UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 31 1995

MEMORANDUM

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

SUBJECT: Sodium fluoroacetate RED- EEB Science Chapter

TO: Dave Farrar
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (7507C)

FROM: Anthony F. Maciorowski, Chief
Ecological Effects Division
Environmental Fate and Effects Division

Attached is the EEB Science Chapter for the Sodium fluoroacetate (Compound 1080) RED. The EEB has sufficient data and/or information to complete a comprehensive risk assessment for both terrestrial and aquatic organisms from the use of Compound 1080 in the Livestock Protection Collar (LPC).

The following is a summary of EEB's assessment:

* Residue data indicate that the greatest exposure and potential for hazard comes from scavenging the neck area of the dead collared livestock and that secondary hazard from scavenging the carcass of the dead coyote and/or consuming vomit is highly unlikely to pose any unacceptable risk.

* Results of feeding tests, simulated studies and actual field studies indicate that feeding behavior for many scavengers, decomposition of livestock carcasses, and the emetic nature of 1080 are all factors that greatly reduce the likelihood of exposure to non-target organisms below the Agency's level of concern. In addition, environmental hazard statements, special use restrictions, and endangered species protection statements, that are required to be placed on the label, greatly reduce primary hazard to non-target organisms including endangered species.

* Based upon results of field studies, monitoring reports, low volume usage, environmental fate data, which suggests that 1080 is not likely to get into aquatic habitats, and residue analysis, that shows that the total amount of 1080 likely to be released into the environment is quite low, the EEB

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believes that the use of the Compound 1080 LPC will not exceed the Agency's unacceptable risk criteria for either non-target aquatic or terrestrial species.

Any questions or comments should be referred to R. Felthousen at 305-5829.

ECOLOGICAL EFFECTS BRANCH
REREGISTRATION ELIGIBILITY DOCUMENT FOR SODIUM FLUOROACETATE
SCIENCE CHAPTER

I. TOXICITY DATA

A. Topical Summaries

1. Avian Species

In order to establish the toxicity of sodium fluoroacetate to birds, the following tests are required using the technical grade material: one avian single-dose oral LD50 study on one species (preferably the mallard duck (Anas platyrhyncos) or the bobwhite quail (Colinus virginianus); two subacute dietary studies (LC50) on one species of waterfowl (preferably the mallard duck) and one species of upland game bird (preferably the bobwhite quail or the ring-necked pheasant (Phasianus colchicus).

a. Acute Oral

The acute oral LD50 value for the technical grade of sodium fluoroacetate (1080) for avian species has been reported in the literature. Hudson et al., (1984) reported the acute oral LD50 values for the ring-necked pheasant, mallard duck and chukar (Alectoris graeca) to be 6.4 (95% C.I. = 3.85-10.8), 9.1 (95% C.I. = 5.6-14.6) and 3.51 (95% C.I. 2.58-4.78) mg/kg, respectively. Ward and Spencer (1947) determined the acute lethal doses for numerous avian species and reported LD_{50} values as low as 3.0, 5.0, and 15 mg/kg for the widgeon (Mareca americana), golden eagle (Aquila chrysaetos), and black vulture (Cartharista urubu), respectively. Atzert (1971) reported the LD50 for the black-billed magpie (Pica pica) to be 1 mg/kg. In addition, the USDA conducted a series of acute oral LD_{50} tests on the magpie to get toxicity data for a species that is likely to scavenge the carcasses of coyotes and/or livestock (Burns and Connolly, 1992). Results of these studies showed that the acute oral LD_{50} for the magpie ranged from 1.78-2.3 mg/kg, depending on temperature and season.

These results indicate that 1080 can be classified as being very highly toxic to avian species on an acute oral basis. The guideline requirements for this test have been satisfied. Table 1 is a data summary for the acute toxicity of 1080 to avian species.

TABLE 1: AVIAN ACUTE ORAL TOXICITY DATA

Species	LD_{50} mg/kg	Conclusions	Reference
Mallard duck	9.1	Acceptable	Hudson et al., (1984)
Chukar	3.5	Acceptable	Hudson et al., (1984)
Ring-necked Pheasant	6.4	Acceptable	Hudson et al., (1984)
Widgeon	3.0	Acceptable	Ward and Spencer, 1947
Golden eagle	5.0	Acceptable	Ward and Spencer, 1947
Black vulture	15.0	Acceptable	Ward and Spencer, 1947
Magpie	1.0	Acceptable	Atzert, 1971

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b. Dietary

Campbell et al. (1994) reported that the avian dietary LC_{50} values of 1080 for the mallard duck and bobwhite quail were 231 (95% C.I.=150-338) and 486 (95% C.I.=339-696) ppm, respectively (MRID #s 43210602; 43210601). Based on these data, 1080 can be classified as being highly toxic to avian species on a dietary basis. The guideline requirements for a dietary study have been satisfied. Table 2 is a data summary for the dietary toxicity of 1080 to avian species.

TABLE 2: AVIAN SUBACUTE DIETARY TOXICITY DATA

Species	LC_{50} (ppm)	Conclusion	Reference
Bobwhite quail	486	Acceptable	Campbell et al., 1994 MRID#43210601
Mallard duck	231	Acceptable	Campbell et al., 1994 MRID#43210602

2. Mammalian Species

Wild mammal testing is required on a case-by-case basis, depending on the results of the lower tier studies such as acute and subacute testing, intended use pattern, and pertinent environmental fate characteristics. Because the proposed use pattern is specifically designed to take a wild mammal (i.e., coyote), wild mammal toxicity testing is required.

