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CASE HISTORIES OF BALD EAGLES AND OTHER RAPTORS KILLED BY ORGANOPHOSPHORUS INSECTICIDES TOPICALLY APPLIED TO LIVESTOCK

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ABSTRACT: Since 1982 when secondary poisoning of a red-tailed hawk (*Buteo jamaicensis*) was documented following the recommended use of famphur applied topically to cattle, the Patuxent Wildlife Research Center has tested dead birds of prey for poisoning by famphur and other pour-on organophosphorus (OP) insecticides. Brain cholinesterase (ChE) activity was first determined, then if ChE was depressed ≥50%, stomach and/or crop contents were evaluated for anti-ChE compounds. This report presents the circumstances surrounding the OP-caused deaths of eight bald eagles (*Haliaeetus leucocephalus*), two red-tailed hawks, and one great horned owl (*Bubo virginianus*) between March 1984 and March 1985. OP poisoning of raptors by pour-on insecticides in the United States is widespread, but its magnitude is unknown.

Key words: Raptors, bald eagle, red-tailed hawk, great horned owl, organophosphorus poisoning, famphur, fenthion, livestock.

INTRODUCTION

A 1982 field study associated with the topical treatment of 535 cattle with famphur (phosphorothioic acid *O*-[4-(dimethylamino)sulfonyl]*O*,*O*-dimethyl ester) insecticide at the recommended rate resulted in the deaths of a substantial number of black-billed magpies (*Pica pica*) over a 3-month period in Washington (Henny et al., 1985). Furthermore, we documented the death of one red-tailed hawk (*Buteo jamaicensis*) that had eaten a magpie and the intoxication of another whose depressed plasma cholinesterase (ChE) indicated anti-ChE exposure. In a separate incident at Malheur National Wildlife Refuge, Oregon, another red-tailed hawk died from famphur poisoning after it had eaten a European starling (*Sturnus vulgaris*) (Henny et al., 1985).

Organophosphorus (OP) pesticides are comparatively labile in homeothermic animals compared to organochlorines which are well-known for their secondary hazards. Therefore, secondary poisoning by OP's traditionally had not been suspect when raptors died from unknown causes, although Hill and Mendenhall (1980) noted the potential for secondary hazard to raptors from famphur. However, beginning in the late 1970's, all bird kills (exclusive of bald eagles, *Haliaeetus leucocephalus*, which were handled separately) received at the Patuxent Wildlife Research Center (PWRC) were routinely checked for possible poisoning from commonly used OP's and carbamate pesticides. Prior to 1982, only two bald eagles were included in these routine evaluations for anti-ChE exposure and both were negative. Previously, bald eagles were routinely analyzed only for organochlorines and heavy metals.

The year after the field study with famphur in Washington was completed, a moribund bald eagle was found near a cattle feedlot in Delaware. Franson et al. (1985) concluded that cowbirds (*Molothrus ater*) and European starlings possibly were poisoned after consuming famphur near the feedlot and that the eagle had died of secondary poisoning after eating the poisoned birds. The above results led to additional birds of prey being tested at PWRC in 1984 and 1985.

Because dead bald eagles found in the United States were routinely submitted to PWRC for determining the role of contaminants in their deaths, many of the first

raptors we tested were bald eagles. This report documents five previously unreported cases of famphur- and fenthion-caused raptor deaths in 1984 and 1985. Both products are poured on the backs of livestock.

MATERIALS AND METHODS

Brain ChE activity was the initial measurement. If the activity was depressed ≥50%, death was presumed from exposure to an anti-ChE substance (Ludke et al., 1975), and the undigested food remains were removed for OP and carbamate residue analysis. Brain ChE activities of poisoned birds were compared with values obtained from the same species, with assumed normal brain ChE activities, that had died from causes unrelated to contaminants. Cholinesterase activities were determined by the method of Ellman et al. (1961) as modified and described by Hill and Fleming (1982). The stomach and/or crop contents (all or a portion thereof) were removed and extracted with methylene chloride as described by White et al. (1982). The sample extracts from each bird were analyzed separately with a gas chromatograph equipped with a flame photometric detector using a 3% OV-101 column for famphur and a 1.5% SP2250/1.95% SP2401 column for fenthion (phosphorothioic acid *O,O*-dimethyl *O*-[3-methyl-4-(methylthio)phenyl]ester). The presence of famphur was confirmed in two red-tailed hawks, and two bald eagles from Idaho and California by gas chromatography-mass spectrometry (GC-MS) and also in the bald eagle from Delaware (Franson et al., 1985). The presence of fenthion was confirmed by GC-MS in three bald eagles from Iowa.

The eight dead bald eagles discussed in this report were necropsied at the National Wildlife Health Center of the U.S. Fish and Wildlife Service in Madison, Wisconsin. The necropsies revealed no lesions suggestive of infectious disease or trauma that could be implicated as the cause of death. Also, microbiology and virology results were negative for pathogenic organisms of significance. Attempts to detect toxic amounts of certain hazardous substances such as strychnine, thallium, and lead were negative.

