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Test of compound 1080 from a poison collar on a captive vulture

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Introduction

The poison collar was developed in the USA in the late 1970s. It was designed to be an effective and highly selective means of killing Coyotes *Canis latrans* that preyed on domestic stock, without harming non-target individuals and species (Connolly *et al.* 1978; Saverie & Sterner 1979). The collar has been exported to other parts of the world, where it is used against mainly medium-sized mammalian predators.

The poison collar consists of two rubber pouches containing poison under low pressure, and two straps with velcro attachments. The collar is fitted around the neck of a sheep or goat and the pouches are positioned around the throat, which is the site of attack by most mammalian predators. The exact position of the pouches depends on the expected predator. A number of young domestic animals (usually at least 20) are fitted with collars and released with a larger flock of adult animals into the camp where losses are being experienced. The predator usually attacks one of the smaller animals. On biting into one of the poison pouches, a lethal dose of poison squirts into the predator's mouth and is ingested.

In the USA a wide spectrum of poisons were tested for use in the collar (e.g. Connolly *et al.* 1978; Saverie & Sterner 1979; Sterner 1979). Compound 1080 (sodium monofluoroacetate) was found to be the most suitable toxin and was registered for this purpose (Scrivner 1983; Howard & Schmidt 1984). The use of the poison collar and compound 1080 were vigorously opposed and intensively monitored by a number of environmental pressure groups in the USA (e.g. Anon. 1982; Doherty 1982; Sibbison 1984). The issue was eventually settled in court. The verdict was in favour of the use of the collar and compound 1080 because, after extensive testing by impartial organisations, no secondary poisoning was found and no non-target animals were killed (Connolly 1983; Eastland & Beasom 1986). Recent investigations of secondary poisoning concluded that consuming carcasses of Coyotes killed by 1080 poison from a collar poses little, if any, hazard to Striped Skunks *Mephitis mephitis* and Golden Eagles *Aquila chrysaetos* (Burns *et al.* 1991).

The use of compound 1080 is banned in Namibia and the Republic of South Africa. In these countries an alternative poison was used in the collar, an organophosphate called PDB1. This acronym (for the Afrikaans "problem animal control 1") was adopted to prevent the toxin, which is readily available from farmers co-operatives and other outlets, from being misused.

The poison collar with compound 1080 was used in Namibia to a limited extent in the early 1980s. In 1989 the collar was again introduced into Namibia, this time with PDB1. In 1990 the Ministry of Wildlife, Conservation and Tourism established a monitoring programme to determine the effectivity and selectivity of this predator control method under field conditions. Field trials lasted 1053 collar-use days. Four mammalian predators were killed, two Blackbacked Jackals *Canis mesomelas* and two Lynx *Felis caracal*. Nine non-target animals died, all birds of prey, consisting of one Tawny *Aquila rapax*, three Black Eagles *A. verreauxii*, one Whitebacked *Gyps africanus* and four Lappetfaced Vultures *Torgos tracheliotus*. All the non-target animals died after eating from the dead domestic animals which had been contaminated by PDB1 leaking out of punctured collars (Gildenhuys & Brown 1991).

A recent report from the north-eastern Cape Province in South Africa revealed the poisoning of 15 Cape *Gyps coprotheres* and three Bearded Vultures *Gypaetus barbatus* by PDB1 in the poison collar (Boshoff 1991), and expressed an urgent need to investigate an alternative poison for use in the poison collar in southern Africa.

During September and October 1991, the person who developed the poison collar in the USA, Roy McBride (1974), visited Namibia and South Africa. He concluded that non-target deaths were occurring because PDB1 was being used in the collar instead of compound 1080. He attributed the safer properties of the latter to the toxicity values for members of the dog and cat families compared to those for other groups, particularly birds of prey.

The LD50 values for an average Blackbacked Jackal of 7 kg is about 130 mg for PDB1 (19 mg/kg) and 0.7 mg for compound 1080 (0.1 mg/kg). Eagles of the *Aquila* group (based on tests on the American Golden Eagle and the Australian Wedgetailed Eagle *A. audax*) have LD50 values of about 1.3-9.5 mg/kg for compound 1080 (Atzert 1971; McIlroy 1984). No data exist on the toxicity of PDB1 in raptors, but closely related poisons are typically about 50 times more toxic to the Golden Eagle than to dogs (Osweiler *et al.* 1985). Extrapolating to an average sized Tawny Eagle (2.3 kg), the LD50 values for PDB1 and 1080 would be about 0.9 mg and 3-22 mg respectively. No data exist for Old World vultures. New World vultures, which are not closely related and cannot be assumed to be similar, have an LD50 value of 15 mg/kg for compound 1080. From these figures it is apparent that birds of prey are about 13-150 times more tolerant to compound 1080 relative to body mass than are members of the dog family. Conversely, raptors are about 50 times more sensitive to PDB1 than are the mammalian predators, a situation found with most other toxins. In addition, there is evidence that animals in areas that have plants containing compound 1080 (southern Africa, parts of South America and Australia) have developed a tolerance to this poison (Oliver *et al.* 1977; McIlroy 1982, 1984). Finally, raptors usually regurgitate their food if contaminated by 1080 (McIlroy 1984), but do not seem to do so when exposed to PDB1.

