POTENTIAL HAZARDS OF SECONDARY POISONING OF NON-TARGET VERTEBRATE SPECIES THROUGH THE USE OF THE 1080 TOXIC COLLAR ON SHEEP AND/OR GOATS

by

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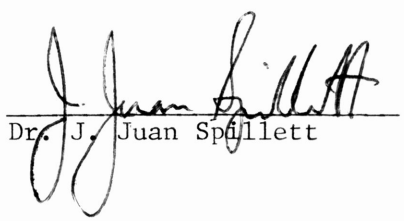
Approved by:



Dr. J. Juan Spillett

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ABSTRACT

Predation on sheep and goats by coyotes constitutes the major cause of stock losses in the western United States. No effective method currently exists for selectively removing problem coyotes from a wild population. Development of the 1080 toxic collar presents a potentially efficient means for selectively removing sheep and goat-killing coyotes by directly affecting livestock coyote interactions.

Measured dosages of Sodium Monoflouroacetate (Compound 1080) were orally administered to 18 experimental coyotes. Twelve measured dosages used in establishing an LD_{100} ranged from 0.16 mg of 1080/kg body weight to 0.20 mg of 1080/kg body weight. The LD_{100} was determined to be 0.18 mg of 1080/kg body weight. Six experimental coyotes were orally dosed with 250 mg of 1080 to simulate potential maximum doses from a toxic collar. Six control coyotes also were used.

Three replicates of tissue samples were collected from each experimental animal from the brain, heart, lungs, liver, kidneys, stomach contents or vomitus, intestines, and hip muscle. The samples were weighed and frozen for later analyses.

INTRODUCTION

The sheep and goat industries lose millions of dollars annually to predation by coyotes (Canis latrans) (U.S. Fish and Wildlife Service 1971). An effective and economical method of predator control which selectively removes problem coyotes is needed. Current methods of removal include steel leghold traps, snares, and the M-44 in conjuction with sodium cyanide. Sodium Monoflouroacetate (Compound 1080) was first developed for predator control in the 1940's and has since been used widely in New Zealand and Australia (Egekeze and Oehme 1979). Use of Compound 1080 in the United States has been limited, due to the supposed possibilities of secondary poisoning of non-target species(Wade 1977).

Compound 1080's mode of action is the inhibition of the Krebb's Cycle (Atzert 1971). Death results from general cardiac failure or ventricullar fibrillation, progressive depression of the central nervous system, respiratory arrest, or a combination of the three symptoms (Atzert 1971). Death in carnivores generally results from nervous disorders (Wade 1977).

The time elapsing from ingestion of 1080 until death affects the viability of 1080 as a toxicant (Connolly 1980). Whereas death by sodium cyanide may result within minutes after exposure, death due to 1080 may take several hours and the affected predator may travel miles or feasibly attack other livestock (Connolly 1980).

Compound 1080 is an economically viable predicide, costing approximately $25.00 per pound of powder when bought from the manufacturer in quantity (Tull Chemical Company, Inc. 1980). The LD_{100} of coyotes has

been reported to be 0.16 mg of 1080/kg body weight (Connolly 1980). Therefore, taking less than 3 mg to kill a coyote. The economic drawbacks associated with the 1080 toxic collar are the need to sacrifice some livestock and the continual shifting of collared stock to areas of predation. Given the selectivity of the 1080 toxic collar, the cost of removing only problem coyotes could be lower than that of a comprehensive predator control program using trapping and other methods such as M-44's, snares, and calling.

The purpose of this study was to determine the LD_{100} of coyotes using 1080. The results obtained will be included in a larger study concerning the safety and efficacy of the 1080 toxic collar as a predator control method to protect sheep and goats.

METHODS

Eighteen live-trapped coyotes were orally dosed with 1080. The coyotes used in this study were trapped, using leghold traps and snares, by Federal Troubleshooters and State Trappers in several parts of Texas. (Appendix Table 1).

Potential maximum doses of 250 mg of 1080 per coyote (which possibly could be obtained by biting the 1080 toxic collar) were administered to six experimental coyotes. Twelve additional coyotes were given varying doses of 1080 to establish the LD_{100} . Dosage levels began at 0.16 mg of 1080/kg body weight and were increased by 0.05 mg 1080/kg of body weight up to 0.018 mg of 1080/kg bodyweight, and then increased to 0.20 mg of 1080/kg body weight as a check. Six coyotes were used as controls and killed by shooting in the neck with a .22 caliber rifle.

