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# USE OF TOXICANTS FOR COYOTE CONTROL BY LIVESTOCK PRODUCERS IN ALBERTA

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ABSTRACT: This paper examines and evaluates the use of strychnine baits and cyanide guns for coyote (Canis latrans) control by livestock producers in Alberta. Livestock predation occurred almost exclusively during spring, summer, and fall; livestock predation was negligible during winter. In contrast, use of toxicants was negligible in spring, distributed rather evenly through the summer and fall, and most intense in mid-winter. Forty-eight percent of the producers set toxicants in response to predation, and 1/2 of these apparently resolved their predator problems. Fifty-five percent of the producers set toxicants for preventive control, predominantly during October-February when the effectiveness of control was probably negligible or at least minimal. Overall, the program may be less than 30% effective. The producer-training program must be re-examined in an effort to make coyote control more effective. Preventative control with toxicants, where necessary, should be conducted immediately prior to the whelping season or no more than a month in advance of anticipated livestock losses. Changes in livestock management must be emphasized.

## INTRODUCTION

Alberta Agriculture is responsible for control of coyote predation of domestic livestock in agricultural areas of Alberta. Since 1951, Alberta Agriculture has had a cooperative coyote control program with municipal governments. (A municipality in Alberta is comparable to a county in the United States.) This grass-roots program allows municipal governments to determine the intensity of coyote control within their boundaries. The primary objective of the program is to train livestock producers to resolve their own problems. The control program is characterized by an emphasis on the use of strychnine baits and cyanide guns on individual farmsteads; other methods of lethal control (e.g., trapping, denning, shooting) are not emphasized. Each municipality has a pest control officer-authorized to initiate coyote control upon request of a producer, or to train producers in the handling and setting of strychnine baits and cyanide guns. These toxicants are issued at the discretion of the pest control officer under a permit system. If the producer has no previous experience in the use of toxicants for predator control, the pest control officer normally visits the farmstead as part of the producer's training.

Since 1973, Alberta Agriculture has also employed 8 provincial predator specialists who assist producers with coyote control. Most often, lethal control is handled directly by predator specialists, with minimum assistance from livestock producers. Provincial predator specialists have handled a larger percentage of the requests for coyote control each year since 1973. In 1977, 2/3 of the requests for coyote control were handled by predator specialists. However, the producer-training program still plays an important part in coyote control in Alberta. In 1977, 42% of the producers who requested assistance with coyote control were authorized to use strychnine baits and cyanide guns; 80% were trained by municipal pest control officers and 20% were trained by provincial predator specialists.

Personnel responsible for predator control in Alberta have always assumed that the use of toxicants by producers was effective in reducing livestock losses. This assumption was based on casual observations and producer satisfaction. However, the program has never been formally evaluated to determine how effective producers were in reducing predation losses with toxicants. This paper examines the use of strychnine baits and cyanide guns for coyote control by livestock producers trained by municipal pest control officers in 1977, and attempts to evaluate effectiveness of control. The paper also examines use of toxicants for preventive control and control in response to predation.

## METHODS

Twenty-five percent of the producers who received toxicants from municipal pest control officers in 1977 were randomly selected and personally interviewed. Producers were asked numbers and species of livestock on their farms in 1977, predation losses in 1976 and 1977, months that predation occurred in 1977, predators responsible, months that toxicants were set, methods used to set the toxicants, frequency in which baits were checked, length of time baits were left out, species taken with toxicants, where toxicants were stored, whether or not coyotes were pelted, and whether or not they resolved their problem to their own satisfaction.

Use of toxicants was classified as either set in response to predation or set as a preventive measure. Toxicants set in response to predation were defined as those that were set after predation commenced but not later than 1 calendar month after predation ceased. Toxicants set as a preventive measure were defined as those that were set 1) before predation started, 2) later than 1 calendar month after predation ceased, or 3) when there had been no predation during 1977.

Control in response to predation was considered effective when toxicants were consumed or disappeared and when predation ceased no later than 1 calendar month after toxicants were set; e.g. predation must have ceased prior to September 1 when toxicants were set in July. I found no satisfactory method to evaluate effectiveness of preventive control.

RESULTS

Forty-three municipal pest control officers issued 4,418 strychnine cubes (175 mg strychnine alkaloid/cube) and 845 cyanide shells (Robinson 1943) to 275 livestock producers in Alberta in 1977. About 1/3 of the strychnine cubes were issued in a prepared pellet of approximately 20g of tallow and lard. Of the 70 producers selected for personal interviews, 63 set toxicants for predators, 5 were issued but did not set toxicants, 1 used toxicants for magpie control, and 1 refused to be interviewed.

