001) and the lack of such carcasses would be a serious problem if most of them were removed. For the Egyptian Vulture up to 25.1% of its food has been considered to come from sheep/goats carcasses (Donázar, 1993, Donázar et al. 1996). Thus, it must be aware of changes in the surveillance plan against BSE. Without doubts, the great success of Spanish vulture populations has not been the result of establishing vulture restaurants in the past but the food abundance together with measures to protect colonies and human prosecution (Donázar and Fernández, 1990). Vultures have been well adapted to the human landscapes for a long time ago (Donázar, 1992; Houston, 1996) and other hazards make their populations to be highly threatened.

Some people/institutions with a poor knowledge of vulture biology, have suggested that if domestic livestock is not allowed for feeding carrion eating birds, other species like bulls from bullfighting or game could be employed. From the data gathered for this study only 2,924 bulls were removed in Madrid Province during 2001 being otherwise normally processed for human consumption. Because they would have to be transported to the feeding sites far away, costs after processing cannot be assumed for supplementary feeding, resulting in a too expensive process. On the other hand, game does not reach sufficiently high densities to be enough for vultures to feed exclusively on them. Andalusia is a region that hosts one of the highest densities of Red Deer *Cervus elaphus* in Spain, being on average 19.79-22.99 ind./Km^2 (Junta de Andalucía, 2003). Other game species like the Spanish Ibex *Capra hispanica* in Cazorla, Segura and Las Villas and the Chamois *Rupicapra rupicapra* in Picos de Europa or Pyrenees are constrained in these mountainous areas. Here, these food resources could play an important local role but are not a solution for all the Spanish vulture populations (Lorente,1996). Furthermore, both Wild Boar *Sus scrofa* and Deer species are mainly restricted to forested areas (Purroy et al. 1986; Sáez-Royuela, 1989; Camiña, 2003c). There, vultures do not exploit food resources efficiently as a consequence of forest cover (Camiña, in prep.). From Table 1 it can be estimated an average livestock density

of 123.36 individuals/km^2 (range 61.08-247.39), up to 5-6 times higher than the game species in central-southern Spain.

Anyway, it is necessary to investigate the use among avian scavengers of vulture restaurants according to their food requirements, species present, different ages of vultures and season of the year. This can help to a true management program of feeding stations. Food provisioning ceased in one of the feeding stations in La Rioja because griffons frequently flew outside the regional boundaries for feeding, as they did before BSE appeared (Camiña, 2001b). There, large amounts of pig were still available at an intensive farm area. Food provision at the vulture restaurant was clearly unbalanced with the food requirements of Eurasian Griffons in the area. Further studies in Central Spain (Camiña 2001a; Benítez et al. 2003; Palomo & Camiña unpub. obs.; Donázar pers. comm.) have clearly demonstrated that vultures and other carrion eating raptors exceed geographical provinces when foraging or migrating (i. e. Egyptian vulture) and management plans cannot be restricted to political boundaries. On the other hand, vulture restaurants can help to reduce poisoning incidents in those areas where poison pose a threat (Benítez et al. 2003). These authors consider that, for the Egyptian Vulture in Andalusia, high adult mortalities are probably due to poisoning incidents and are the main reason of the decline of the population there. Even for subadults and/or juvenile Egyptian Vultures poison is a threat because no concentrations at roosting sites, highly related with secure food sources, were found. Other breeding parameters or incidence of contamination remained at normal levels. Finally, foreign carrion eating birds from other countries cannot be forgotten, as is the case of French griffons that are vagrant in Spain (up to date, 58 re-sighted all over the territory, unpubs. obs.) or wintering Red Kites *Milvus milvus* (Viñuela et al. 1999).