The Ministry of Wildlife, Conservation and Tourism in Namibia has been given approval by the Ministry of Health and Social Services to use compound 1080 for the experimental control of mammalian predators. Because of the proven non-target mortalities of PDB1 and the apparently more selective characteristics of compound 1080, it seemed appropriate to test 1080 in the collar under local conditions. However, before authorisation is given to use 1080 in field trials, it was considered necessary to determine whether this poison was in fact safer than PDB1 for Old World vultures, which have not previously be tested.

Methods

As neither the technical infrastructure nor the inclination exists in Namibia to determine the LD50 of vultures for compound 1080, which involves the poisoning to death of large numbers of birds, a less rigorous and simpler method was used in which a worst case scenario was tested on a single Whitebacked Vulture. A standard poison collar containing 30 ml of a 1% solution (weight-volume percent, i.e. 10 mg/ml) of compound 1080 together with a yellow dye, supplied by Rancher's Supply, Inc., Texas, U.S.A., was fitted to the fresh carcass of a young goat of about 4 months old. The pouches were punctured and poison was released onto the neck, chest and shoulders of the goat. Additional poison was squeezed out of the pouches onto the carcass until the pouches were compressed and exerted a negative internal pressure. Three incisions, each about 10 cm long, were made through the wet skin of the goat, within the main area of poison contamination.

The goat carcass was introduced to the adult Whitebacked Vulture in a wire mesh cage of about 3 x 2 m by 2 m high at about 11h00 on day one. The vulture weighed about 5.5 kg and had been in captivity in a large aviary in a stable condition for 10 months, but could not be released to the wild because of partial blindness. The vulture had been denied food for three days prior to the experiment, but was supplied with water throughout. The test ran for two days (46 h), during which time the bird ate three times from the carcass. All three meals were from the area where the incisions had been made. All the meat in the contaminated area had been removed by 09h00 on day three. The vulture was then moved from the small cage to its large aviary, fed on uncontaminated meat and watched closely for 10 days.

Results

The vulture's first meal was at about 18h00 on day one. About 0.5 kg of food was taken. Within 30 min the bird regurgitated its entire crop contents. The bird fed again at midday on day two, taking about 0.3 kg, which it kept down. It fed again at about 17h00 on day two, from the carcass (about 0.5 kg) and from the meat regurgitated on day one (about 0.2 kg). Within about 20 min it regurgitated about 0.3 kg but kept the remainder down until nightfall. On arrival at the cage at 07h30 on day three it was apparent that the vulture had regurgitated about 0.2 kg of food during the night, and that it had been pulling at the carcass, but not feeding much, as its crop was empty.

In addition to feeding from the incisions, and gaining access through them to meat between the skin and skeleton, the bird had tugged and torn the contaminated skin. At no stage did the vulture show any symptoms of 1080 poisoning other than regurgitation. Common symptoms are depression, unsteady gait and loss of balance, closed eyes, hunched posture and raised or fluffed feathers (McIlroy 1984). After returning the bird to the large aviary, it fed on clean meat on the afternoon of day three and showed no signs of having been poisoned.

Discussion

Recent work in southern Africa has clearly demonstrated the link between poisons used in predator control programmes on farmlands and the dramatic decline in the numbers of scavenging birds of prey (e.g. Brown 1991a, b; Brown & Piper 1988). Other non-target animals, such as mammalian scavengers, are also severely affected, but these animals have received little attention with regard to poison-related mortalities.

The main methods by which farmers attempt to poison predators is either to place the poison into the carcass of a domestic animal (usually one killed by a predator), or to poison a number of blocks of meat or fat (sometimes birds such as doves are shot for the purpose) and distribute these over their farm. Birds of prey are far more efficient at finding the baits than are the target animals (e.g. Watson 1986), and some farmers have estimated that for every target animal they kill, over 100 non-target animals die (Ledger 1986; Brown 1988). By "target animal" it is meant that an individual of the species supposedly responsible for the predation is killed, not necessarily the actual predator that killed the domestic animal.

Against this background, a predator control method that (a) kills the specific predator actually attacking domestic stock, (b) allows innocent predators to live safely and perform their useful ecological functions, (c) poses little or no threat to non-target animals, with respect to both secondary poisoning and spillage, and (d) is relatively inexpensive, safe and easy to use, offers the ideal solution to both farming and conservation practices. In addition, such a solution would justify the phasing out of current predator control methods, such as poisoned carcasses and blocks of meat, which are unselective.

Based on the positive result of this worst-case scenario, it has been recommended that the poison collar with compound 1080 be used in field trails on farmlands in Namibia, under the supervision of staff of the Ministry of Wildlife, and that the same methods be used as those described by Gildenhuys & Brown (1991). Particular attention should be paid to the effects of scavenging on collared carcasses by Lappetfaced Vultures, because these birds eat more skin than other species and may therefore ingest more poison.

If the poison collar with 1080 is found to be acceptable and is released to farmers, then the PDB1 collars should be withdrawn from the market. In addition, the following conditions are recommended:

a) Farmers should be registered to use the poison collar only after they have completed an appropriate course.
b) The 1080 collar should remain under experimental registration in Namibia so that (i) the distribution of all collars is regulated by the Ministry of Wildlife, Conservation and Tourism and records are kept of which farmers have collars, and (ii) farmers should keep records of target and non-target animals killed and the effectiveness of the method in reducing stock losses.
c) Once proven as an effective and selective predator control method, other less selective methods should be discontinued. In particular, strychnine poison and the gin trap should be banned.

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