RESPONSE OF CAPTIVE COYOTES TO RENARDINE COYOTE REPELLENT

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ABSTRACT: Renardine[1] is a bone tar product available for use as a coyote (*Canis latrans*) repellent in Canada. The substance is applied to pasture borders to prevent coyotes from entering and attacking sheep. Because data regarding the effectiveness of Renardine are lacking, we designed two experiments. In the first, six pairs of coyotes were first presented with 400 g of ground meat in two pans (200 g/pan) with false screen bottoms. Beneath the screens were absorbent tubes wetted with 10 ml of distilled water. Subsequently, during a treatment period, the absorbent tube was wetted with 10 ml of Renardine. Pans were presented for 60 minutes, and the amount of time to consume the meat was recorded. In the second experiment, six additional pairs of coyotes were first presented with 200 g of ground meat inside a barrier created with baling twine and wooden dowels. The area inside the barrier was 1 m^2, and the twine was tied onto the dowels 0.25 m above the ground. During the treatment period, the twine and dowels were painted with Renardine. In both experiments, all coyote pairs consumed all of the ground meat shortly after presentation. We conclude that Renardine probably is not an effective coyote repellent. However, because the active ingredient in Renardine is bone tar oil and bone tar oil is deer repellent, we speculate that Renardine may have utility as an herbivore repellent.

KEY WORDS: *Canis latrans*, coyote, depredation, livestock, Renardine, repellent

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INTRODUCTION

Despite high interest, few non-lethal methods of coyote depredation management are available. Methods that do exist (e.g., various husbandry practices, fencing, frightening devices, guard animals) are expensive, sometimes difficult to implement, and often effective for short periods only (Knowlton et al. 1999). While a number of sensory (Burns and Mason 1997) and post-ingestive (Gustavson et al. 1974) repellents have been tested as cost-effective, non-lethal deterrents to predation, no effective strategy has been identified. Even under optimal circumstances, relief is temporary (Lehner 1987; Lehner et al. 1976). This lack of success may reflect the fact that killing and consumption are differently motivated; indeed, chemical repellents can readily deter coyotes when the act of predation is not the behavior of concern (Werner et al. 1997).

Recently, another chemical repellent became commercially available in Canada as a coyote deterrent. Renardine (Roebuck-Eyot, Bishop Aukland, County Durham, United Kingdom) is a bone tar and kerosine emulsion originally developed in the United Kingdom as a red fox repellent. The label instructions indicate that Renardine is to be applied to pasture borders to prevent mammalian predators from entering and killing livestock.

We designed the present experiments to test the potential efficacy of Renardine for two reasons. First, bone tar oil is a known repellent for herbivores (Denton 1967), but herbivore repellents often attract carnivores (Mason et al. 1994). Second, there is almost no evidence that repellents cause animals to abandon areas, except when highly palatable and easily obtained alternative foods are readily available nearby (Milunas et al. 1994). When alternative foods are scarce or not especially palatable, animals typically return to treated areas and resume damage (El Hani and Conover 1998).

[1]Mention of trade names and manufacturers is for identification only and does not imply endorsement by the U.S. Department of Agriculture.

MATERIALS AND METHODS

Tests were conducted between February and May 1999 in 0.1 ha pens at the Logan Field Station of the National Wildlife Research Center (NWRC), located 8 km south of Logan, Utah. Twelve male-female pairs of coyotes were arbitrarily selected to serve as experimental subjects. Throughout the experiment, all animals were provided with a normal daily ration of feed (ground meat) and water *ad libitum*.

Experiment 1

Six coyote pairs were randomly selected from the 12 pairs assigned to the study. During a two week adaptation period, in addition to their daily feed ration on Mondays through Fridays, each pair was given 400 g of ground meat in two aluminum pans (200 g/pan) placed 2 m inside the entrance to the pen. Presentations occurred about 60 minutes following presentation of the daily ration. Each pan had a false bottom, fabricated from a piece of hardware cloth (0.5 cm^2 squares). An absorbent tube, wetted with 10 ml of water was placed beneath the false bottom. Time to consume the feed was recorded.

A two week test period immediately followed adaptation. In addition to their daily feed ration on Mondays through Fridays, all pairs were again presented with 400 g of feed in aluminum pans with false screen bottoms. The absorbent tube beneath the screen was wetted with 10 ml of Renardine. Time to consume the 400 g of feed was recorded. These values were statistically evaluated in a two-factor repeated measures analysis of variance (ANOVA). The factors were period (two levels; adaptation, testing) and days (five levels).

Experiment 2

The remaining six pairs of coyotes were presented with ground meat inside barriers constructed with twine and four wooden dowels. As in Experiment 1, the ground meat was in addition to their daily feed ration on Mondays through Fridays, and testing occurred about 60 minutes after presentation of the daily feed ration. The area inside each barrier was 1 m^2 and the twine was tied onto the dowels 0.25 m above the ground. During the two week adaptation period, 200 g of meat was placed in the center of the space inside the barrier. As in Experiment 1, the time to complete feeding was recorded.

During a two week test period immediately following adaptation, all pairs were presented with 200 g of ground meat inside the twine and dowel barrier after the barrier was painted with Renardine. Time to complete feeding was recorded.

Mean times to complete feeding during adaptation and testing were calculated. These values were statistically evaluated in a two-factor repeated measures ANOVA. The factors were period (two levels; adaptation, testing) and days (five levels).