Captive coyotes were first weighed. The exact dosage for individual coyotes was derived by multiplying the weight in kilograms times the dosage level used. The experimental 1080 was dissolved in 25 cc's of water and orally tubed into the gut of the experimental coyotes, using 1/8-inch-diameter plastic tubing. The coyotes were secured for tubing by two neck snares, with their mouths held open by a 2-foot section of aluminum pipe, which was tied with cord to the muzzle of the coyote. The pipe contained two holes, drilled horizontally through the sides, through which the tubing was inserted through the esophagus into the gut of the experimental coyotes. A 30 cc syringe containing the aqueous 1080 was attached to the tubing and the 1080 was delivered by depressing the

plunger. Air was then pushed through the tubing until no 1080 visibly remained in the tubing. The dosed coyotes then were transferred to 4 x 4 x 6 - foot holding pens for observation. Experimental coyotes were observed and their reactions were recorded continuously until death or 24 hours post dosage, at which time they were killed by shooting in the neck with a .22 caliber rifle.

Coyotes were necropsied immediately after death and tissue samples were collected (Appendix Table 2). Tissue samples included: brain, heart, lung, liver, kidney, stomach contents or vomitus, intestines, and hip muscle. Three replicates were taken of each tissue for a total of 27 samples from each coyote. The tissues were weighed wet, stored in whirlpacks, and frozen for later analyses. Six control coyotes also were killed, necropsied, and sampled.

RESULTS

All six coyotes dosed with the potential maximum dosage from a 1080 toxic collar of 250 mg of 1080 per animal, died between 0.90 hours and 1.90 hours, with a mean of 1.10 hours (Table 1). Their initial reaction times ranged from 0.30 hours to 1.10 hours, with a mean of 0.75 hours. Convulsions lasted from 0.10 hours to 0.65 hours, with a mean of 0.30 hours. The 12 coyotes dosed in determining the LD_{100} for coyotes died between 0.50 hours and 14.90 hours, with a mean of 3.90 hours (Table 2). Initial reaction times ranged from 0.30 hours to 12.40 hours, with a mean of 4.00 hours. Duration of convulsions ranged from 0.10 hours to 13.00 hours, with a mean of 5.50 hours. Vomiting occurred in two coyotes dosed with 250 mg of 1080 and in five coyotes dosed with an LD_{100}. In all seven cases, vomiting immediately preceeded convulsions.

Two coyotes dosed with 0.16 mg of 1080/kg body weight did not die and were shot and necropsied at 24 hours post dosage (Table 3). One coyote was dosed at 0.165 mg of 1080/kg body weight and although it appeared to be dead at 14.9 hours, upon necropsy the heart still was beating. Two coyotes dosed at 0.17 mg of 1080/kg body weight did not die and were shot and necropsied at 24 hours post dosage. Three coyotes were dosed at 0.175 mg of 1080/kg body weight, with two dying between 4.25 hours and 4.30 hours. The third coyote did not die, but exhibited paralysis of the hindquarters when shot and necropsied at 24 hours post dosage. The two coyotes dosed with 0.18 mg of 1080/kg body weight died between 0.60 hours and 0.90 hours, with a mean of 0.75 hours. The two

Table 1. Sequence and mean reaction times for coyotes orally dosed with Sodium Monoflouroacetate (Compound 1080) at a rate of 250 mg of 1080 per coyote. (n=6)