Ward and Spencer (1947) determined the acute lethal doses of 1080 for numerous mammalian species and reported LD_{50} values as low as 0.1 mg/kg for both the cotton rat (Sigmodon hispidus) and coyote (Canis latrans). They also reported that the LD_{50} for the deer mouse (Peromycus sp.) was 4.0 mg/kg. Beasom (1982) reported that the LD50 values for the opossum (Didelphis virginiana) and raccoon (Procyon lotor) were 41.6 and 1.1 mg/kg, respectively. Atzert (1971) reported that the LD50 of 1080 to the striped skunk (Mephitus mephitus) and opossum is 1 and 60 mg/kg, respectively. These data indicate that 1080 can be classified as being very highly toxic to mammals on an acute oral basis. The guideline requirement for the wild mammal toxicity test has been satisfied. Table 3 is a data summary for the acute toxicity of 1080 to mammals.

TABLE 3: MAMMALIAN ACUTE TOXICITY DATA

Species	LD50 (mg/kg)	Conclusions	Reference
Coyote	0.1	Acceptable	Ward and Spencer, 1947
Cotton rat	0.1	Acceptable	Ward and Spencer, 1947
Deer mouse	4.0	Acceptable	Ward and Spencer, 1947
Raccoon	1.1	Supplemental	Beasom, 1982
Opossum	41.6	Supplemental	Beasom, 1982
Skunk	1.0	Acceptable	Atzert, 1971

3. Toxicity to Aquatic Animals

i. Freshwater Fish

In order to establish the toxicity of a pesticide to freshwater fish, the minimum data required on the technical grade of the active ingredient are two freshwater fish toxicity studies. One study should use a coldwater species (preferably the rainbow trout), and the other should use a warmwater species (preferably the bluegill sunfish).

Collins (1993) reported that the 96-hour LC_{50} values of technical grade 1080 to the rainbow trout (Oncrhynchus mykiss) and bluegill sunfish (Lepomis macrochirus) were 54 mg a.i./l and > 970 mg a.i./l, respectively. Based on these data, 1080 can be classified as being slightly toxic to coldwater fish species and practically non-toxic to warm water fish species. The guideline requirements for freshwater fish toxicity tests have been satisfied (MRID #s 42961601; and 42961602). Table 4 is a data summary for the toxicity of 1080 to freshwater fish.

TABLE 4: FRESHWATER FISH ACUTE TOXICITY DATA

Species	96-hour LC_{50} (mg a.i./l)	Conclusions	Reference
Rainbow trout	54	Acceptable	Collins, 1993 MRID# 42961601
Bluegill sunfish	970	Acceptable	Collins, 1993 MRID# 42961602

ii. Freshwater invertebrates

The minimum testing required to assess the toxicity of a pesticide to freshwater invertebrates is a freshwater aquatic invertebrate toxicity test, preferably using the first instar Daphnia magna or early instar amphipods, stoneflies, mayflies, or midges (Chironomids sp.).

Collins (1993) conducted an acute static toxicity test on daphnids and determined that the 48-hour EC50 of 1080 was 350 mg a.i./l (MRID # 42961603). Based on these data, 1080 can be classified as being practically non-toxic to freshwater invertebrates. The guideline requirement for the freshwater toxicity test has been satisfied. Table 5 is a data summary for the toxicity of 1080 to freshwater invertebrates.

TABLE 5: FRESHWATER INVERTEBRATE TOXICITY DATA

Species	48-hour EC50 (mg a.i./l)	Conclusions	Reference
Daphnia magna	350	Acceptable	Collins, 1993 MRID# 42961603

iii. Estuarine and Marine Animals

Acute toxicity testing with estuarine and marine organisms is required when an end-use product is intended for direct application to the marine/estuarine environment or is expected to reach this environment in significant concentrations. Because the terrestrial non-food use of 1080 will not result in exposure to the estuarine environment, the data requirement is not required.

4. Toxicity to Plants

Terrestrial plant testing (seed germination, seedling emergence and vegetative vigor) is required for herbicides which have terrestrial non-food or aquatic non-food (except residential) use patterns and which have endangered or threatened plant species associated with the site of application. Because 1080 is not a herbicide, the data requirement is not required.

II. FIELD STUDY DATA

From 1978 to 1980, the U.S. Fish and Wildlife Service conducted field research in various states to assess the primary and secondary hazards from the use of the 1080 LPC (Connolly, 1980). It was found that the primary scavenger of collared goats that were killed by coyotes in Texas were turkey (Cartharista aura) and black vultures while red-tailed hawks, caracaras and ravens infrequently scavenged kills. No scavenging by mammals was observed. In Montana and Idaho, magpies were the most "conspicuous scavengers of coyote killed sheep with infrequent scavenging by ravens. With regard to primary poisoning the following summary was reported:

" In summary, coyote-killed collared livestock were known to have been scavenged by turkey vultures, black vultures, magpies, ravens, red-tailed hawks, caracaras, a skunk and a coyote during the present studies. No scavenger was known or believed to have been poisoned. Scavengers ignored the collars and fed instead upon the viscera and muscle that has been exposed by the killer coyote."

Field observations of secondary poisoning studies, conducted in Texas and Montana showed that turkey vultures were the only scavengers of dead coyotes eventhough numerous other scavengers such as golden eagles, ravens , magpies, skunks and other potential scavengers were abundant in the area.

From 1981 to 1983, the New Mexico Department of Agriculture conducted an experimental field program evaluating the efficacy and safety of the toxic collar. A total of 330 collars ware used over approximately 1,000 days. Twelve collared lambs were attacked but only 5 collars were actually punctured by predators. A total of 18 collars were accidentally punctured while 21 collars were lost. A total of three predators (2 coyotes and 1 bobcat, (_Lynx rufus_) were found dead. The only non-target believed to have been poisoned during the study was a skunk. The results of this study suggest that non-target exposure to 1080 from either feeding on the coyote carcass or the neck area of the collared livestock was low and did not result in any significant adverse ecological effects (Littauer, 1983).

