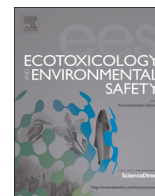




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## VIGILANCE POISON: Illegal poisoning and lead intoxication are the main factors affecting avian scavenger survival in the Pyrenees (France)



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### ABSTRACT

A specific surveillance program has been set up to monitor avian scavenger populations in the French Pyrenean Mountains, hosting a high proportion of the French populations. The two main purposes of the study were to identify all causes of death and to investigate poisoning cases. All 170 birds found dead during the 7-year program were submitted to full necropsy, X-Ray, parasitological investigations and consistent analytical toxicology screenings (Cholinesterase inhibitors, anticoagulant rodenticides, organochlorine insecticides, Pb, Cd). Over the study period, 8 Bearded Vultures, 120 Griffon Vultures, 8 Egyptian Vultures and 34 Red kites were eventually collected. Mortality events were often multifactorial, but poisoning was by far the most common cause of death (24.1%), followed by trauma/fall (12%), bacterial diseases and starvation (8%) and electrocution (6%). Illicit use of banned pesticides was identified as a common cause of poisoning (53% of all poisoning cases) and lead poisoning was also identified as a significant toxicant issue (17% of all poisoning cases). Lead isotopic signature could be associated primarily with ammunition. Last, a positive association between trauma and lead contamination was detected, indicating that lead could be a significant contributor to different causes of death. These results urge for severe restrictions on the use of lead ammunition to prevent scavengers from detrimental exposure.

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### 1. Introduction

In Europe, wildlife species suffer from severe anthropic pressure, most notably predator and scavenger species.

In the French Pyrenees, scavenging birds of prey are mostly located in the western part of the mountain range, where major sheep herds can still be found. Scavenger species may feed on dead cattle and sheep, which provide a complementary food source to resources from wild ungulates. The vulture populations on the French Pyrenees have benefited both from populations still

well present in northern Spain in the 1970s and from increasing protection measures in France (Terrasse, 1992; Razin and Bretnolle, 2002).

The central part of the Pyrenees is a natural barrier to all migratory bird species flying to Africa or wintering in Spain, and most of them cross the mountain range at selected passes (Hilgerloh et al., 1992), providing abundant food sources for birds of prey during migration. Among those species, the wood pigeon *Columba palumbus* suffers from severe hunting in fall during migration across the Pyrenees (Jean, 1997; Rouxel and Czajkowski, 2004). Unrecovered bodies (as well as bodies of local game species not collected such as wild ungulates, partridges etc.) may represent an important seasonal food source for some scavenging bird species (Cramp and Simmons, 1980; Margalida and Bertran, 1997; Mateo-Thomas and Olea, 2010; Margalida 2010).

Scavenging birds may sometimes be perceived as “undesirable” species, because of their feeding habits and some reports of vultures feeding on moribund animals (Choisy, 2013). They may also

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be unexpected victims of local use of poisons to eradicate unwanted species such as water voles or even the brown bear (Choisy, 2013). As a consequence, poisoning cases have been identified since 1992 (Berny and Gaillet, 2008) in France in Red kites (*Milvus milvus*), but also in Griffon Vultures (Razin – personal communication) and this has resulted in the development of a program to survey mortality and identify causes of death in order to suggest conservation actions to the French Government responsible for the management of European conservation programs. Similarly, in Spain, there is ample evidence that illicit poisoning and accidental lead exposure from carcasses of game species is very common in scavenging birds of preys (including vulture species) (Margalida, 2012; Margalida et al., 2013). Figures for Spain include at least 53 Bearded Vultures (*Gypaetus barbatus*), 366 Egyptian Vultures (*Neophron percnopterus*) and 2877 Eurasian Griffon Vultures (*Gyps fulvus*) from 1990 to 2010 (Margalida, 2012). No such data could be found for scavenging birds of prey in France.

The objectives of the present study were to determine the causes of death of Pyrenean avian scavengers, and specifically to investigate toxicant exposure as a potential threat for the survival of endangered birds species involved in major European conservation programs.

## 2. Material and methods

### 2.1. Study area

The French Pyrenees Mountains stretch over 350 km between the Atlantic Ocean and the Mediterranean sea across ca 10,000 km<sup>2</sup>. It is constituted of abrupt mountain areas with a piedmont area. The highest peaks reach over 3000 m and are separated by deep valleys, in which livestock breeding (pastoralism) and wood production have profoundly affected the landscape. The piedmont area is more devoted to agriculture (livestock breeding, corn production in the center and western parts, orchards and vineyards in the eastern part). Industrial activities are poorly developed in very localized areas. In the XIXth century lead, iron, copper, zinc and silver mining existed and may result in persisting environmental contamination (Cottard et al., 2003; Gourdon 1858; Milian, 2004) cf Fig. 3.

