The Veterinary Journal 183 (2010) 260–265

Contents lists available at ScienceDirect

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvjl

Review

Animal poisoning in Europe. Part 3: Wildlife

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ARTICLE INFO

Article history:
Accepted 27 March 2009

Keywords:
Toxicoepidemiology
Wild birds
Lead shot
Anticholinesterase agents
Oil spill

ABSTRACT

This review article is the third in a series on animal poisoning in Europe and represents a collation of published and non-published wildlife poisoning data from Belgium, France, Greece, Italy and Spain over the last 10 years. Birds, particularly waterfowl and raptors, were more commonly reported as victims of poisoning than wild mammals. In addition to specific but important toxicological disasters, deliberate primary or secondary poisonings are of concern to all countries. Metals (particularly lead arising from sporting/hunting activities) and pesticides (mainly anticholinesterases and anticoagulants) are frequent causes of poisoning, and often have fatal consequences. A more unified and consistent approach throughout European countries to improve the reporting and the analytical confirmation of wildlife poisoning would help to reduce the number of cases of malicious or negligent animal poisoning.

Introduction

Due to their geographical position and geophysical diversity, Belgium, France, Greece, Italy and Spain provide an important habitat for wildlife. Deforestation, wetland filling and other human activities threaten many species, but accidental or deliberate poisoning has been documented over many years in these European Union (EU) countries (Antoniou et al., 2005; Berny, 2007; Martínez-Haro et al., 2008).

This is the third of three review articles in a series dedicated to animal poisoning in Europe. In the previous two papers, we reviewed poisoning in livestock (Guitart et al., 2010) and domestic animals (Berny et al., 2010) in an endeavour to provide useful toxicoepidemiological data for veterinarians. This review is devoted to wild mammals and birds, in which accidental or intentional, direct or secondary poisoning, has been recorded over the last 10 years.

General overview

Poisoning is a major cause of wildlife mortality in the five EU countries considered and this has led to a significant number of recent studies. In France, most wildlife poisoning cases are reported via the SAGIR Network[1] (Lamarque et al., 1999): hunters submit all animals found dead to the local veterinary laboratory for routine necropsy and, whenever necessary, samples are sent to the Toxicology Laboratory at the College of Veterinary Medicine in Lyon for toxicological investigation (Lamarque et al., 1999). According to data from SAGIR, poisoning accounted for 6.5% of the identified causes of death in wildlife (1001/15,431) between 1986 and 1998 (Lamarque et al., 1999). This proportion appears to be fairly consistent on an annual basis, as can be seen in the 2004 SAGIR Annual Report (Terrier et al., 2005), but several episodes of severe outbreaks of poisoning have also been reported (Berny and Gaillet, 2008). Birds accounted for 57% of cases, whilst wild mammals comprised the remaining 43%.[2]

Apart from specific major ecological disasters (see below), an important part of the routine work of Spanish veterinary toxicology laboratories is focused on suspected accidental or deliberate wildlife poisoning (Martínez-Haro et al., 2006; Soler Rodríguez et al., 2006). In 1997, a national programme was launched (Programa Antídoto)[3] with the objective of fighting against the widespread use of poisons intended to control different predators (Sánchez, 2000; Martínez-Haro et al., 2006). Amongst others, Griffon vultures (*Gyps fulvus*, $n = 570$), red and black kites (*Milvus milvus* and *M. migrans*, $n = 408$), cinereous vultures (*Aegypius monachus*, $n = 391$), golden eagles (*Aquila chrysaetos*, $n = 72$) and Spanish imperial eagles (*Aquila adalberti*, $n = 68$), were reported to have been killed by the illegal use of poisons (Hernández, 2000). Between 1990 and 2003,

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[1] SAGIR Network (Réseau national de surveillance de l'état sanitaire de la faune sauvage: National network for the surveillance of the health status of wildlife).

[2] See: http://www.oncfs.gouv.fr.

[3] See: http://www.ecologistasenaccion.org/spip.php?article164.

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doi:10.1016/j.tvjl.2009.03.033

over 6500 suspected cases were investigated, and 2877 (44.3%) of these involved protected species, including many birds and four cases in brown bears (*Ursus arctos*) (Caravaca and Hernández, 2004).

Birds

In the last few years, corpses of birds of prey or other predators have frequently been brought to the Faculty of Veterinary Medicine at Ghent University, Belgium, for routine diagnosis. In Flanders, the common buzzard (*Buteo buteo*) is frequently the victim of deliberate poisoning. Of 162 buzzards presented for diagnosis during the period 2003–2006, 91 appeared to have been maliciously killed either by poisoning ($n = 79$) or shooting ($n = 12$). Other birds involved in poisoning incidents were the kestrel (*Falco tinnunculus*), sparrow hawk (*Accipiter nisus*), red kite (*M. milvus*), magpie (*Pica pica*), carrion crown (*Corvus corone*) and pheasant (*Phasianus colchicus*) (P. Tavernier, personal communication).

In France, birds are more commonly poisoned than mammals, representing up to 27.5% of cases reported although more usually the percentage fluctuates between 15% and 20% according to mortality data collected by the SAGIR Network (Lamarque et al., 1999). The most common birds sent for analysis are game species, such as pigeons (*Columba livia domestica*, 119 cases), mallard ducks (*Anas platyrhynchos*, 84 cases) and partridges (*Alectoris rufa*, 55 cases). Birds of prey are frequently sent for analysis and are confirmed as having been poisoned; for example, 92 common buzzards (17% of all bird cases) were reported to have been poisoned between 1986 and 1998 (Lamarque et al., 1999).

