TOXICOVIGILANCE OF PESTICIDES IN WILDLIFE: EXPERIENCE OF THE SAGIR NETWORK

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Introduction

Toxicovigilance is a new concept in animals and in wildlife especially. A recent definition has been given (Lelièvre et al., 2002). It is the gathering of information on a product and its adverse effects on humans, animals or the environment. It implies three steps:

1. identification of the adverse effect.
2. estimation of the impact of the adverse effect on populations.
3. prevention of the adverse effect.

This concept has not been implemented in animals. We developed a specific network, based on the wildlife disease surveillance system existing in France (SAGIR). The purpose of this presentation is to describe the network and present some results regarding pesticide poisoning in wildlife.

Material and Methods

The SAGIR network is organized under the authority of the Office National de la Chasse et de la Faune Sauvage (ONCFS - National Hunting and Wildlife Office) and is primarily made of the regional hunting federations. Hunters and local network representatives are the keystone of the network. They are primarily responsible for the submission of wild animals found dead to a local veterinary diagnostic laboratory. There are SAGIR representatives in every part of France and, consequently, the network has a nation-wide impact.

At the laboratory, necropsy is performed and bacteriological, parasitological or histopathological examinations are eventually performed. Samples may be submitted to the toxicology laboratory, with information on the circumstances of exposure and results of examinations already performed. Procedures are being implemented for the entire network, in order to work on a standardized basis. Once a case is completed, all the data are sent to the centralizing Laboratory (AFSSA French Agency for Food Safety – Wildlife Pathology Laboratory) in Nancy. This organism serves as the central laboratory for the evaluation of the SAGIR network. (Figure 1)

At the toxicology laboratory, the samples are analyzed according to our internal procedures and with validated methods. Mainly crop, gizzard and liver are used for toxicological examination. The laboratory analyzes biological specimens for the detection of insecticides (mainly organophosphate and carbamate insecticides, pyrethroids, organochlorine insecticides, fipronil and imidacloprid according to Berny et al. (1999) and rodenticides, primarily anticoagulant compounds according to Berny et al. (1995). Based on exposure information, other products may be analyzed specifically, but most of them are not acute toxicants and less often involved in suspected poisoning cases. Each suspected poisoning case received at the toxicology laboratory is recorded on a specific computerized database to enter data regarding the species, number of animals involved, gender, age, date and location of death, clinical and necropsy findings, analytical results. The database was set up in 1990 and more than 10,000 suspected poisoning cases have been included over the last 6 years (including domestic species). In order to confirm a suspected poisoning case, exposure information (treatment application, bait found etc.), clinical/necropsy finding (clinical signs suggestive of poisoning) and the presence and amount of a compound (in biological samples) need to be assessed and to be conclusive.

Results and Discussion

Overview of wildlife poisoning cases

From 1995 through 2001, the laboratory received 12,015 cases involving domestic and wild animals. Among those cases, 2952 cases involved wildlife species, as can be seen in Figure 2.
As can be expected, game species represent the most common species involved. It should be pointed out, however, that non-game species, especially predators are often sent for analysis.

The toxicants found include primarily anticoagulant rodenticides (Table 1). Poisoning was confirmed in 51% of the cases and percentages were even higher with organophosphate and carbamate insecticides (Cholinesterase inhibitors) or with anticoagulant rodenticides. In these situations, circumstances, clinical signs and lesions may be quite indicative and therefore field hypotheses are often confirmed by laboratory findings (Berny et al., 1998; Lamarque et al., 1999). Indeed, anticoagulant poisoning is suspected when animals are found dead with massive hemorrhages and coagulation disorders. In several instances, we investigated poisoning cases and realized that massive use of bromadiolone, a second-generation anticoagulant, against field voles (Arvicola terrestris) had occurred (Berny et al., 1997). Cholinesterase inhibitors are usually highly toxic and animals die near to the treated area or bait.

As can be seen in Figure 3, many cases are reported in several areas of France. In each part of France a different kind of problem is encountered: anticoagulant poisoning is reported in raptors, foxes and wild boars in the Eastern part of France, and in hares and rabbits in the western part of the country. Pigeon poisoning with coated seeds occurs in the northern part of France.

**Major issues in game birds**

In these species, we selected data for pigeons (Columba livia), partridges (Perdix perdix) and Waterfowl (Anas platyrhynchos) since they are the most frequent animals sent for analysis (Figure 4). In pigeons and partridges, poisoning involved mainly seeds coated with insecticides. The products used (furathiocarb and imidacloprid respectively) are known for their toxic effects in various bird species. We developed a specific analytical technique for imidacloprid, since this product was quite new at the beginning of our study period and nothing was known about the product in partridges (Berny et al., 1999). Our data indicate that cereals coated with insecticides can cause death of several tens of animals, but acute poisoning cases should not be a threat to bird populations, as was demonstrated for pigeons and furathiocarb poisoning, although the number of birds found dead reached several thousand a year (Lelièvre et al., 2002). Indeed, less than 1 bird per 10,000 was killed. The poisoning case was solved when several preventative measures were taken: information leaflets were distributed (on the toxicity of the product, the good agricultural practices etc.) and color was added to the product and changed it from pink to brown. The latter resulted in a drastic decrease in the number of animals found dead (Lelièvre et al., 2002). In partridges, population dynamics is not excellent and this species is declining in France. A large study has been carried out by the ONCFS and its results pointed out several causes for the decline, especially with regards to the space use and habitat modification, resulting in limited reproduction and increased predation. Poisoning does not seem to play any significant role in this decline.