Seventy-four percent of the producers reported predation losses in 1977, 6% had predation losses in 1976 but not in 1977, and 20% had no predation losses in either 1976 or 1977. Percentage of producers reporting predation losses of sheep and goats, cattle, ducks, and geese, and chickens was 29, 15, 19.and 26 respectively in 1977; 15% of the producers reported predation losses in more than one of the preceding classes of livestock (e.g. sheep and geese). Predation losses averaged 0.6% for calves, 2.0% for adult sheep and goats, 5.4% for lambs and kids, 12.6% for unconfined chickens, and 4.5% for unconfined ducks and geese. Extrapolating from the sample, total predation losses in 1977 for the 275 toxicant users were approximately 24 goats, 80 ewes, 500 lambs, 4 cows, 90 calves, 2,400 chickens, and 1,900 ducks and geese.

The coyote was reported responsible for 88% of predator-related losses; the remaining losses were attributed to either coyotes or dogs, red fox (Vulpes fulva), and mink (Mustela vison).

Predation losses were lowest during December-February when only 2 of 69 producers (3%) reported predation (Fig. 1). Predation of sheep and goats commenced in May, peaked in June and July, and gradually declined during the remainder of the year. Calf predation was reported every month during February-June. In addition, 1 producer reported the loss of a calf in September. One cow was reported killed by coyotes in March after she became stuck between 2 trees, probably in the act of defending her calf. Predation of chickens was 1st reported in April, peaked in July, and then gradually declined each month through November. Predation of ducks and geese tended to occur later in the year than other poultry, with peak predation reported during September and October (Fig. 1).

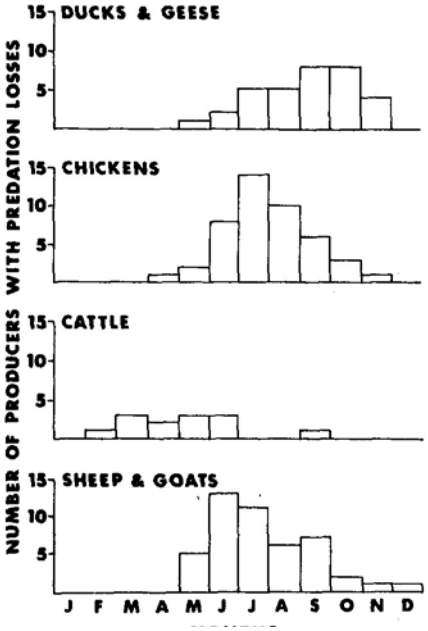


**Fig. 1. Monthly chronology of reported predation of livestock.**

Forty-three percent of the toxicants were set during December-February, even though only 3% of the producers reported predation during those months; coyote control was most intense in January when 22% of the toxicants were set, and was lowest during March-May when only 5% of the toxicants were set (Fig. 2). While predation occurred almost exclusively during spring, summer, and fall (Fig. 1), use of toxicants was negligible in spring, distributed rather evenly through the summer and fall, and then peaked sharply in mid-winter (Fig. 2).

Bait sites were restricted to a relatively small area on each farmstead; 78% of the producers set toxicants within an area of 65 ha or less, and no producer set toxicants on more than 260 ha.

Use of toxicants was compared during November-March and April-October. These intervals coincide roughly with snow-covered and snow-free months in Alberta. Mean number of cyanide shells and strychnine cubes set per producer was higher during November-March than during April-October (Table 1, $P < .05$). However, mean number of coyotes recovered per producer did not differ significantly between these intervals (Table 1, $P > .05$), although number of coyotes recovered by producers was more variable

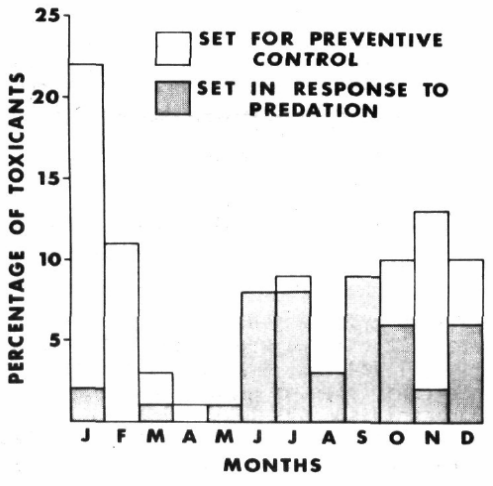


Fig. 2. Percentage of toxicants set each month in response to predation and for preventive control.