Neither the National Royal Decree nor the European Decision take into account the role of ruminant species in extensive grazing areas. There, carcasses from cattle and sheep are the only food available for vultures (Lorente, 1996; Margalida et al. 1997; Camiña, 2000 and 2001a). It is obvious that such carcasses are difficult to locate and remove. Even the National Strategy for the Bearded Vulture preservation pointed out that extensive grazing had to be ensured (Dirección General de Conservación de la Naturaleza,2002). In addition, both regulations are impossible to fulfil from the technical point of view, being the process very expensive. Before dropping carcasses at

vulture restaurants they must test negative for encephalopathies. Some questions regarding the 322/2003 Decision remain unanswered. Who and where these analyses will be done?, who will pay that costs?, how can a shepherd wait for results with the corpse on the farm awaiting disposal?. It must be pointed out that tests last from 24-48 hours and slaughterhouses cannot accept dead animals. It is urgently needed to determine if carrion eating birds process infected tissues/proteins or their role for spreading this or related diseases (CMIEET, 2001). In this way some previous data have been already collected (Joncour, 1999). Currently, food availability for vultures in Spain – even without vulture restaurants- is a minor issue relative to poisonings. However, present regulations and food availability need to be evaluated carefully so that they do not seriously affect vultures in a near future. Surveillance of vulture populations must remain in following years as well. Finally, some of the Local regulations in Spain exceed national or EU regulations being less restrictive. Nevertheless, because vultures breed normally and food is still available enough, no further work has been developed in order to establish an easily framework regulating vulture restaurants.

Acknowledgements

Steven Piper and Lindsay Oaks made useful comments and corrections on a previous draft of the manuscript. Munir Virani highly improved the English grammar. I also want to acknowledge the following people / Institutions for their co-operation: The "Dirección General del Medio Natural" from Gobierno de La Rioja funded the "Assessment of breeding parameters of the Griffon vulture population" for 2001 and supported to some extent this study. Also thanks to Luis Lopo and Ignacio Gámez for their constant help on the vulture project.

People that helped on each region are mentioned as follows:
Navarra: Alfonso Senosiaín, David Campión, Carmelo Fernández. Aragón: Fundación para la Conservación del Quebrantahuesos (Luis Lorente, Kiko Gil), Fondo de Amigos del Buitre (Manuel Aguilera, Alejandro Martín, Manuel Castillo and David Gómez) Andalusia: Consuelo Atencia and Saturnino Moreno from the FAADN, José Rafael Garrido from University of Wales, Ventura Talavera from EGMASA, Justo Martín and Alfonso Godino. Castilla la Mancha: Victor Diez, Rafael Palomo. Castilla y León: Ignacio Molina, Francisco Sánchez Aguado from Junta de Castilla y León, Luis Suárez from Adena/WWF and Fidel José Fernández y Fernández Arroyo. Extremadura: Javier Prieta. La Rioja: Javier Puértolas from Consejería de Agricultura y Ganadería del Gobierno de La Rioja provided us with number of carcasses removed from the fields for different species accounts. Rafael Heredia, National co-ordinator for the Bearded Vulture. Catalonia: Antoni Margalida (GEPT) and Diego García from Departament de Medi Ambient (Generalitat de Catalunya). Juan Sánchez Artés (Black Vulture Conservation Foundation) provide us with unpublished data concerning Cinereous Vulture. Finally, comments from Guy Joncour and Michel Terrasse were highly appreciated.