As part of the registration requirements, the Registrant (USDA/APHIS) had to submit data/information on any non-target hazards resulting from the use of the 30 ml Livestock Protection Collar (LPC) that was collected as a result of its use in Montana, Wyoming, New Mexico, South Dakota and Texas (USDA/APHIS, 1991). The major findings from the actual use of the collar during 1988, 1989 and 90 as well as a report on the field and laboratory research conducted from 1978 to 1980 are as follows:

- the contents of a small portion (13%) of the collars placed on livestock were actually released into the environment. The total amount of 1080 involved in the release (assuming that each collar was completely emptied) was 88.2 grams. This is an average of 29.4 grams/year over the four state area where the collars were used (none used in South Dakota).

- there were no reports of deaths of non-target animals associated with the use of the LPC collars during this period.

- only limited scavenging occurred on coyote carcasses by 2 species of vulture and a caracara.

- livestock carcasses were scavenged by vultures, magpies, ravens, red-tailed hawks, caracaras, skunks and coyotes but none of these non-target species were poisoned as a result.

- scavenger species tended to feed mainly on viscera and muscle of hind quarters.

- of the 13% (294) of the collars, that had there contents released during the time period, only 5% (108) were punctured by coyotes.

II. EXPOSURE ASSESSMENT- ESTIMATED ENVIRONMENTAL CONCENTRATIONS

1080 residues on the necks of collared livestock

Knowlton and Ebbert (1991) conducted a physiologic marker study, using radio-labeled 1080, to determine the amount of 1080 likely to be consumed by the coyote and the amount of 1080 likely to occur on the necks of collared goats (*Capra* spp.) when the pouches on the 30 ml livestock protection collar were punctured. They found that the average amount of dispensed fluid from the 30 ml collar was 19.2 (11.9-27.8) mls, while the average amount of fluid ingested by the coyote was 1.0 (0.1-2.9) mls. The average amount of fluid contaminating the neck of the goat was 75 mg (range 39-118 mg) whereas the average amount of fluid not identified was 113 mg (range 0-234 mg.). It was also determined that, once punctured, the pouches containing the 1080 discharged over 85% of their contents, within a very short period of time, and that relatively little of the 1080 is actually ingested by the coyote (i.e., 6 of the 15 coyotes ingested less than 5mg in the process of killing the goat.

Savarie et al. 1990, also conducted a study designed to determine the amount of 1080 contamination likely to occur on the necks of collared lambs (*Ovis spp*.) that are killed by coyotes. They found that 12 1080-contaminated sheepskins contained an average of 96 mg 1080 with the range from 23 to 200 mg.

A comparison of the data between these two studies suggest that the amount of 1080 exposure on the neck of the collared livestock is similar regardless of the species of livestock. For instance the average amount of 1080 released from the collar in the goat study was 130 mg compared to 135 mg for the sheep study while the amount of lost or unaccounted for fluid from the collar was 5.6 mg for the goat study *vs*. 6.1 mg in the sheep study (USDA/APHIS, 1991b).

1080 residues in coyote tissue

Connolly (1980) reported on the amount of 1080 residues found in muscle tissues from captive coyotes that received known oral doses of 1080. At a known oral dose of 5.0 mg the residue in muscle was determined to be 0.10 ppm while the 10 mg dose resulted in muscle residues of 0.19 ppm. Based on this relationship, a coyote that ingests an average of 1 ml (10 mg) will have muscle tissue residues of 0.19 ppm 1080. The highest 1080 residue level found in muscle tissue was 0.93 ppm.

Compound 1080 residues in coyotes that have killed sheep wearing the 30 ml collar have also been determined (Burns et. al. 1984). They reported that the average 1080 residues for muscle tissue, stomach contents and vomitus, were 0.15, 0.5 and 0.35 ppm, respectively. The highest residue found occurred in the stomach contents and was 2.3 ppm.

Knowlton and Ebbert (1991) analyzed muscle tissue from 10 coyotes that were killed as a result of puncturing the collars. Residues were detected in the muscle of all the coyotes. The mean amount of 1080 in the muscle tissue was 0.089 ppm (range of 0.05 - 0.280 ppm) while the mean ± SE of 1080 lost from the 12 collars was 92 ± 56 mg (range from 3-183 mg).

III. HAZARD ASSESSMENT

Aquatic Hazard Assessment

Compound 1080 has been classified as being practically non-toxic to warmwater fish species and aquatic invertebrates, only slightly toxic to coldwater fish species (MRID# 42961603; 42961601; 42961602). The use of the collar is such that the likelihood of 1080 getting into any body of water is extremely low and has never been reported. Therefore, because of its low toxicity to aquatic organisms and because exposure is low, the EEB concludes that use of the collar does not exceed the Agency's unacceptable risk criteria.

Terrestrial Hazard Assessment

Non-target exposure from the use of the Livestock Protection Collars (LPCs) comes from four potential sources (1) contaminated sheep or goat carcasses with either broken (punctured) or unbroken collars (primary hazard) (2) toxicant that has been spilled on the ground/vegetation as a result of the collar being punctured (primary hazard) (3) the carcasses of the poisoned coyote that has not been found (secondary hazard) and (4) the vomitus of poisoned coyotes (primary hazard). Primary hazard has been defined as that effect which results from direct ingestion of the toxicant, while secondary poisoning can only result from scavenging the remains of an animal that has directly ingested the toxicant (Connolly, 1980).

i. Primary Hazards

Contaminated neck areas

The residue data clearly demonstrate that the greatest environmental exposure comes from 1080 contamination on the neck of the collared livestock. In the Knowlton and Ebbert study, the average amount of fluid contaminating the neck of the goat was 7.5 (3.9-11.8) mls. This amounts to approximately 75 mg of 1080 toxicant which clearly exceeds toxicity values for numerous birds and mammals that could scavenge the carcass and indicates that primary hazard to these scavengers is quite high. However, results of field studies suggest that mortality to scavengers, that feed on these carcasses, is minor. For example, it has been observed that vultures, magpies, ravens (Corvus corax), red-tailed hawks (Buteo jamaicensis), caracaras (Polyborus cheriway), coyotes and skunks all scavenged the carcasses of coyote killed collared livestock yet none of these non-target species were poisoned as a result (USDA/APHIS, 1991; Connolly, 1980; Littauer, 1983).

There are several factors that may account for this apparent discrepancy. First of all, because of the typical behavior of scavenging birds to feed at the wounds or openings in the carcass or where the skin has been torn away from the carcass (as opposed to feeding on the contaminated neck area), the likelihood of primary hazard to avian species such as the bald eagle (Haliaeetus leucocephalus) may be greatly reduced (USFWS, 1984 ; USFWS, 1985). For example, Connolly (1980), in order to simulate the primary hazard to non-target animals, conducted a series of tests exposing magpies and domestic dogs (Canis familiarus) to dead collared livestock. Although the dogs and magpies fed heavily on the carcass, neither the dogs nor magpies were poisoned. Connolly further observed that both the magpies and dogs tended to feed on the exposed parts (i.e. where the coyote had fed on the animal) of the dead livestock rather than on the neck area (where the highest contamination is likely to occur) and concluded that .."the intrinsic feeding behavior of scavengers confers a degree of protection against accidental poisoning by livestock collars.

Secondly, toxicity data suggest that, in general, birds, especially raptors, that are likely to scavenge dead carcasses, are less susceptible to 1080 poisoning than most mammals, especially canids (Haegele et al., 1984; Ward and Spencer, 1947 and Atzert, 1971). In addition, emesis has been clinically observed as being a early symptom of 1080 poisoning (Ward and Spencer, 1947) and may cause certain raptors to discontinue feeding before lethal amounts of 1080 are absorbed (Dana, 1971). This characteristic would greatly reduce exposure to raptors scavenging on livestock carcasses and, in addition, probably make them less likely to continue feeding on them.

Another factor that can greatly influence the extent of primary hazard is the fact that livestock carcasses decompose rapidly under field conditions which may render them unpalatable to many avian and mammalian species (Burns et al. and Connolly).

Spilled/lost toxicant

Based on the data presented by Knowlton and Ebbert (1991), the average amount of fluid not identified (lost) was 11.3 (0-23.4) mls or approximately 113 mg of 1080 (nearly 33% of the total amount in the 30 ml collar). It is believed that most of the unidentified fluid is spilled on the ground. The amount of fluid lost from the collar is not considered to be a primary hazard because 1080 exhibits a high degree of adsorption to vegetative material and is not likely to be carried from the site where it was deposited (Hilton et al. 1969). In addition, because fluoroacetate is rapidly broken down by soil bacteria and other organisms it is doubtful that spillage will pose any significant route of exposure to non-targets (David and Gardiner 1966). As such, the EEB believes that there is no real hazard to non-target organisms from the 1080 that spills on the ground as a result of the collar being accidentally punctured or deliberately punctured by the attacking coyote.

ii. Secondary Hazards-

Contaminated coyote tissue

Table 7 shows the approximate amounts of muscle tissue, stomach contents and vomitus, from coyotes killed with the 30 ml LPC, that scavengers would have to consume to obtain an LD50 of 1080 (Burns et al., 1984). These data suggest that secondary hazard to non-targets that may feed on a contaminated coyote is unlikely (Burns et al., (1984), Connolly, (1980) and Knowlton and Ebbert, (1991).

TABLE 7: Approximate amounts of tissue from coyotes killed with the 30 ml LPC that scavengers would have to consume to obtain an LD50 of 1080.

				Amounts that contain one LD50 dose		
Animal	Average wt.(kg)	LD50 (mg/kg)	LD50 dose (mg)	Muscle .15 ppm (kg)	Stomach 0.5ppm (kg)	Vomit 0.35ppm (kg)
Black vulture	2.0	15.0	30	200	60	85.7
Golden Eagle	4.54	5.0	22.7	151	45.4	64.8
Magpie	0.18	1.0	0.18	1.2	0.36	0.51
Coyote	11.4	0.1	1.14	7.6	2.28	3.25

Skunk	3.18	1.0	3.18	21.2	6.36	9.08

Muscle Tissue

Calculations show that most species would have to consume considerable amounts of contaminated muscle tissue, relative to their body weight, to obtain lethal dosages of 1080. For example, the black vulture, golden eagle and magpie would have to consume 100X, 33X, and 6.6X their body weights, respectively, to obtain an equivalent LD_{50} from just eating muscle tissue. Even the most sensitive species tested (i.e., the coyote) would have to eat approximately 67% of its body weight to get an LD_{50} from scavenging on the muscle tissue from a coyote killed by the 30 ml toxic collar.

Stomach Contents

Examination of Table 7 also shows that, because of the higher concentrations of 1080 present in the stomach contents, scavengers, which feed primarily on the viscera, may be at greater risk than those that feed primarily on muscle tissue. For example, the black vulture, golden eagle and magpie would have to consume 30X, 10X and 2x their body weight, respectively, to obtain an equivalent LD_{50} doses from eating the stomach contents. These data indicate that, under natural conditions, it is highly unlikely that scavengers could either find and/or consume sufficient quantities of contaminated coyotes to be secondarily poisoned from these carcasses.

Vomitus

Clinical observations suggest the 1080 exerts an emetic action, especially to canids which have digested more than an LD50 (Ward and Spencer, 1947 and TAMUS, 1983). Observations of coyote behavior made during the TAMUS study not only demonstrated this but also found that some coyotes would cache the vomitus (which may further reduce this source of exposure). Connolly (1980) reported that residue levels in vomitus from four poisoned coyotes ranged from below detectable limits (0.1 ppm) to 0.72 ppm. In addition, the average amount of 1080 in vomitus, from five coyotes that attacked sheep wearing the 30 ml collar, has been reported to be 0.35 ppm (USDA/APHIS, Unpublished Report, 1986). Although these levels may be toxic to certain species that are very sensitive to 1080, the EEB believes that it is unlikely that sufficiently large amounts of vomitus would ever be available and/or found by non-targets under field conditions to exceed the Agency's risk criteria. For example the coyote and skunk would have to consume 280.5% and 280% of their body weights, respectively, to obtain LD50 equivalents from eating vomitus. These calculations suggest that the coyote may be at risk from consuming vomitus, however, even if non-targets coyotes were to feed on the vomitus, it is doubtful, because the total amount of exposure associated with the vomitus is extremely low, that adverse effects would exceed the Agency's risk criteria.

Burns et al. (1986) also conducted a study to determine secondary effects to coyotes killed with single drop baits (SDBs) treated at 5 mg/bait. They found that the average 1080 residues in coyotes killed by the SDBs were 0.29, 0.30 and 0.31 ppm for muscle tissue, small intestines and the stomach, respectively. They concluded that these values were similar to those found in the 30 ml LPC study conducted by Connolly (1980). They also conducted a series of feeding tests to determine if there was any potential for secondary hazard to non-target animals that fed on coyotes poisoned by the SDBs. All of the removed tissue, except the gastrointestinal tract, was fed to 3 dogs (Canis familiaris), 3 coyotes, 4 striped skunks and 15 magpies for periods ranging from 14 to 35 days. The total amount of contaminated tissue consumed, and expressed as percent of body weight averaged 67% for dogs, 152% for coyotes, 117% for skunks and 371% for the magpies. Still, none of the test species exhibited any signs of 1080 poisoning or had any detectable 1080 residues in there tissue. Again, these data indicate that even if non-target species were to feed on the carcass of a coyote killed by the collar, it is highly unlikely that they could ingest sufficient quantities of the contaminated tissue to cause any secondary hazard.

Finally, As part of the registration requirements, the US. Fish and Wildlife Service, was required to conduct research on the potential secondary hazards to non-target organisms from the use of the 30 ml LPC. In order to simulate secondary poisoning, coyotes were administered doses of 4mg, 100 mg and 400 mg of 1080. Upon death, all the coyotes were skinned, eviscerated and all muscle tissue was removed from the skeleton. All the tissue, except the gastrointestinal tract, was ground-up and then fed (100 to 200 g) to stripped skunks, raccoons and opossums. Results of this study indicated that only those coyotes receiving more than 200 mg of 1080 would present any secondary hazard, and then only to those species that have a relatively low tolerance to the chemical (TAMUS, 1983). The dosages that caused effects greatly exceed those found to be administered to the coyote by the LPC and indicate that mortality to non-target from the operational use of the collar is unlikely.

iii. Total Collar Use

In addition to knowing residue levels, that are likely to occur in dead coyotes and/or on the necks of livestock, it is also important to put into perspective, from a hazard standpoint, just how many collars are likely to be used under typical coyote control operations. It appears, based on the results of several field studies, conducted in various states, that the total number of collars used and total amount of 1080 actually lost to the environment are both quite low. For example, in the study conducted in New Mexico, only 23 of 330 (7 %) collars were ever punctured and of the 23 only 5 (22%) were punctured by coyotes (Littauer, 1991).

During the three year study conducted in Wyoming, Montana, Texas and New Mexico only 294 out of 2257 collars (13%) were actually punctured and had their contents released to the environment. The total amount of 1080 involved in this release (assuming that each collar was completely emptied) was 88.2 grams. This is an average of 29.4 grams/year over the four state area where the collars were used. What is even more significant is that only 108 collars, out of the total 294 (36.7%) collars that were punctured, were punctured by coyotes. The total amount of 1080 released from collars punctured by coyote attacks (assuming that each collar was emptied) was 32.4 grams or an average of only 10.8 grams/year over the four state area. Additionally, data show that nearly as many collars (80 collars or 4%) were punctured from vegetation and other unknown causes as were punctured from coyote attacks. This source of 1080 exposure does not pose any primary or secondary hazards because neither the collared livestock nor attacking coyote become a source of exposure to scavenging by non-target organisms.

All of these data suggest that there is very little secondary hazard to non-target organisms that feed on coyotes killed by the LPC and/or their vomitus. Because such consumption is unlikely to occur under natural conditions, may explain why there have been so few field observations of mortality to non-target species that feed on coyotes that have been killed by the LPC.

Endangered Species

On March 21, 1985, the EEB requested formal Section 7 Consultation relative to the United States Department of Interior's Application to register Compound 1080 Livestock Protection Collar. On June 14, 1985, the USFWS-OES responded and concluded that the use of the 1080 collar, as proposed, with all the use directions and restrictions, posed no jeopardy to the bald eagle, San Joaquin kit fox, black-footed ferret (Mustela nigripes), and gray wolf (Canis lupus) but was likely to jeopardize the continued existence of the grizzly bear (Ursus arctos horribilus), Rocky Mountain wolf (Canis lupus irremotus) and California condor (Gymnogys californianus) (USFWS, 1985).

At this time the USFWS-OES provided specific state and county recommendations for avoiding adverse effects to the non-jeopardy species as well as reasonable and prudent alternatives for precluding jeopardy to the three species in jeopardy from the use pattern. Based on this information, the EEB developed specific endangered species label precautions and use restrictions for the 30 ml 1080 toxic collar. These use restrictions have been included in a Technical Bulletin that accompanies the labeling.

In 1987, as a result of informal consultation with field operations personnel from the USFWS, the EEB became aware that additional precautions, specifically addressing the use of the LPC in Texas, were required to protect both the ocelot (Felis pardalis) and jaguarundi (Felis yagouarundi cacomitei) (USFWS, 1986). These additional use precautions were reviewed by the Agency and subsequently included into the Technical Bulletin.

VII. SUMMARY

The major routes of exposure to nontarget wildlife, from the use of the Compound 1080 LPC, comes from four potential sources; (1) contaminated sheep or goat carcasses with either broken (punctured) or unbroken collars (primary hazard) (2) toxicant that has been spilled on the ground/vegetation as a result of the collar being punctured (primary hazard) (3) the carcasses of the poisoned coyote that has not been found (secondary hazard) and (4) the vomitus of poisoned coyotes (primary hazard).

Residue data indicate that the greatest exposure and potential for hazard comes from scavenging the neck area of the dead collared livestock and that secondary hazard from scavenging the carcass of the dead coyote and/or consuming vomit is highly unlikely to pose any unacceptable risk.

Results of feeding tests, simulated studies and actual field studies indicate that feeding behavior for many scavengers, decomposition of livestock carcasses, and the emetic nature of 1080 are all factors that greatly reduce the likelihood of exposure to non-target organisms below the Agency's level of concern. In addition, environmental hazard statements, special use restrictions, and endangered species protection statements, that are required to be placed on the label, greatly reduce primary hazard to non-target organisms including endangered species.

Based upon results of field studies, monitoring reports, low volume usage, environmental fate data which suggests that 1080 is not likely to get into aquatic habitats, and tissue residue analysis, that shows that the total amount of 1080 likely to be released into the environment is quite low, the EEB believes that the use of the Compound 1080 LPC will not exceed the Agency's unacceptable risk criteria for either non-target aquatic or terrestrial species.

VIII. LABELING

The current label precautions, restrictions, and directions regulating the use of the Compound 1080 Livestock Protection Collar are some of the most comprehensive and stringent for any registered pesticide. In addition to the standard environmental hazard statements and use restrictions, the label also contains 19 special use restrictions that regulate the use, and disposal of the collars as well as a Technical Bulletin that provides specific information regarding endangered species (Appendix I). The EEB believes that current labeling is adequate to protect non-target fish and wildlife resources.

IX. RISK MITIGATION MEASURES

The EEB believes that Technical Bulletin Use Restriction No. 8 should be modified to further reduce risk to non-targets. Specifically, The EEB believes that allowing use of the collar in areas where annual precipitation is less than 20 inches and the vegetation of the pasture is sparse makes very little difference in finding carcasses if topographical features are not considered. The EEB believes that very few, if any, ranching operations in the west could bear the additional expense or take the time to routinely ground search (every 7 days according to use restrictions) for dead animals that could be spread over a 15.6 sq. mile (10,000 acres) area. Instead the EEB recommends that fenced pastures should be limited to no more than 5,000 acres in size. Even with the use restriction, there will be some areas where an effective search for dead collared animals and/or the carcasses od dead coyotes would be greatly hindered by vegetative and topographical features. The current size limitation amounts to an open range use.

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- Larsen

APPENDIX 2
9-30-91

Technical Bulletin

for the

Sodium Fluoroacetate (Compound 1080) Livestock Protection Collar

EPA Registration Number: 56228-22

by

Guy Connolly

Wildlife Research Biologist

August 1989
Revised July, 1991

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Animal Damage Control
Science and Technology
Denver Wildlife Research Center
Denver, Colorado

ACCEPTED
with COMMENTS
In EPA Letter Dated:

SEP 30 1991

Under the Federal Insecticide, Fungicide, and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 56228-22

DON'T

-- waste time by placing collared animals where coyotes won't attack them

-- use collars if your livestock can be protected more easily or economically by other measures

-- use so few collared animals that coyotes won't find them

-- use more than 20 collars in any 100-acre or smaller pasture, or more than 50 collars per section (640 acres) of pasture (see page 18)

-- use collars on unfenced, open range (see page 14)

-- use collars where their use is prohibited to protect endangered wildlife (see page 16-17)

-- use collars without required authorizations from the Fish and Wildlife Service Endangered Species Office (see pages 16-17)

-- use contaminated animals for food or feed (see page 18)

-- use leaking or damaged collars

-- remove toxicant from collars

Section I. USER INSTRUCTIONS

A. INTRODUCTION AND THEORY

The Livestock Protection Collar (LP Collar), invented by Roy McBride of Alpine, Texas, exploits the coyote's habit of killing sheep and goats by bites to the throat (photo 1). As described in McBride's U.S. Patent No. 3,842,806 (issued in 1974), coyotes that attack collared livestock usually bite through the collars and receive oral doses of the contents. When used with a toxicant such as sodium fluoroacetate (Compound 1080), LP Collars kill the attacking coyotes. Collars may be used only by specifically certified LP Collar applicators or persons under their direct supervision (see Section II. 2). This Technical Bulletin is part of the EPA-approved labeling and contains detailed instructions for safe and effective use of LP Collars.

Coyotes' attacking and feeding behaviors do not seem to be affected by the presence of LP Collars. Attacking coyotes usually kill and feed upon collared animals just as they would if no collar were present. After a lethal dose of sodium fluoroacetate (Compound 1080) has been ingested, symptoms of intoxication typically do not appear for 2 or more hours. Death occurs from 2 to 7 hours (average 4 hour 20 minutes) after the collar is punctured.

When LP collars are used properly, coyotes may puncture them in 75 percent or more of their attacks. A 100 percent puncture rate is unlikely to be achieved because coyotes sometimes attack body sites other than the throat (photo 2).

Effective use of LP Collars requires not only that collars be positioned correctly, but also that coyote attacks be directed or targeted to collared livestock. Targeting may be difficult or impossible under some conditions. If coyotes are killing less than once per week, the collar technique may be impractical. Collars are recommended for ranches with high rates of coyote predation and management conditions that permit effective targeting of predations to collared livestock.

Experienced persons usually can evaluate local conditions quickly to decide whether or not LP collars will be effective. In addition to the basic problem of targeting, other factors to consider in deciding whether or not to use collars include availability and effectiveness of other control methods; costs of collars; labor requirements to

C. DESCRIPTION OF LP COLLARS

The LP Collar is a rubber bladder that contains a solution of Compound 1080, with neck straps for attachment to a sheep or goat. The type of collar used most up to 1985 has two Velcro[R] neck straps (0.75 inches wide and 22-24 inches long on new collars). Three-strap models also are available and are intended for use on goats. Each collar has two toxicant reservoirs that contain 150 mg (0.15 grams) of sodium fluoroacetate (active ingredient). Each collar contains a total of 300 mg (0.3 grams) of sodium fluoroacetate (active ingredient).

LP Collars of two sizes have been developed (photo 3), but the large collar has not yet been approved for field use. The small collar is intended for lambs and kids weighing from 25 to 50 pounds. LP collars are not recommended for small animals (under 25 lbs). A small collar, properly in place on a lamb, is shown in photo 4.

D. MANAGEMENT OF LP COLLARS ON SHEEP AND GOATS

1. Things to do before putting LP collars on livestock:

   a. Be sure you have enough LP collars (see Section E).

   b. Inspect all LP collars for leaks and inspect straps to be sure they are securely attached. Do not use leaking or torn collars (photo 7) or collars on which the straps are coming loose (photo 8). Loose straps may be reattached by sewing.

   c. Check the fence around the pasture where collared animals are to be placed and repair as necessary to keep animals within the pasture.

   d. Establish locations for warning signs (Appendix B), and be sure you have enough signs (see use restriction 10).

   e. Inform neighbors of your intent to use LP Collars and advise them of the potential hazards to free-roaming dogs.

enough that the applicator can insert 2 fingers between the strap and the animal. Collars stay in place well on animals with wool or mohair, but may be difficult to keep in position on newly shorn or slick-necked animals, particularly goats (photo 11). Head and neck conformation varies among animals and it may be impossible to keep collars in place on some individuals. They should be taken out of the collared flock.

d. A suitable method of permanently identifying individual animals in a target flock is required to keep track of LP collared livestock. One such method is the use of numbered ear tags. Tags that can be read from a distance of 50 feet or more are most useful (photo 15). If you are using ear tags, attach them before the animal is collared.

e. When the LP collar is in place, release the animal into a corral or other confined area and observe it carefully. Listen for labored breathing that may indicate the collar is too tight. When first released, collared sheep and goats often shake their heads, rub or make other attempts to rid themselves of the collars. This behavior will stop within a few hours if collars are not too tight. After you are satisfied that the collars are properly attached, move collared animals to the desired location.

f. Place warning signs at logical points of access (see Section II. 10 and Appendix B).

g. After handling LP Collars, wash your hands with soap and water.

3. Monitoring LP collared livestock

a. Once LP collared animals are in the desired location, the pasture should be checked every 7 days or more often if frequent predation is expected. During each check try to locate each animal and observe collars to be sure they are in position. If the collar has slipped out of position, catch the animal and reposition its collar. Inspect each animal's neck for yellow dye, which could indicate a punctured or leaking collar. If dye is seen, catch the animal and have been carried or dragged away by coyotes. Some were found as far as half a mile away from kill sites, but about half of the missing collars were never recovered. Coyotes sometimes cache (hide or bury) them. Whenever a collar is missing, make a reasonable effort to find it. See Section II. 11.

f. If you see an animal that you think may have been poisoned, report it promptly to the appropriate regulatory agency. Any suspected poisoning of threatened or endangered species must be reported immediately. See Section II. 6.

4. Handling LP collars and contaminated animal remains, vegetation, clothing, water and soil.

a. The toxic solution in the LP Collar contains a yellow dye, tartrazine, which is used as a marker for the presence of 1080 on punctured, damaged or broken collars; on clothing, animal remains, vegetation, soil, or other materials; and in water. Always use waterproof gloves when handling collars or any materials known to be contaminated by 1080.

b. Inspect carcasses of LP collared animals to determine the cause of death. When the carcasses are fresh (within 24 hours after death), coyote kills usually are obvious (photo 17). Remove punctured collars carefully and examine the punctures. Holes made by coyote teeth usually can be distinguished from accidental punctures. When collars are punctured by cactus thorns, the thorns sometimes remain in the holes (photo 18).

c. If the LP collar was punctured, remove it carefully to minimize leakage and place in a leakproof plastic bag or other container for transport to your disposal site. If necessary, doublebag to prevent leakage. Examine the carcass for contamination as indicated by yellow dye. Cut away the contaminated parts for disposal along with the punctured collar. See Section II. 12-13. Dispose of the remainder of the carcass using your normal practice. Cut or dig up contaminated forage and soil and place them in a leakproof container for transport to the disposal site.

Incineration may be used instead of burial for disposal in the field (preferably on property owned or managed by the applicator) at least ½ mile from human habitation and water supplies. Place collars and wastes (listed above) in an incinerator or refuse hole, saturate with diesel fuel, and ignite. Attend the burn until the contaminated material is completely consumed.

Alternatively, contact your State Pesticide or Environmental Control Agency or the Hazard Waste representative at the nearest EPA Regional Office for guidance in disposing of wastes at approved hazardous waste disposal facilities.

b. When snow or frozen ground make on site disposal impractical, up to one cubic foot of wastes may be stored in a leakproof container, in a dry, locked place for up to 90 days.

E. DIRECTING COYOTE PREDATION TO LP COLLARED LIVESTOCK

1. General Comments

The process of directing coyote predation to LP collared livestock is called targeting. Knowledge of targeting is in its infancy and should improve as more people gain experience with LP Collars. Three different approaches or targeting strategies are described here. Ranchers and predation control specialists are encouraged to apply these methods as necessary to achieve the best results in their own circumstances.