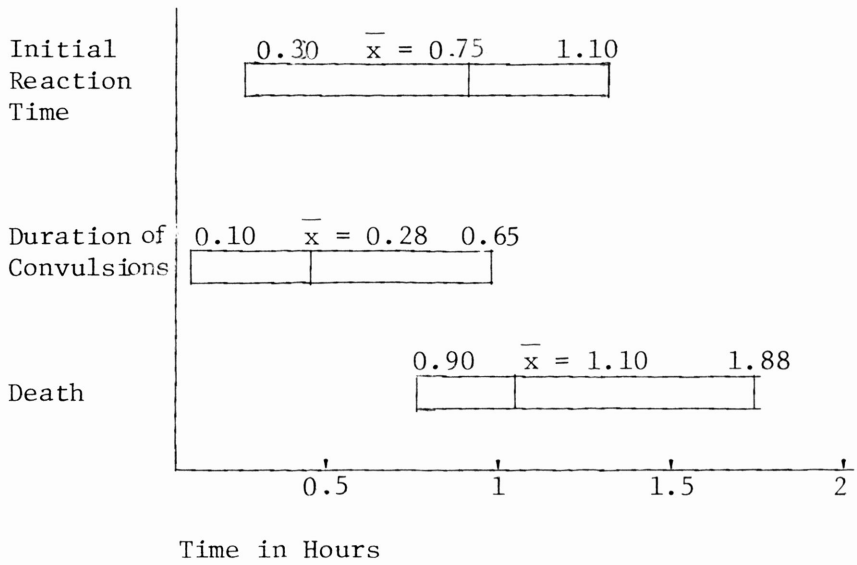
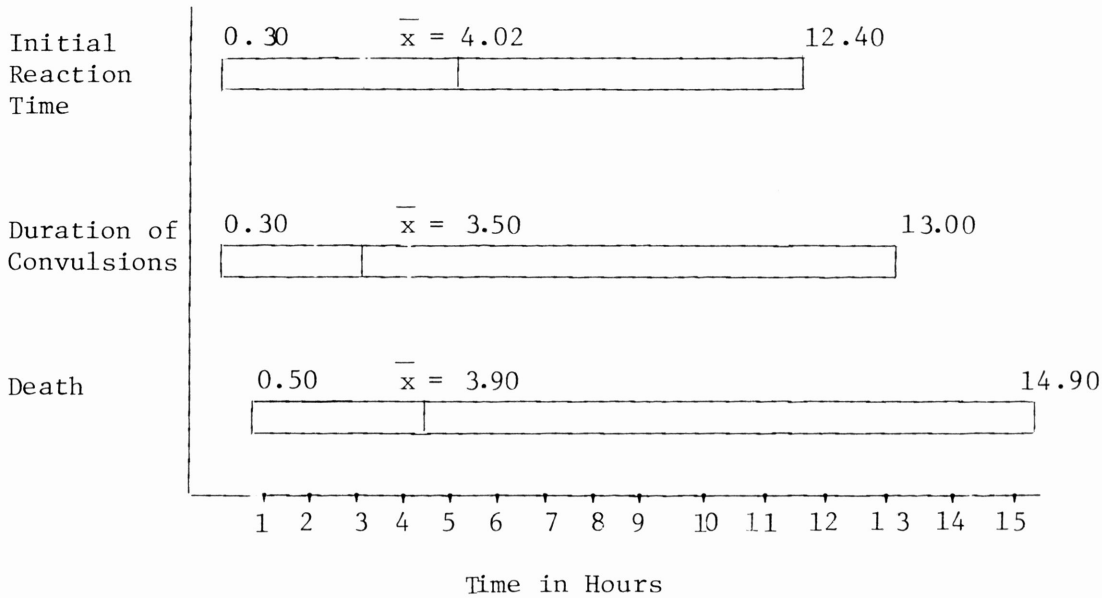
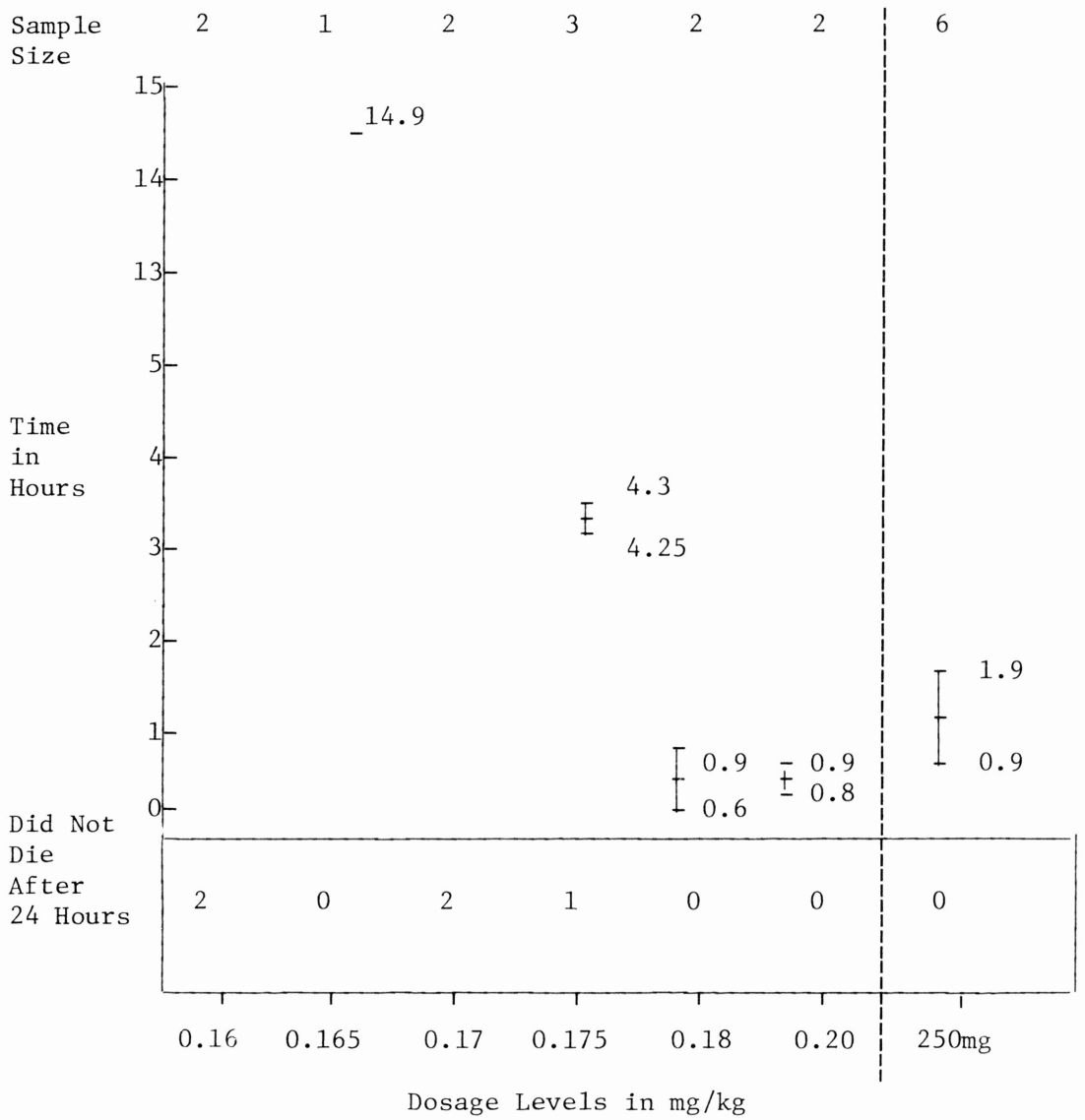