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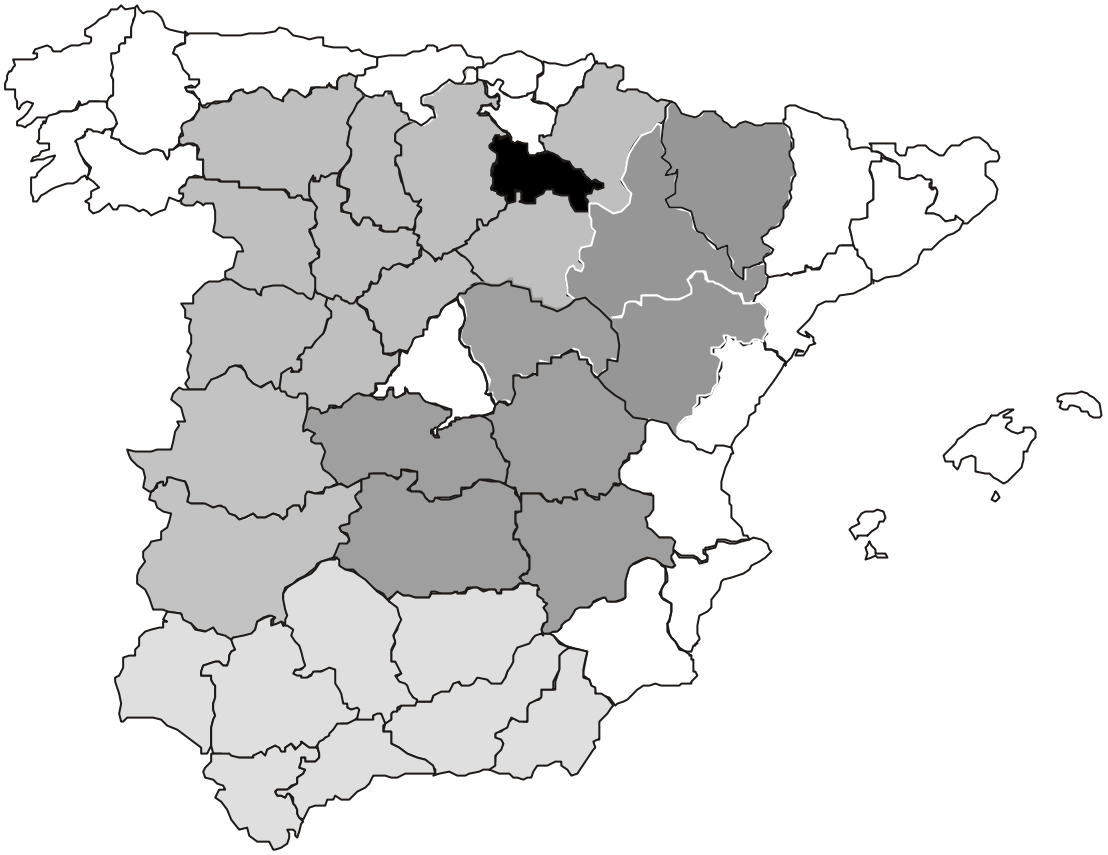

Figure 1.- Map of Spain showing the seven regions (Local Governments and provinces that they comprise) considered in this study.

Aragón, Navarre, La Rioja, stilla-León, Extremadura, Castilla la Mancha and Andalusia. See text for details.

Table 1. – National Livestock Censuses for the six regions considered in this study, totals for the whole Spain and % that these regions represent on the overall census (n. a. means not available).

Region (year of census)	Horses	Goats	Pigs	Sheep	Cattle
Andalusia (1998)	213,355	1,375,649	2,249,117	2,765,505	504,261
Aragon (2000)	n. a.	18,124	3,559,535	2,530,817	359,301
Castilla & Leon (1999)	n. a.	209,951	3,027,081	6,360,827	4,645,566
Castilla la Mancha	n. a.	383,485	1,293,212	3,475,941	211,156
Extremadura (1998)	n. a.	248,721	117,593	3,074,377	377,943
Navarra (2000)	n. a.	with sheep	473,959	904,951	115,664
La Rioja (2001)	5,636	15,013	118,165	252,460	51,900
SUM	218,991	2,249,943	10,838,662	19,364,878	6,265,791
SPAIN	**n. a.**	**2,743,149**	**22,079,591**	**20,989,148**	**6,360,827**
Percentage	**n. a.**	**81.99**	**49.08**	**92.26**	**98.51**

Table. 2- Numbers of each type of carcasses removed to be destroyed in 2001. * For Castilla la Mancha and Navarra all were classified as cattle according to Gobierno de Navarra (2000) and Junta de Castilla la Mancha (2003).