RESULTS

In Experiment 1, there were no differences among days ($p>0.25$) or between periods ($p>0.25$), and no interaction between periods and days ($p>0.50$; Figure 1). This was not the case in Experiment 2. In that study, there were differences among days ($F=3.8$; $df=4,20$; $p<0.02$), and an interaction between periods and days ($F=4.04$; $df=4,20$; $p<0.01$). The analysis was interpreted in terms of the interaction. Tukey *post-hoc* tests showed that times to complete feeding decreased during the adaptation period, and remained consistently low throughout the treatment period (Figure 2).

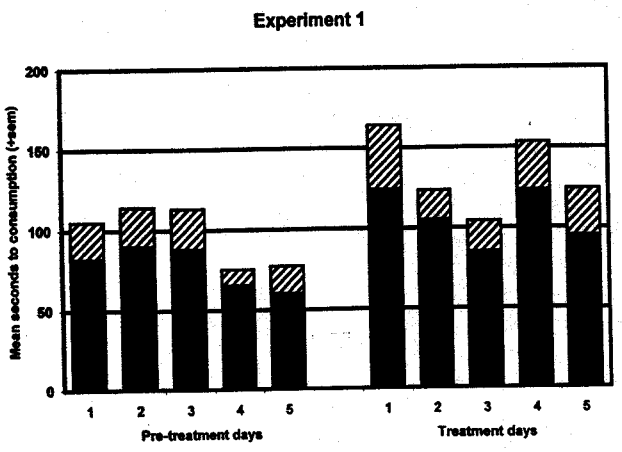

Figure 1. Time to consumption in Experiment 1 by pairs of coyotes presented with water (adaptation) or Renardine (test) beneath 400 g of ground meat in two pans (200 g/pan). Capped vertical bars represent standard errors of the means.

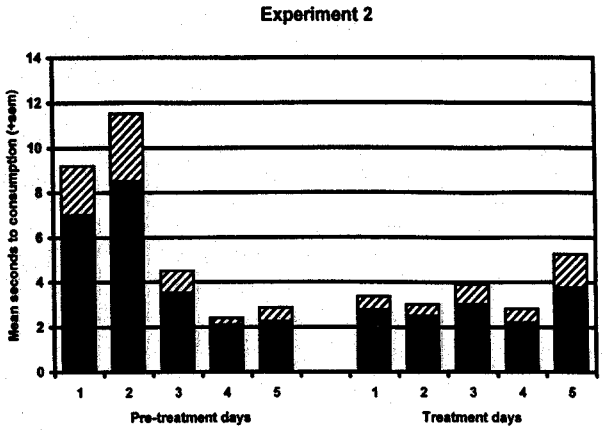

Figure 2. Time to consumption of feed in Experiment 2 by pairs of coyotes presented with 200 g of ground meat inside a barrier treated with water (adaptation) or Renardine (test). Capped vertical bars represent standard errors of the means.

DISCUSSION

We conclude that Renardine failed to repel coyotes either when placed just beneath food (Experiment 1), or when used as an odor barrier (Experiment 2). This lack of positive findings is consistent with other results suggesting that often coyotes fail to respond to topically applied chemical repellents (Burns and Mason 1997). Our results also are consistent with the broader observation that repellents rarely, if ever, prevent wildlife from entering areas, particularly when items within the repellent barrier are highly palatable (Milunas et al. 1994).

More generally, while sulfur-containing compounds rarely repel carnivores or omnivores, there is mounting evidence that they are broadly effective against herbivores, including deer (Milunas et a. 1994), elk (Andelt et al. 1992), mountain beaver (Nolte et al. 1993), beavers (DuBow et al., unpubl. obs.), and rabbits (Mason et al. 1999). There is anecdotal evidence that sulfur-containing deer repellents may attract canids (Bullard et al. 1978). One plausible explanation for these differences is that predator odors often contain volatile sulfur compounds and fatty acids (Mason et al. 1994). Accordingly, these substances should invite inspection by predators (carnivores and omnivores) because they signal the presence of potential competitors or mates. Prey (i.e., herbivores), on the other hand, should flee sulfurous odors because they may indicate the presence of danger (Melchoirs and Leslie 1985). Alternatively, or in addition, poisonous plants often emit volatile sulfur compounds. Herbivores should avoid these odors because they signal toxicity (Mason et al. 1999).

MANAGEMENT IMPLICATIONS

Renardine does not repel coyotes. In fact, on the basis of theoretical considerations, the substance might actually have been somewhat attractive. Sulfurous odors are often attractive to carnivores. Because the same odors often are aversive to herbivores, Renardine may have value as an herbivore repellent. Indeed, bone tar oil was the active ingredient in Magic Circle Deer Repellent (Denton 1967), a product that effectively repelled deer, and possibly, other herbivores as well (Benford and Lindsley 1979; c.f. Owen et al. 1984). Magic Circle is no longer available because re-registration cost more than the commercial value of the product (Federal Register 1993, 58(163):44826).

At present, the two most effective commercial deer repellents are Big Game Repellent and Plantskydd (Nolte 1998). Both of these repellents are effective, at least in part, because of sulfurous compounds. Because bone tar oil contains a variety of sulfur compounds that are qualitatively similar to those in Big Game Repellent and Plantskydd, Renardine warrants investigation as a herbivore repellent.

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