Table 1. Mean number of toxicants set and coyotes recovered.

| | Interval[a] | |
|---|---|---|
| | November-March | April-October |
| Number of producers setting | | |
| Strychnine baits | 24 | 28 |
| Cyanide guns | 10 | 9 |
| Mean number of toxicants set per producer | | |
| Strychnine cubes[b] | 21 (20.5) | 11 (9.6) |
| Cyanide shells[b] | 21 (22.9) | 6 (4.2) |
| Mean number of coyotes recovered per producer setting | | |
| Strychnine baits | 3.8 ( 6.9) | 1.2 (2.2) |
| Cyanide guns | 15.3 (23.6) | 2.3 (3.3) |
| Mean number of coyotes recovered per toxicant set | | |
| Strychnine cubes | 0.19 ( .21) | 0.12 ( .22) |
| Cyanide shells | 0.52 ( .31) | 0.28 ( .34) |

a. Standard deviations are in parentheses.

b. Means of rows are significantly different ($P<.05$).

during November-March than during April-October. Maximum number of coyotes recovered by a producer during April-October was 9 using strychnine and 9 using cyanide guns. In contrast, 1 producer reported taking 78 coyotes and another reported taking 30 coyotes with cyanide guns during November-March; these individuals accounted for 2/3 of the coyotes taken with cyanide guns during this interval. Similarly, 2 producers reported finding 30 and 15 coyotes that were poisoned with strychnine during November-March; these individuals accounted for 1/2 of the coyotes poisoned with strychnine and recovered during November-March.

Number of coyotes recovered per unit of toxicant (i.e., per strychnine cube and cyanide shell) did not differ significantly between November-March and April-October (Table 1, $P>.05$), even though baits were left in the field for longer periods of time during months of snow cover ($P<.05$). Toxicants were left in the field for an average of 3 months during November-March as compared to only 1 month during April-October. In general, during months of snow cover, baits were left in the field until they disappeared or until the following spring.

In summary, in terms of coyotes recovered, a small percentage of producers (probably less than 10%) used toxicants effectively during November-March. However, on the average, the ability of producers to kill coyotes with toxicants appeared comparable between November-March and April-October. It is possible that use of toxicants may be more effective, in terms of coyotes killed, during April-October considering that coyote carcasses were probably easier to find during months of snow cover (November-March) and the incentive to search for coyotes was greater when pelts were prime and salable.

Non-target species poisoned with strychnine were reported by 42 and 14% of the producers during November-March and April-October, respectively. Total number of non-target animals killed with strychnine was not determined. However, of the producers who found non-target species, 79, 14 and 7% reported killing black-billed magpies (Pica pica), ravens (Corvus corax), and dogs, respectively.

Non-target species were taken with cyanide guns by 6 of 19 producers (32%). Approximately 1 non-target animal was found for every 22 cyanide shells set. Non-target species reported taken were 7 striped skunks (Mephitis mephitis), 1 red fox, 1 white-tailed jack rabbit (Lepus townsendii), 1 dog, and 1 pig; non-target canid and non-canid species comprised 1 and 5 percent, respectively, of the reported kill. For comparison, non-canid species taken with the M-44 (sodium cyanide spring loaded ejector mechanism) comprised 4, 6, and 11 percent of the total reported kill in coyote control programs in Montana, South Dakota, and 11 western states, respectively (Matheny 1978).

Forty-eight percent of the producers set toxicants in response to predation; 46% of the toxicants that were set were included in this class. As might be expected, most of these toxicants were set during June-December (Fig. 2), when predation was most prevalent (Fig. 1).

Control in response to predation was considered effective when 1) toxicants were consumed or disappeared, and 2) predation ceased no later than 1 calendar month after toxicants were set; e.g. predation must have ceased prior to September 1 when toxicants were set in July. By this criterion, control measures were effective for 17 of 33 producers (52%). Similarly, 17 of 33 producers stated that their predation problems had been satisfactorily resolved.

Effectiveness of control in response to predation apparently was not related to the species of livestock involved or the type of toxicant used. Control measures in response to predation of sheep, cattle, and poultry were classified as effective and ineffective, respectively, for 7 and 6, 2 and 4, and 6 and 10 producers. Control measures were classified as effective and ineffective, respectively, for 14 and 12 producers who used strychnine and for 3 and 4 producers who used cyanide guns.

Fifty-five percent of the producers used toxicants for preventive control. These producers used 54% of the toxicants. Over 90% of these toxicants were set during October-February (fig. 2) when coyote pelts were salable. Apparently, producers believed that they could reduce the probability of predation the following spring and summer, and still obtain revenue from the sale of coyote pelts.