Region	Horses	Goats	Pigs	Sheep	Cattle	% over census
Andalusia	0	16,017	0	31,964	21,478	0.97
Aragon	51	44	309	19,331	17,221	1.26
Castilla & Leon	0	with sheep	0	38,205	21,551	0.41
Castilla la Mancha*	0	0	0	0	5,913	0.03
Extremadura	0	0	0	4	2,277	0.16
Navarra *	0	0	0	0	4,663	0.31
La Rioja	202	1,087	14,913	29,352	2,471	10.97
SUM	**253**	**with sheep**	**15,222**	**149,203**	**129,342**	

Table 3.- Number of carcasses removed from field in La Rioja for 2001 and 2002, carcasses per day and % they account over the regional Livestock census (Gobierno de La Rioja 2001). For Chicken and Rabbits results are in tons (n. a., not available).

	2001	*car./day*	*Car./ census*	*2002*	*car./day*	*Car./ census*	*Census*
Sheep	29,352	80.41	11.62%	10,644	29.16	4.21%	252,460
Cattle	2,471	6.77	4.76%	2,443	6.69	4.71%	51,900
Goats	1,087	2.97	7.24%	1,232	3.37	8.21%	15,013
Pigs	14,913	40.85	12.62%	16,765	45.93	14.18%	118,165
Horses	202	0.55	3.58%	193	0.53	3.42%	5,636
Chicken (T)	200*	0.54	n.a	251,7*	0.67	n.a.	2,815,550
Rabbits (T)	54*	0.14	n.a	53,5*	0.14	n.a.	21,488
Total of carcasses	**48,025**	**132.23**		**31,277**	**86.49**		**3,280,212**

Table 4.- Breeding success before and after the BSE disease. N = number of colonies controlled.
N = Number of colonies considered.

	Before	After	t-test	Sig. Level
NAVARRA				
B. Success	0.75±0.15	0.66±0.17	0.92	0.37
N	5	7		
LA RIOJA				
B. Success	0.77±0.10	0.80±0.22	- 0.002	0.98
N	8	23		
CASTILLA-LEON				
B. Success	0.57±0.05	0.55±0.04	0.529	0.60
N	28	30		

Table 5.- Breeding parameters for Andalusia Egyptian vulture population (Benítez et al. 2003). Pr: productivity, F. s. fledging success. (N_1, N_2 = number of pairs used for calculating productivity or fledging success).

Year	N_1	Pr.	N_2	f.s.
2000	20	1	16	1.25
2001	23	0.73	14	1.21
2002	22	0.90	16	1.25

Table 7. Number of legal feeding stations working in Spain for Bearded Vultures (whole Spain).

Region	***Number***
Guipúzcoa Province (Basque country)	2
Navarra	3
Aragón	12
Catalonia	11

Figure 2.- Average monthly use of three vultures restaurants by Bearded Vultures (all ages) throughout the year: Abundance index of Bearded Vultures was estimated by counting the number of days that birds were seen attending feeding sites (see text for explanations).