### 2.2. Selection of bird species and population estimates

Among a wide variety of birds of prey, Bearded Vulture, Griffon Vulture, Egyptian Vultures and Red kite are locally abundant and represent 72%, 57%, 77% and 15–20% of non-migratory French populations respectively (Razin, 2012; Lecuyer and Neouze, 2012; Ponchon et al., 2012; Balleraud and Tlahoëts, 2012; Mionnay, 2004; Pinaud et al., 2009) (Table 1). The Ligue pour la Protection des Oiseaux (LPO, Bird Life) coordinates a network of volunteers,

public institutions (National Parks, National Game and Wildlife Agency, National Forestry Agency), local nature protection associations, hunting associations etc. to monitor Bearded Vultures, Griffon Vultures, Egyptian Vultures and Red kite populations for the Ministry of Environment (Razin, 2002).

Griffon Vulture is the most abundant of the three local vulture species (Bearded Vulture, Griffon Vulture, Egyptian Vulture), markedly in the western part of the Pyrenees (it was not found on the eastern/Mediterranean part before 2008) (Razin et al., 2009). Its diet (mostly remains of carcasses of wild and domestic ungulates) is partially shared with the three other species. The Bearded Vulture is highly specialized and its diet is made of bones (80%) from ungulates. The rest of its diet is constituted of carcasses of birds, reptiles and mammals (rodents, mustelids). The Bearded Vulture is the last scavenger to feed in a group of scavenging birds (Terrasse and Terrasse, 1974). Because Bearded Vultures may be confused with Griffon Vultures, they are potentially exposed to the same threats, mostly from illicit poisoning (Margalida et al., 2001). The diet of the Egyptian Vulture is more diversified. It feeds on remains of ungulates left by other vulture species, on small mammals, on birds, on insects and on waste (Cramp et Simmons, 1980). The Red kite has an opportunistic diet. It may feed on remains left by other scavengers and also hunt small rodents (among which the water vole *Arvicola terrestris* (Coeurdassier et al., 2011), bird species, earthworms, and consume organic wastes issued from intensive breeding units (poultry, rabbits, pigs) or waste management sites (synthesis in Cramp and Simmons, 1980). Because of their diet, the last two species are potentially more exposed to insecticides or rodenticides used in agriculture than the other 2 species.

The Griffon Vulture population is monitored on a 5-year basis by the same team. All cliffs, identified colonies are monitored, birds counted and breeding success and an annual population check is performed on a specific sub group in the Ossau Natural Reserve (Razin et al., 2008). The Red kite population is monitored during the migration season at selected passes, wintering areas, in breeding areas and through national surveys (Urcun and Filippi-Condaccioni, 2009; Riols, 2009; Bretagnolle et al., 2009).

Bearded Vultures and Egyptian Vultures are classified Endangered in France, the Red kite is considered vulnerable and the Griffon Vulture is classified as minor preoccupation (UICN France et al., 2011). All 4 species are subject to national conservation programs. These figures do not take into account migratory birds. The Bearded Vulture is sedentary (Margalida et al., 2013). The Egyptian Vulture migrates across the Sahara, but population numbers were taken during the presence of birds in spring and summer (maximum population, Kobierzycki, 2012). The Red kite is a partial migratory bird, with most northern European populations wintering in Spain and in the Pyrenees. In winter, large wintering dormitories may be seen in the French Pyrenees, representing up to 55% of the total French wintering population (3892 birds counted out of a total of 7052 identified during the same time-

**Table 1**  
Age, gender and geographic origin of avian scavenger species collected between 2005 and 2012 (GB : *Gypaetus barbatus*, MM : *Milvus milvus*, GF : *Gyps fulvus*, NP : *Neophron percnopterus*) – Estimated populations in the Pyrenees and in France.

Species*	Adult	Immature	Juvenile	Unknown	F	M	Unknown	64 <sup>a</sup>	65 <sup>a</sup>	31 <sup>a</sup>	09 <sup>a</sup>	11 <sup>a</sup>	66 <sup>a</sup>	Pyrenees <sup>b</sup>	France <sup>b</sup>	Ref
<b>GB (8)</b>	6	1	1		5	2	1	3	5	–	–	–	–	33	46	Razin2012
<b>MM (34)</b>	29	1	4		14	15	5	17	9	6	1	1	–	350–604	2330–3020	Balleraud2012
<b>GF (120)</b>	29	26	60	5	37	49	34	79	16	3	6	15	1	832	1462	Lecuyer2012
<b>NP (9)</b>	5	2	2		1	3	5	3	–	3	–	3	–	72	93	Ponchon2012
<b>Proportion</b>					33.5	40.6	26.4	59.9	17.5	7.0	4.0	11.1	0.5			

\* Total number of birds for each species in parentheses.

<sup>a</sup> Numbers refer to the French administrative “départements” from West to East (see also Fig. 1).

<sup>b</sup> Estimated population in 2012.

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