2. Targeting Strategies

a. Place LP Collars on vulnerable livestock. Collaring all sheep or goats on a ranch would solve the targeting problem. This strategy has not been tested due to the cost of collars and the large number that would be required in large flocks (over 100 animals). Nevertheless, in small flocks (50 or fewer animals) it may be practical to collar all the lambs or kids. In flocks with 50 to 100 lambs or kids, it may be worthwhile to collar the smallest 20 to 50 individuals. Do not use more than 20 collars in any pasture under 100 acres, or more than 50 collars per square mile of fenced pasture.

b. Placing collars where predation is too infrequent. In one such case, collared sheep were exposed for four weeks during which no predation occurred. The users then lost interest and removed the collars. There was no further predation on this ranch for several months. Collars cannot be used effectively where there is little or no predation.

c. Using target flocks that are too small. In a Montana trial, six LP-collared lambs were placed in a 640 acre pasture. Coyotes passed through the pasture without finding the collared animals and then killed sheep from a large flock in an adjacent pasture. The larger the flock, the more likely it is to attract coyotes. The optimum size for target flocks has not been determined, but pastures of 100 acres or more should probably contain at least 50 head.

d. Using target flocks that are not sufficiently isolated from uncollared livestock. On one small farm, a group of ewes and LP collared lambs was exposed while other sheep on the place were penned each night. Instead of killing in the collared flock, coyotes switched to a neighbor's unprotected flock half a mile away. With small farm flocks, adjacent land owners may have to work together to achieve effective targeting.

e. Using small collars on large sheep or goats. When small LP collars are used on large sheep or goats, the throat region is inadequately covered (photo 10). Coyotes frequently kill these animals without puncturing the LP collars.

f. Attaching collars improperly or insecurely. When LP collars are attached improperly, or they slip out of position (photo 13), coyotes will kill these animals but are unlikely to puncture the collars. LP collars in proper position are shown in photos 4, 5, 6, 11 and 16.

g. Placing collars on sick or cull animals. Placing collars on sick or cull animals in an effort to avoid sacrificing more valuable livestock may be false economy, as coyotes may not attack ill or lethargic animals. Collars should be used only on animals of the size and kind that coyotes have been killing locally.

(d) Instructions on record keeping.

4. Registrants or their agents shall keep records of all collars sold or transferred at their address of record. Records shall include the name, address, state where LP Collar certification was issued, certification number of each recipient, and dates and numbers of collars sold or transferred.

5. Each applicator shall keep records dealing with the use of LP Collars and the results of such use. Records shall be maintained in accordance with appropriate State or Federal regulations but for not less than two years following disposal or loss of collars. Such records shall include, but need not be limited to:

   (a) The number of LP collars attached on livestock.
   (b) The pasture(s) where LP collared livestock were placed.
   (c) The dates of each attachment, inspection, and removal.
   (d) The number and locations of livestock found with ruptured or punctured LP collars and the apparent cause of the damage.
   (e) The number, dates, and approximate location of LP collars lost.
   (f) The species, locations, and dates of all suspected poisonings of humans, domestic animals or non-target wild animals resulting from LP collar use.

6. Any suspected poisoning of threatened or endangered species must be reported immediately (within three days) to the Environmental Protection Agency[3], as will each suspected poisoning of humans, domestic animals or non-target wild animals.

7. Only the registrant or collar manufacturer is authorized to fill LP collars with 1080 solution. Certified applicators are not authorized to fill LP collars. Compound 1080 solution may not be removed from collars and used for any other purpose.

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[3]Robert A. Forrest (PM-14), Registration Division (H-7505-C), EPA, 401 M Street, SW, Washington, DC 20460.

If more than nine (9) LP collars are unaccounted for during any 60 day period, remove all collars from animals and terminate their use. Do not resume use until adequate steps have been taken to prevent further, excessive loss of collars.

12. Damaged, punctured, or leaking LP collars shall be removed from the field for repair or proper disposal. Damaged collars shall be placed individually in leakproof containers while awaiting repair or proper disposal. Authorized collar repairs are limited to minor repairs of straps and fastenings. Leaking or punctured collars must be properly disposed.

13. Dispose of 1080 wastes (punctured, leaking, or otherwise unrepairable LP collars; contaminated leather clothing, animal remains, wool, hair, vegetation, water, and soil) under three feet of soil, at a safe location, preferably on property owned or managed by the applicator and at least 1/2 mile from human habitations and water supplies. No more than 10 collars may be buried in any one hole. If buried in a trench, each group of 10 collars must be at least 10 feet apart.

Incineration may be used instead of burial for disposal in the field (preferably on property owned or managed by the applicator) at least ½ mile from human habitation and water supplies. Place collars and wastes (listed above) in an incinerator or refuse hole, saturate with diesel fuel, and ignite. Attend the burn until the contaminated material is completely consumed.

Alternatively, contact your State Pesticide or Environmental Control Agency or the Hazardous Waste representative at the nearest EPA Regional Office for guidance in disposing of wastes at approved hazardous waste disposal facilities.

When snow or frozen ground make on-site disposal impractical, up to one cubic foot of wastes may be stored in a leak-proof container, in a dry, locked place for 90 days.

Metal Container: Triple rinse contaminated and uncontaminated containers with water. Puncture and dispose of contaminated container and rinsate as above.

Plastic Container: Triple rinse with water. Then puncture and dispose of container and rinsate as above.

Michigan	Keweenaw (Isle Royal) and entire Upper Peninsula	Twin Cities, Minnesota 612-725-3576
Minnesota	Aitkin, Becker, Beltrami, Carlton, Cass, Clearwater, Cook, Crow Wing, Hubbard, Itasca, Kittson, Koochiching, Lake, Lake of the Woods, Mahnomen, Marshall, Pennington, Pine, Roseau, and St. Louis	Twin Cities, Minnesota 612-725-3576
Montana	Beaverhead, Carbon, Flathead, Gallatin, Glacier, Lake, Lewis and Clark, Lincoln, Madison, Missoula, Park, Pondera, Powell, Sanders, Stillwater, Sweet Grass, and Teton	Helena, Montana 406-449-5225
Washington	Pend Oreille, Okanogan (National Park and Forest Land), Skagit, and Whatcom	Boise, Idaho 208-334-1806
Wisconsin	Douglas, Florence, Lincoln, Oneida, and Price	Twin Cities, Minnesota 612-725-3576
Wyoming	Fremont, Park, and Teton and Yellowstone National Parks	Helena, Montana 406-449-5225