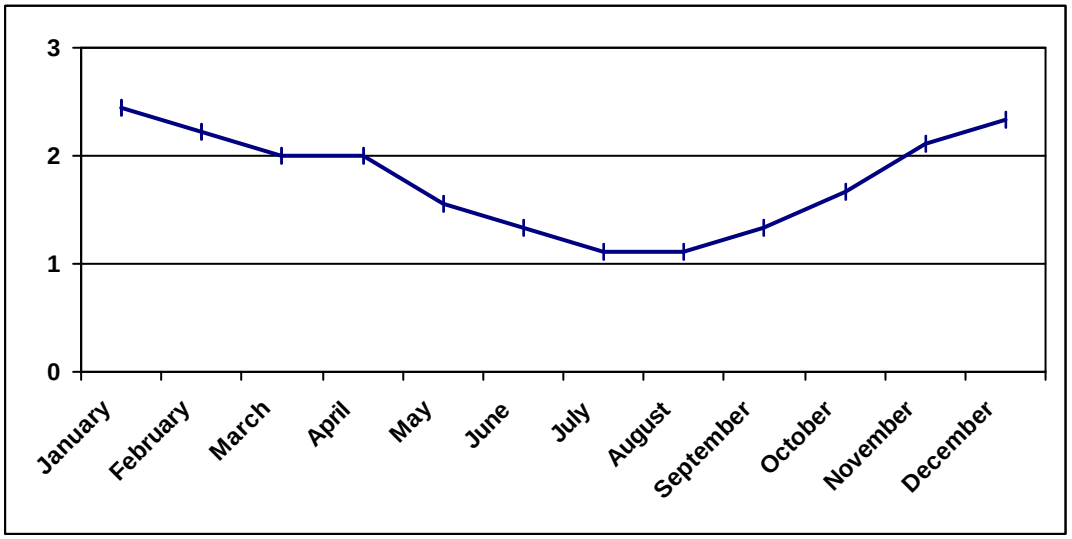

Table 8. Results on the second survey (2002) on traditional illegal feeding areas (muladares) for vultures in Aragón (Fundación para la Conservación del Quebrantahuesos, FCQ, 2003).

Type	ACTIVE	LESS ACTIVE	CLOSED
Feeding sites	79	10	8
Feeding sites/ Rubbish dump	7	1	2
Rubbish dump/ Feeding site	5	5	3
Rubbbish dump	9	0	4
TOTAL	**100**	**16**	**17**

	LA RIOJA **Orden 7/2001, 8th March 2001. BOR 30, 10th March 2002.**	**VALENCIA** **Orden 1st October 2001. DOGV 4108, 17th October 2001.**	**NAVARRA** **Orden Foral 30th April 2001**	**SPAIN** **(RD 1098/2002) BOE 262 1st November 2002**
TYPE OF CARCASSES THAT CAN BE USED	All carcasses (pigs, chicken, rabbits, horses) except from ruminant species (sheep, goats and cattle).	All carcasses except from ruminant species (sheep, goats and cattle).	All carcasses except cattle, including ruminant species (sheep, goats) if they have not neurological symptoms.	All carcasses, including ruminant ones if both SRM have been previously removed and animals are negative to encephalopathies tests.
WHO DECIDE THAT THERE IS FOOD LACKING FOR CARRION EATING BIRDS?	Environmental authorities	Environmental authorities	Does not explain this.	Environmental authorities on each Local Government.
REQUISITES FOR LEAVING CARCASSES AT FEEDING STATIONS	- Veterinarian certificate that the farm is free of diseases. - Authorisation for the farm. - Close to the feeding point. - Register of species, number of carcasses, identification, vehicle employed and route to the feeding point. - Only non ruminant farms.	- Veterinarian certificate that the farm is free of diseases. - Authorisation for the farm. - Close to the feeding point. - Register of species, number of carcasses, identification, vehicle employed and route to the feeding point.	- Be registered for carrying carcasses. - Register of species, number of carcasses, identification, vehicle employed and route to the feeding point.	- **Authorisation for EACH carcass.** - Close to the feeding point. - Register of species, number of carcasses, identification, vehicle employed and route to the feeding point. - **Certificate of being free for encephalopathies.**

CHARACTERISTICS OF THE FEEDING POINT	- Fenced: - 1.75 metres height. - 0.5 metres deep. - Far from human settlements.	- Fenced: - 2 metres height. - 0.5 metres deep. - Far from human settlements.	No details provided.	- Fenced. - Far from human settlements.
WHO CARRY AND DROP CARCASSES AT FEEDING POINTS?	The shepherd himself.	The shepherd himself.	The shepherd himself.	The shepherd himself.

Table 6. Main features of the different Local and National regulations on carcass disposal in Spain.

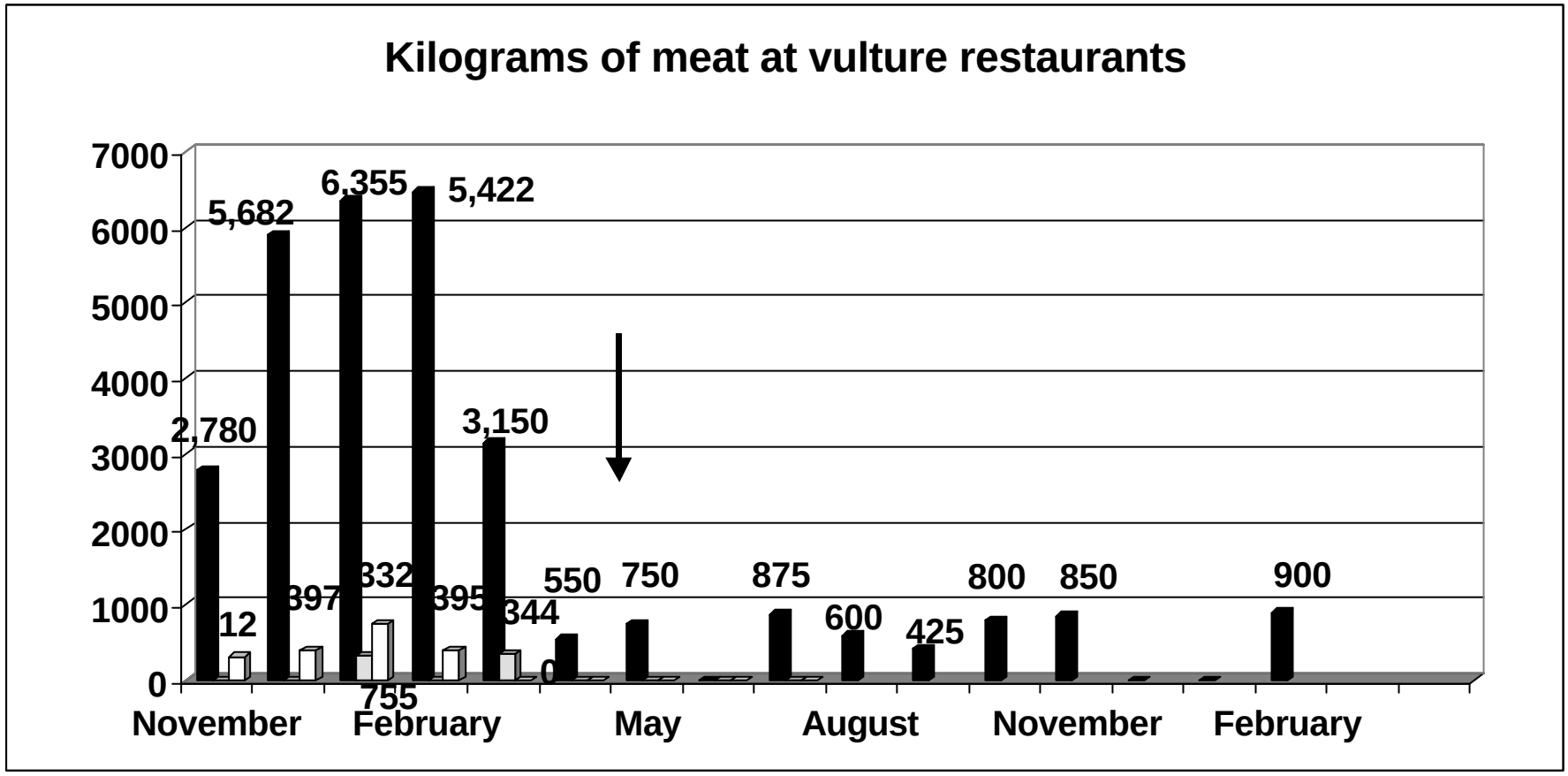

Figure 3. Kilograms of meat provided at two vulture restaurants in La Rioja from November 2001 until February 2003. Black bars: Pigs, white bars: Rabbits, dotted bars: Chicken. The arrow means ceasing activities at one of the vulture restaurants.