Despite their protected status, the poisoning of birds of prey is now more commonly reported and confirmed. For example, between 1992 and 2002, 62 red kites were reported to have been poisoned, with 80% of these cases confirmed in the laboratory (Berny and Gaillet, 2008). Pesticides accounted for 78.3% ($n = 569$) of all avian poisonings in France (Lamarque et al., 1999), although suspected cases of heavy metal toxicity are seldom sent for analysis.

Two dramatic toxic disasters have occurred in Spain in recent years affecting a great number of wild animals, particularly birds. The first was on 25th April 1998 in Aznalcóllar, near the Doñana National/Natural Park (South-west Spain). A massive holding lagoon, containing pyrite ore processing waste, failed and released an estimated 5 million m^3 of acidic water and metal rich sludge into the Agrio River, a tributary of the Guadiamar River, one of the principal sources of freshwater for Doñana. Several toxic metals contaminated 2656 ha of the Natural Park, but only 98 ha of the more valuable National Park (Pain et al., 1998; Grimalt et al., 1999). The second disaster was the wreck of the *Prestige* oil tanker off the Galician coast (North-west Spain) on 19th November 2002, when approximately 63,000 tons of heavy fuel-oil slowly leaked from the ship and continued to do so until August 2003. The resultant slick contaminated a wide area of the Northern Spanish shores and also affected the Portuguese and French coasts (Bosch, 2003; García et al., 2003; Albaigés et al., 2006; Laffon et al., 2006).

Lead

Poisoning of waterfowl and upland birds through the ingestion of spent lead pellets or sinkers has been well documented in many countries (Guitart et al., 1999; Beintema, 2001; Fisher et al., 2006). Lead poisoning was diagnosed in 5/30 live and 4/99 dead anseriformes presented at the Bird Clinic of the Veterinary Faculty of Ghent University in the period 2002–2004 (Tavernier et al., 2005a). Acute poisoning caused by lead shot ingestion was also diagnosed in two young racing pigeons (Tavernier et al., 2005b).

In the Camargue area of South-east France, the prevalence of mallard duck with lead shot in the gizzard has been estimated at 11%, whilst between 19% and 29% of all birds were found to have lead shot embedded in muscle tissues. An estimated decrease (−19%) in survival rate was not significant because of the wide variation of basal survival rates in the area. Nevertheless, lead poisoning has been described as one of the major toxicological issues in wetlands (Tavecchia et al., 2001). Recently, Guillemain et al. (2007) developed a model which suggested that the presence of lead shot in the gizzard and musculature was associated with a significant reduction in the survival rate of teal (*Anas creca*).

The limited studies available in Italy refer to sporadic cases of lead shot ingestion involving the mute swan (*Cignus olor*), black-tailed godwit (*Limosa limosa*), mallard and some other species (Tirelli and Tinarelli, 1996; Tirelli et al., 1996). Episodes of lead poisoning have also been observed in greater flamingos (*Phoenicopterus ruber*) (Ancona et al., 2008).

In Spain, toxicoepidemiological studies carried out in the 1990s in some of the country's most important wetlands (Guitart et al., 1994; Mateo et al., 1997b, 1998) estimated that lead poisoning resulted in the death of some 50,000 waterfowl every year. An outbreak in greater flamingos was reported in El Hondo (Eastern Spain) (Mateo et al., 1997a), a wetland where cases were still being recorded in subsequent years (León-Quinto et al., 2004). A greater concern in Spanish wetlands has been that lead ingestion led to increased numbers of deaths in two duck species threatened with global extinction, namely, the marbled teal (*Marmaronetta angustirostris*) and the white-headed duck (*Oxyura leucocephala*) (Mateo et al., 2001b; Svanberg et al., 2006). Removal of shot pellets from affected regions appeared to reduce the risk of toxicity for waterfowl and birds of prey (Mateo et al., 2000, 2006, 2007a). There are also implications for health authorities as humans may be at risk of secondary toxicity after consuming poisoned or contaminated wildfowl (Guitart et al., 2002; Guitart and Thomas, 2005; Mateo et al., 2007b).

Non-raptor upland birds can also be affected by lead poisoning following ingestion of toxic ammunition (Fisher et al., 2006). These include pigeons and red-legged partridges (*A. rufa*) in Spain (Guitart et al., 1999; Soler Rodríguez et al., 2004). It has been reported that 7.8% of partridges hunted on estates had lead shot in the gizzard and/or >5 mg/kg dry weight of lead in the liver (Ferrandis et al., 2008). Similarly, there have been several reports over the last 10 years of poisoning or high exposure levels of lead (compatible with sub-clinical or clinical signs) in birds of prey, both predators and scavengers (Mateo et al., 1997c, 2003; Guitart et al., 1999; Donázar et al., 2002; García-Fernández et al., 2005; Pain et al., 2005; Hernández and Margalida, 2008). The relationship between lead exposure and consumption of prey during the hunting season has also been demonstrated (Mateo et al., 1999, 2001a).

Mercury

Zucca et al. (2004a) described mercury poisoning (20 mg/kg in liver and kidney) in a marsh harrier (*Circus aureoginosus*) found dead in a wetland of Friuli Venezia Giulia (North-east Italy). It was reported that these habitats can be polluted with high levels of methylmercury (Horvat et al., 2003).

Diverse metals and metalloids

It was fortunate that the toxic flood in Doñana had minimal medium and long-term impact on vertebrate wildlife as an emergency soil clean-up operation quickly started after the mine spill. The released sludge contained high concentrations of sulfur (35–40%) and iron (34–37%), and lower concentrations of more toxic metals and metalloids such as zinc (0.8%), lead (0.8–1.2%), arsenic (0.5–0.6%), copper (0.2%), thallium (0.005%), cadmium (0.0025%) and mercury (0.0015%). Nevertheless, the disaster was