Of the producers who set toxicants for preventive control, 12 (32%) had no predation losses from coyotes during the previous 12 months. Three producers set toxicants during March and April to prevent calf predation, and 1 set toxicants in September to prevent predation of ewes. One producer set toxicants in February for wolf (Canis lupus) control, which is illegal. The remaining 7 producers set toxicants during November-February and were primarily interested in obtaining coyote pelts, but had little or no concern in preventing predation. I reached this conclusion from statements made during interviews, from the absence of livestock susceptible to predation, and from the sites where toxicants were placed.

Twenty-six producers (.38%) had predation losses during February-October and set toxicants 2-6 months later, as a preventive measure. Half of these individuals also set toxicants in response to predation.

I found no satisfactory method to evaluate effectiveness of toxicants used for preventive control. Seventeen producers set toxicants as a preventive measure during January-July 1977; with the exception of 3 producers who set toxicants during March and April, all had predation losses in 1977 after the toxicants were set. Whether or not predation would have occurred earlier or would have been more intense in the absence of preventive control was undetermined.

All individuals were aware that strychnine and cyanide are toxic to human beings. However, only 25% of the producers stored these toxicants in locked containers. Provincial regulations state that special warning signs must be posted in the area where coyote control devices are set; these regulations were adhered to by 88% of the producers. No person in the sample set baits closer than 400 m from an occupied building, other than his own, as specified by provincial regulations.

## DISCUSSION

Over 1/2 of the producers set toxicants for preventive control, primarily during October-February. Effectiveness of preventive control was undetermined. However, Griffiths et al. (1978) reported a significant negative correlation between numbers of coyotes taken in control operations during January-May and subsequent predation losses of sheep on a 1200 ha ranch in Washington state. Thus, preventive control apparently can be effective under certain conditions, one of which may be a large area. Preventive control on single farmsteads will probably reduce the probability of predation only if (1) individual coyotes habituated to killing and eating livestock during the previous spring, summer, or fall, are eliminated, or (2) local coyote populations are eliminated or sharply reduced during months when predation normally occurs.

When predation occurs, an immediate response should be encouraged rather than preventive control with toxicants 2-6 months later. Logically, the best time to eliminate coyotes that are killing livestock is at the time when predation occurs, because predation losses should be minimized and the probability of eliminating the offending individual should be greater. If control is delayed until the following winter, then the chances are greater that the toxicants will be picked up by coyotes other than the offending individual; viz. pups and individuals moving into the area. Further, many offending individuals would be eliminated without preventive control; Nellis and Keith (1976) reported mortality rates of 71% for coyotes between 0-1 years of age and 36 to 42% for coyotes over 1 year of age in central Alberta.

Number of coyotes removed from a farmstead may not necessarily reflect the effectiveness of preventive control, but instead may reflect the mobility of coyotes during the period of control. If coyotes are sedentary, the removal of a few individuals may eliminate or reduce numbers of coyotes on a particular farmstead. On the other hand, large numbers of coyotes may be removed from a farmstead without materially affecting coyote densities when coyotes are highly mobile, or during periods of dispersal. Effectiveness of control measures will depend, in part, on the mobility of the coyotes after toxicants have been removed. Since most toxicants were set in areas of less than 65 ha, minor changes in the distribution of coyotes could nullify effectiveness of preventive control measures.

Todd and Keith (1976) found that removal of agricultural carrion, a major food source for coyotes, resulted in movement and subsequent changes in distribution of coyotes during mid-late winter in central Alberta. L.D. Roy and M.J. Dorrance (unpublished data), working in the same area, recorded dispersal of coyotes that started in mid-February and continued through April. These movements probably negate or minimize the effect of preventive control on local coyote populations in central Alberta prior to mid-February. Moreover, mortality of coyotes is high during winter months. Large numbers of coyotes are taken by hunters; 11 of 29 coyotes radio-collared in central Alberta during January and February, 1977 and 1978 were killed by hunters prior to mid-March (L.D. Roy and M.J. Dorrance, unpublished data). Thus, many coyotes taken for preventive control during late fall and early winter would probably have died before spring anyway.

Knowlton (1972) suggested that where general suppression is warranted, the removal of coyotes would be most effective as dispersal wanes and immediately prior to the ensuing whelping season. Reductions would be additive to natural losses and would also remove part of the incipient reproduction. Efforts at this time have the additional advantage of removing coyotes just prior to the period when depredations are traditionally greatest. Because coyotes whelp during late April and early May in Alberta (Soper 1964), preventive control would probably be most effective during March-May and no more than a month prior to the date of anticipated livestock losses.

A delay in the initiation of preventive control until after March 1 would also ensure that producers were primarily interested in the reduction of livestock losses rather than procurement of pelts, for coyote pelts begin to deteriorate in late February and are generally not salable after mid-March. It is illegal to kill coyotes with toxicants in Alberta, except as specified by regulations enacted to control depredation or potential depredation of crops, livestock, and other property. Thus, use of toxicants solely to procure coyote pelts constitutes an abuse of the coyote control program. Twelve of the 69 producers interviewed had no predation losses from coyotes during the previous 12 months; 8 of these were interested primarily in the taking of pelts or in wolf control. These data provide an additional reason for not distributing toxicant for preventive control prior to March 1, particularly to those producers who had no documented predation losses in the previous year.

Control in response to predation was considered effective if predation ceased no later than 1 calendar month after toxicants were set. By this criterion, 52% of the producers who set toxicants in response to predation successfully resolved their own problem. However this may represent a maximum estimate of the effectiveness of toxicants, for some producers made management changes that were probably as effective as the use of toxicants, including semi-confinement of livestock and movement of livestock from 1 pasture to another. In other cases, vulnerability of livestock to predation may have diminished within the period designated for effective control. For example, calves are most susceptible to coyote predation within 1 month of birth and most calves are born within 2 or 3 months during spring in Alberta. Hence, control measures may have been considered to be successful for some producers, when in reality calves were no longer susceptible to predation. Similarly, ducks and geese were most susceptible to predation during September and October (Fig. 1). If toxicants were set in October, then by the criterion used in this study, control was considered effective if predation ceased prior to December 1. However, much of the success might be dependent upon the marketing of geese or changes in management with snowfall in November and consequently, changes in the susceptibility to predation. On the other hand, some producers were judged to be ineffective in resolving their problem, when in fact their livestock may have been preyed upon by several coyotes in succession. Thus, they may have removed an offending individual, only to be confronted with predation from another. Regardless, the estimate of the effectiveness of control in this study should serve as a yardstick for comparisons in future years.

The producer-training program must be re-examined in an effort to make coyote control more effective. Presently, this program may be less than 30% effective considering that only 1/2 of the producers were able to resolve their problems by setting toxicants in response to predation and less than 10% of the producers set toxicants for preventive control during March-May. Effectiveness of control was apparently not related to the type of toxicant used or species preyed upon. Effectiveness of control was probably related, at least in part, to the skill of the individual producer. Municipal pest control officers may not have sufficient expertise to adequately train livestock producers

Training should be conducted by professional predator specialists. Certain subjects can be presented to small groups at informal seminars; e.g., biology of coyotes, safety procedures, livestock management practices which reduce predation. However, most of the training should take place on the producer's own farmstead.

The location of baits within the farmstead is probably an important factor in determining the success of control operations; data presented by Matheny (1978) indicated that numbers of coyotes taken differed with M-44 placement location in Montana. The producer should be shown the most likely sites for bait placement. Thereafter, records of bait disappearance and coyotes recovered should be maintained so that the producer can set baits in the most promising locations in future years. There are probably other factors affecting success: e.g., certain livestock management practices may enhance the effective use of toxicants.

More importantly, changes in livestock management must be emphasized. Removal of agricultural carrion may be just as effective in reducing coyote populations as direct removal with toxicants. Todd and Keith (1976) found that the removal of agricultural carrion resulted in a significant reduction in coyote population densities during mid-late winter in central Alberta. Presently, Alberta Agriculture encourages farmers to remove carrion, and in fact, disposal of dead livestock is required under provincial regulations. Proper disposal of carrion should be a prerequisite to the receipt of toxicants for coyote control.

Twenty-six percent of the producers reported predation of unconfined chickens. Presently, the province pays compensation for predation losses of food-producing domestic animals, but does not pay compensation for predation losses of unconfined chickens because it is considered poor management to allow chickens to run at large. By the same logic the province should not assist with predator control for unconfined chickens.

Geese are largely herbivorous and do benefit from grazing. Ducks do not benefit from pasture but apparently do benefit from free access to water for swimming (Merritt and Aitken 1961; Snyder n.d.). Consequently, there is justification for not confining domestic waterfowl. Tests should be conducted to determine the effectiveness of barrier and electric fences for protection of domestic waterfowl. Without changes in management or control practices, coyote predation of poultry will be a recurring annual problem.

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