In ducks, poisoning occurred mainly after criminal baiting with chloralose. This product is used extensively in France to kill bird species classified as “noxious”. Only registered products can be used against those species. Wild pigeons and ducks are not classified as such and yet, poisoning is often observed. It is suspected that chloralose is used as a chemical restraint to ensure easy capture of game species by some poachers. Duck populations are still important and expanding and there is no specific threat on these species (Anon, 2000).

**Major issues in birds of prey**

In this group, all species are protected in France. The most commonly found species is the common buzzard (Buteo buteo), but many other diurnal and nocturnal raptors are submitted for analysis as well. As was already stated (Berny et al., 1997, 1998), poisoning cases in birds of prey refer to two major circumstances:

1. Illicit use of pesticides in baits is a common feature, especially with cholinesterase inhibitors.
2. Secondary poisoning with anticoagulant rodenticides is a major problem in these species.

As reported in Figure 5, all species may suffer from criminal baiting. This problem is commonly observed with all predator species. When wolves spontaneously colonized the southern part of the Alps, baiting increased dramatically and this may threaten the limited population observed. Secondary poisoning is quite important. Indeed, field voles undergo population cycles with overpopulations every 4-6 years. When this occurs, most predators feed primarily on these rodents (foxes, mustelids, raptors). Unfortunately, anticoagulant rodenticides are also used to control these populations and predators and scavengers feed on contaminated preys over several days. Our data
clearly showed that there is a direct relationship between the use of bromadiolone and the accidents detected in predators (Berny et al., 1997). The situation may be critical locally for endangered species such as Milvus migrans. Unfortunately, there is no specific information on the actual impact of these products on bird populations. This information is definitely needed and should be looked for. Similarly, in the western part of France, field use of bromadiolone against Myocastor coypu may be extensive and some reports indicate that endangered species may also be poisoned accidentally (scavengers and some predators).

**Major issues in herbivores**

Herbivores are less commonly poisoned than the other species. Many cases are suspected but not confirmed (<40% most of the time). They are usually exposed to various products accidentally. For instance, hares and rabbits may feed on coated seeds of wheat treated with anticoagulants. Unusual cases also include paraquat poisoning. A recent review of the factors influencing the decline of the European Brown Hare was published and showed that paraquat poisoning, although unique to hares, was not a major cause of population decline (Edwards et al., 2000).

In large animals, poisoning is seldom suspected and confirmed. In Roe deer, anticoagulant poisoning has been detected in some individuals. Many questions arise when treatments are applied, but these animals are large enough to escape when spraying occurs.

As depicted in figure 6, the major problem observed concerns wild boars. Once again, anticoagulants are involved. Direct poisoning may occur but, since only Pest Control Operators use bromadiolone and since application is strictly controlled, direct poisoning seldom occurs. Wild boars may also eat dead voles and may therefore be contaminated secondarily as many scavengers. Necropsy of animals often confirmed this hypothesis (unpublished data). Many animals are also sent after hunting, in order to determine the presence and amount of residues of bromadiolone, if any. This question becomes a public health issue in France.

**Conclusions**

The various examples described here are representative of the data collected by the toxicology laboratory and regarding wildlife species. Although the network only provides cases reported by voluntary participants and only relies upon dead animal analysis, the information collected is highly valuable and gives insight on the causes of poisoning of wild animals in France. In Europe, networks set up to report pesticide poisoning incidents are limited and the French system is one of the most active (deSnoo et al., 1999). Our case collection shows that poisoning may occur either accidentally or after criminal baiting. Pesticide poisoning may be a threat to the survival of small populations of endangered species, but, usually, acute poisoning, despite its deleterious effects and sometimes massive effects, does not threaten most populations. Anticoagulant poisoning is of particular concern, together with the criminal use of cholinesterase inhibitors.

**References**


Table 1. Toxic substances found in wildlife poisoning cases.

<table>
<thead>
<tr>
<th>Compound</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticoagulant rodenticides</td>
<td>54</td>
</tr>
<tr>
<td>Cholinesterase inhibitors (insecticides)</td>
<td>34</td>
</tr>
<tr>
<td>Alpha-chloralose</td>
<td>5</td>
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<tr>
<td>Organochlorine insecticides</td>
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</tr>
<tr>
<td>Pyrethroid insecticides</td>
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<tr>
<td>Other insecticides (fipronil, imidacloprid)</td>
<td>4</td>
</tr>
<tr>
<td>Other pesticides</td>
<td>1</td>
</tr>
</tbody>
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Figure 1. Scheme of the toxicovigilance network
Figure 2. Groups of wild animals involved.

Figure 3. Case distribution in France.
Figure 4. Poisoning in game birds, pigeons, waterfowl and partridges.

Figure 5. Poisoning in birds of prey.

Figure 6. Poisoning in herbivores.