CASE HISTORIES

Case I—Bald eagles, Iowa

One bald eagle was found dead on 20 March 1984 near the Mississippi River in Jackson County, Iowa. On 3 April 1984 three additional bald eagles were found dead beneath a roosting area. Another adult bald eagle was found dead in the same general area on 5 April 1984. Brain ChE activities of all five eagles were depressed 80 to 92%, and the stomach contents of these eagles contained 0.1–6.8 ppm (wet weight) of fenthion. Remains of young pigs (feet or hair) were found in the stomachs of all dead eagles. Two farmers had used Tiguvon® (Cutter Animal Health Laboratories, Shawnee, Kansas) on farrowing sows but not on piglets. Tiguvon® contains fenthion and is labeled for use at a rate of ½ fluid oz per 100 lb of swine body weight and is poured uniformly along the backline. Generally sows that die for any reason are picked up quickly and sent to a rendering plant for disposal. However, dead piglets are often thrown into manure spreaders and distributed over the fields where eagles could feed on them. We are not certain whether the piglets became contaminated with fenthion from the sow (dermal contact, licking, and/or suckling) or if dead piglets were illegally treated for use as predator bait. The product is not approved as an insecticide on piglets, but company literature states, "treatment of lactating sows will result in an effective reduction of lice on nursing pigs." The eagle stomach contents did not contain extremely high residues as might be expected if the piglet carcasses had been intentionally laced with fenthion.

Case II—Bald eagles, California

On 14 February 1985 two bald eagles were found dead near a cow carcass in northeastern California (Lassen County). A third eagle was found sick nearby, but it subsequently recovered. Brain ChE activity was depressed 87% and 89% in the two dead eagles. The stomach of one of the eagles contained flesh, presumably from the cow carcass nearby, that was contaminated with 0.9 ppm famphur. A sample from the dead cow (flesh, hair, and hide included) showed 78 ppm famphur.

The cattle in the area had been treated topically with Warbex® (American Cyanamid Co., Wayne, New Jersey) for warble control on 3 and 5 November 1984. Warbex® contains 13.2% famphur and is poured along the backline of cattle at a rate of ½ fluid oz per 100 lb of animal, but not to exceed 4 oz. Based on our earlier work in Washington (Henny et al., 1985), residues of the detected magnitude might be expected if some hair was included in the sample. Some cow hair contained famphur residues 90 days after treatment in the Washington study. The eagles apparently fed directly on a cow that died within about 3 months of being treated with famphur.

Case III—Bald eagle, Idaho

On 7 February 1985 a bald eagle was found dead in southwestern Idaho (Elmore County). Its brain ChE activity was depressed by 81% and its crop contents (flesh and reddish and white hair of possible bovine origin) contained 0.9 ppm famphur. This eagle probably had been scavenging a cow carcass. This case appears similar to Case II.

Case IV—Red-tailed hawks and great horned owl, Oregon

On 1 March 1985 two red-tailed hawks and a great horned owl (*Bubo virginianus*) were found dead under the same tree in eastern Oregon near Ontario (Malheur County) and about 0.4 km from a cattle feed lot. One of the hawks had been partially eaten and was not suitable for analysis. The other hawk had 78% brain ChE depression and its stomach contained the remains of a magpie with 6.2 ppm famphur. The stomach of the great horned owl contained portions of a red-tailed hawk, possibly from the partially-eaten specimen found nearby. The stomach and crop contents of the great horned owl contained 15 ppm famphur and its brain ChE was depressed 85%. Therefore, one red-tailed hawk was secondarily poisoned by eating a magpie, while the great horned owl apparently died from tertiary poisoning from eating the other red-tailed hawk. This case differed from the first three involving bald eagles; the raptors were not feeding on livestock carcasses. A magpie was the intermediary here as it was in the Washington study where another red-tailed hawk had died (Henny et al., 1985).

Case V—Red-tailed hawk, Colorado

On 11 March 1985 a red-tailed hawk was found dead in northwestern Colorado (Garfield County). Its brain ChE activity was depressed by 82% and its crop contents (magpie and mouse) contained 0.3 ppm famphur. This case was similar to Case IV.

DISCUSSION

The cow hair/magpie/raptor route (sometimes also involving cowbirds or starlings as the intermediary), and the livestock carcass/bald eagle scavenging route have both led to raptor mortality involving organophosphorus pour-on insecticides. The persistence of the unabsorbed product on livestock hair (Henny et al., 1985) appears responsible for the long-term indirect (through intermediary bird species) and direct (eating livestock carcasses including hair) mortality of raptors.

Judicious use of the highly toxic OP insecticides is required. Both famphur and fenthion were implicated earlier in the deaths of magpies (Felton et al. 1981, Hanson and Howell 1981, Henny et al. 1985); both have since killed bald eagles. A previous recommendation (Henny et al., 1985) to change from the topical method of administering OP insecticides to livestock would prevent exposure of birds to toxic residues. Warnings added to labels requiring that livestock dying within 3 months (or possibly even longer) of treatment be removed from range or farmland would minimize exposure and offer partial protection for carrion-feeding raptors such as eagles and vultures. It is important to recognize that in three of the five cases,

multiple deaths of raptors occurred in small localized areas. All eagles were wintering birds, whereas the red-tailed hawks in Oregon were probably a breeding pair. Organophosphorus poisoning of raptors by pour-on insecticides in the United States is geographically widespread, but occurs at a rate that is unknown at this time. Effort to pursue its detection has been nearly nonexistent.

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