Table 2. Sequence and mean reaction times for coyotes orally dosed with Sodium Monoflouroacetate (Compound 1080) at rates between 0.16 and 0.20 mg 1080 per kilogram body weight. (n = 12)



Note: 5 of 12 coyotes did not die within 24 hours

Table 3. Dosage to death time spans and means for coyotes orally dosed with Sodium Monoflouroacetate (Compound 1080) at rates between 0.16 mg 1080 per kg body weight and 250 mg 1080 per coyote.



coyotes dosed at 0.20 mg of 1080/kg body weight died between 0.80 hours and 0.90 hours, with a mean of 0.85 hours.

DISCUSSION

The LD_{100}'s reported in the literature for Compound 1080 and coyotes ranged from 0.20 mg of 1080/kg body weight (Robinson and Spencer 1946), to 0.16 mg of 1080/kg body weight (Connolly 1980). Based on the results of this project, the LD_{100} for coyotes is 0.18 mg of 1080/kg body weight. There is no difference in the latent period between dosage and reaction of LD_{100}'s and higher dosages, as reported by Egekeze and Oehme (1979). This may be an important consideration for the levels of 1080 used in the toxic collar as they relate to supposed secondary poisoning hazards. Atzert (1971) and Connolly (1980) feel that, while a potential for secondary poisoning exists, an actual case is unlikely. Due to problems with the gas chromatograph, tissue samples analyses were not completed. Further analyses for 1080 residue levels is scheduled for the summer of 1981 Continued testing also is planned to verify results. Upon completion of tissue analysis, the data obtained will be used in a computer model to simulate and potentially predict possible secondary poisoning hazards to non-target species through use of the 1080 toxic collar.

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Appendix Table 1. Age, sex, weight, and county of aquisition for experimental coyotes.

Coyote #	Age (yrs)	Sex	Location (Co.)	Weight (lbs)
1	3.5	M	Liberty	24
2	1.5	M	Liberty	31
3	2	M	Liberty	38
4	3.5	F	Liberty	30
5	1.5	M	Liberty	31
6	2.5	F	Liberty	30
7	0.5	F	Travis	12
8	3.5	F	Liberty	30
9	2.5	F	Liberty	33
10	1	M	Liberty	28
11	2	F	Liberty	30
12	1	F	Liberty	33
13	2	M	Liberty	37
14	2	F	Liberty	30
15	3	M	Travis	28
16	0.5	F	Travis	19
17	0.5	M	Travis	16
18	1.5	F	Liberty	21
19	2	F	Liberty	28
20	1.5	F	Liberty	30
21	3	F	Brown	22.5
22	2	M	Guadalupe	27.5
23	3	M	Tyler	28
24	2	M	Trinity	32.5

Appendix Table 2.

NECROPSY PROTOCOL

1. Contributor_____ Date_____

Time_____

2. Identification: number____

species_____ sex_____ age_____

weight_____

3. General Condition:

4. Dosage Level: _____

Time intervening between dose administration and death_____

Time intervening between death and necropsy_____

Time intervening between dosage and end of necropsy_____

5. Primary Incision:

6. Sampling Order and wet weights (in grams) 3 repetitions

1). vomitus	1._____	2). liver	1._____	3). kidney	1._____
	2._____		2._____		2._____
	3._____		3._____		3._____
4). hip muscle	1._____	5). heart	1._____	6). lungs	1._____
	2._____		2._____		2._____
	3._____		3._____		3._____
7). intestines	1._____	8). stomach	1._____	9). brain	1._____
	2._____		2._____		2._____
	3._____		3._____		3._____

7. General Observations:

9. Persons Involved: