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Importance of Attractant Qualities for Improving a New Coyote Delivery System

Steven M. Ebbert
Texas Agricultural Experiment Station, College Station, TX

Daniel B. Fagre
Texas A&M University

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Steven M. Ebbert[2] and Daniel B. Fagre[3]

Abstract---Changes in effectiveness and nontarget species selectivity of a new system for delivering ingestible substances to coyotes (Canis latrans) were examined by systematically varying odor type and quantity used to attract coyotes to the device. The new delivery system's efficacy was comparable to the M-44 in our tests in south Texas. A synthetic lure improved the effectiveness of the delivery system when applied in amounts of 0.10 cc or 0.50 cc. Varying odor type did not increase the incidence of desirable coyote behavior, such as biting, but did increase rates of visitation.

INTRODUCTION

A new system for delivering certain types of ingestible substances to coyotes was developed recently based on studies of coyote behavioral responses to chemical odors. The Coyote Lure Operative Device (CLOD) was devised to take advantage of vigorous licking and chewing behaviors of coyotes responding to certain odors (Marsh et al. 1982). The intensity and duration of licking, biting, and pulling by captive coyotes increased when specific odors were applied to some bite-sized objects and combined with sweet tastes (Fagre et al. 1981).

The CLOD system (Marsh et al. 1982) is an integration of several components. A synthetic coyote attractant is applied to a sealed polyethylene bulb mounted over an acrylic stem and base. The CLOD is anchored to a metal stake driven into the ground. A sweetened syrup mixture, which can contain many types of active ingredients, is sealed inside the protective plastic bulb until the bulb is punctured. Coyotes are attracted to the CLOD by the synthetic attractant, and are exposed to the syrup mixture only after biting the bulb. The sweet taste of the syrup increases the likelihood of rapid consumption by coyotes. The CLOD is designed to prevent many nontarget species from being exposed to the syrup mixture. A hard stem inside the bulb is designed to prevent the CLOD from being crushed and/or broken open if trampled by ungulates.

This new delivery system for ingestible substances has potential as a coyote damage control method for toxicants or reproductive inhibitors, but also could deliver oral vaccines, biochemical markers, or combinations of these. If successful, the CLOD system may lead to greater flexibility in dealing with coyote damage problems.

Despite the potential of the CLOD system, there have been no comprehensive field tests involving high rates of coyote interaction with CLODs. South Texas has high coyote densities suitable for such field tests (Linhart and Knowlton 1975, Knowlton et al. 1986). As presently designed, the CLOD system depends upon odor stimuli to attract coyotes to the device and elicit specific behavioral

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[2]Steven M. Ebbert is a Graduate Research Assistant with the Texas Agricultural Experiment Station, College Station, Tex.

[3]Daniel B. Fagre is an Assistant Professor, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Tex.

responses. Odor type and intensity are known to be important for attracting coyotes to scent stations (Bullard et al. 1983) and could be important in eliciting specific behaviors. Coyote behavioral responses also may be a reflection of odor type (Bullard et al. 1983). The CLOD is effective only if specific behaviors (biting, pulling, licking) are elicited from coyotes. Development of the system was based upon specific responses to W-U lure by captive coyotes. As part of our efforts to evaluate and improve the new delivery system, we investigated the influence of odor intensity and type on the effectiveness and species selectivity of the CLOD, and compared the CLOD with another delivery device, the M-44.

STUDY AREAS

CLODs and M-44s were evaluated on several large properties in the Rio Grande Plains Region of southwest Texas. These properties had various coyote densities and previous intensities of predator control. In these tests, the rates of device visitation and types of behavioral responses directed to the devices were determined for coyotes and other animals by use of a modified scent station survey method (Turkowski et al. 1979).

MATERIALS

Delivery Systems

CLOD bulbs are low-density polyethylene 20-ml vials (R-vials[4], Tofunetics Co., San Jose, Calif.) used for storing biological samples and solutions (Marsh et al. 1982). These bulbs are filled with a 19:1 (by weight) corn syrup and powdered sugar mixture. The bulb mouths are trimmed to fit over stems with bases made of acrylic resin. The stems and bases, or cores, are drilled and tapped to screw onto bolts welded to 12 X 3/4-in angle-iron stakes. The stake is driven into the ground and anchors the CLOD.

M-44s are spring-loaded devices that forcibly eject sodium cyanide into or near a coyote's mouth when a baited capsule holder is pulled by the coyote. Ingestion of the cyanide is not deliberate. M-44s are widely used in Texas in efforts to control depredation by coyotes. The M-44 capsule holders were wrapped with 1 x 12-in red felt strips and boiled in paraffin. Plastic capsules containing sodium cyanide are usually inserted into these metal capsule holders, but in our tests, no cyanide capsules were used. Instead of capsules, rubber stoppers were inserted in the tops of the M-44s to prevent moisture and foreign matter from affecting ejector mechanisms.

Attractants

Four different attractants were tested: "W-U lure", "Mast's #6", "Carman's Canine Distant Call Lure" (CDCL), and "Abbreviated Synthetic Fermented Egg" (SFE DRC-6503). Three levels of the W-U lure were used in one test. CLODs and M-44s with no attractant were included in some tests to determine coyote and nontarget animal responses to device appearance.

W-U (Western Regional Research Center and the University of California-Davis) lure is a synthetic attractant that elicits biting and licking behavior from captive coyotes. The CLOD system was developed as a result of observing coyote responses to some chemical components of W-U lure. When applied to a bite-sized object and combined with a sweet taste, W-U lure has elicited vigorous biting and pulling from captive coyotes for as long as 10 min (Fagre et al. 1980). W-U lure is synthetic, so its constituents are known and remain constant between production batches. For these reasons, W-U lure was chosen as the standard attractant used with CLODs in our tests.

Mast's #6 is a commercially available fetid bait commonly used by animal damage control personnel in southwest Texas as a trap and M-44 attractant (Turkowski et al. 1979, 1983).

CDCL is a commercially available canid attractant. It has been evaluated as a coyote attractant in captive trials and in the field in several states. In an extensive study (Turkowski et al. 1979, 1983) in four states, CDCL was superior to 4 of the 6 other attractants tested. A similar unpublished study in Texas showed CDCL's superior ability to attract coyotes to scent stations[5].

Abbreviated SFE (DRC-6503) is a coyote attractant developed for the U.S. Fish and Wildlife Service West-wide coyote

[4]Use of product names does not imply endorsement.

[5]Martin, David. J., and Daniel B. Fagre. 1986. Field evaluation of a synthetic coyote attractant. Texas Chapter of The Wildlife Society Annual Meetings [Kerrville, Tex., Apr. 3-5, 1986].

abundance survey; it is a synthetic alternative to the more variable Fermented Egg Product (Bullard et al. 1978). The excellent attractant qualities of abbreviated SFE are well-documented (Bullard et al. 1978, 1983; Turkowski et al. 1979, 1983).

METHODS

Stations consisting of a 3-ft-diameter circle of sifted earth were established every 1/3-mile on alternate sides of ranch roads. A single experimental treatment (device/lure combination) was placed within each smoothed circle. The assignment of treatments to stations was randomized within each group of treatments. All stations were examined each morning and signs of animal activity were recorded. Coyote responses to odors at scent stations have been described by Turkowski et al. (1979) and Bullard et al. (1978, 1983). The device was only replaced if bitten (CLOD), pulled (M-44), or disturbed in a manner that might affect subsequent visitation. CLOD deliveries were usually characterized by severely torn or punctured bulbs with little or no syrup remaining. It was assumed an M-44 delivery would have happened if the ejector was triggered and there was definite animal sign within the 3-foot circle. If replacement was necessary, the same device type was replaced at the station and the same type and quantity of attractant was applied. Tests lasted an average of 6 days.

Response rates to treatments were calculated two ways. Treatment visitation rates were derived by dividing the number treatment stations visited by each species by the total number of station nights for that treatment. A station night is 1 treatment at 1 station for 1 night. Rates of behavior (such as ingestion rates) were calculated using the number of ingestions presumed to have occurred for each species divided by the number of visits by that species.

The first 2 tests were designed to determine the CLOD's potential for delivering ingestible substances to free-ranging coyotes by comparing visitation and delivery rates of CLODs and M-44s. W-U lure and Mast's #6 were used on CLODs and M-44s on a 10,000-acre private wildlife ranch and a 15,000-acre State Wildlife Management Area (WMA). The private ranch had continuing efforts to control predator damage using M-44s, snares, steel traps, and by shooting from the air and ground. On the WMA, there was no attempt to control predator populations or hinder their movements. However, on this property a few coyotes were killed each year by hunters. CLODs and M-44s without attractant also were used as controls on these properties. A total of 102 stations was established at the private ranch and 72 stations at the WMA.

In the test of odor intensity, 4 levels of W-U lure were applied to CLODs at 108 scent stations on a 70,000-acre livestock ranch to determine the influence of lure amount on coyote visitation and ingestion rates. The lure was diluted with acetone to maintain the same liquid volume while changing only the amounts of W-U lure applied to the devices. Acetone was chosen as the diluent because it rapidly vaporizes and leaves little residue (less than 0.001%), which minimizes possible interaction with the W-U lure. The 4 lure levels were: no lure and 0.50 cc of acetone, 0.02 cc lure and 0.48 cc acetone, 0.10 cc of lure and 0.40 cc acetone, and 0.50 cc of lure with no acetone.

After the optimum quantity of W-U lure was determined, other attractants were evaluated with CLODs for their ability to elicit appropriate coyote behaviors. A test was designed to determine responses of coyotes and nontarget animals to 2 commercially available lures and a different synthetic lure. CDCL, Mast's #6, and abbreviated SFE were selected. In previous field tests[5], these 3 attractants were effective at drawing coyotes to survey scent stations and eliciting specific behavioral responses, such as biting and pulling. On each CLOD, 0.5 cc of attractant was applied.

RESULTS

Field Evaluation of CLODs

After 780 station nights at the first test site (the private ranch) with predator control, overall coyote visitation rate was 4% (35) and device activation rate was 1.5% (12) (table 1). Significantly ($P < 0.05$) more coyote visits were recorded for stations with devices treated with W-U lure than Mast's #6. No significant differences for rates of coyote visits or deliveries were observed between the CLOD and the M-44.

In contrast to the ranch with predator control, coyote visitation was 41% (160) on the second study site (the WMA) without predator control after 390 station nights (table 2). This visitation rate was 10 times greater than the rate at the ranch with predator control. Also, 100 incidents of CLOD or M-44 activations by coyotes occurred at the WMA. Devices treated with W-U lure received signifi-

Table 1.--Frequency of coyote visits and deliveries to coyotes by treatments after 780 station nights at the ranch with predator control[1].

	VISITS			DELIVERIES		
ATTRACTANT	CLOD	M-44	Total	CLOD	M-44	Total
W-U Lure	7	10	17	4	4	8
Mast's #6	9	4	13	0	3	3
Control	1	4	5	0	1	1
Total	17	18	35	4	8	12

[1]Each device/attractant combination had 130 replications.

Table 2.---Frequency of coyote visits and deliveries to coyotes by treatments after 390 station nights at the WMA without predator control[1].

	VISITS			DELIVERIES		
ATTRACTANT	CLOD	M-44	Total	CLOD	M-44	Total
W-U Lure	33	35	68	24	26	50
Mast's #6	27	24	51	21	15	36
Control	28	13	41	12	2	14
Total	88	72	160	57	43	100

[1]Each device/attractant combination had 65 replications.

cantly ($P < 0.05$) more visits and resulted in more deliveries to coyotes than controls or devices treated with Mast's #6. Although there were no significant differences, more coyote visits and deliveries to coyotes were recorded by CLODs than M-44s.

Coyote responses to CLODs often appeared vigorous. Frequently, bulbs were pulled completely off the cores and pieces of the plastic component were found several yards from stations. Occasionally, stakes were pulled up several inches or completely removed from stations. Other coyote activities directed at the devices, such as rubbing and rolling, digging, defecating and urinating were indicated frequently more at CLODs than M-44s.

Odor Intensity Test

After 520 station nights, the number of stations receiving coyote visits was approximately equal for CLODs treated with 0.10 cc (13%) and 0.50 cc (12%) of W-U lure. Coyote visitation was slightly more for the 0.10 cc treatment during the first and second exposure nights, but the 0.50 cc level elicited more biting and chewing by coyotes. Coyote visitation rate was equal (4% each) for 0.02 cc treatments and controls.

Stations with the 0.10 cc and 0.50 cc levels received significantly ($P < 0.05$) more coyote visits than the 0.02 cc level and controls. However, the coyote ingestion rates were not significantly different for the two groups. It was decided to continue to apply 0.50 cc of W-U lure and other attractants to CLODs and M-44s in future tests.

Odor Type Test

CDCL and W-U lure were more attractive and resulted in a greater number of deliveries to coyotes than did Mast's #6 and abbreviated SFE (table 3). CDCL did as well as W-U lure at attracting coyotes to stations and was equally effective at eliciting coyote behaviors neces-

Table 3.---Frequency of coyote visits and deliveries to coyotes by treatments[1] after 400 station nights at the WMA.

LURE	VISITS	DELIVERIES
CDCL	31	13
W-U	24	10
Mast's	16	7
SFE	10	4
Total	81	34

[1]Each device/attractant combination had 100 replications.

sary for deliveries of the syrup mixture within the CLOD (table 3). No qualitative differences were noted for coyote behaviors elicited by these 2 attractants. However, CLODs treated with CDCL were visited by a greater variety of animals than were CLODs treated with W-U lure. Additionally, 3 deliveries to raccoons (Procyon lotor) were recorded at CDCL treated CLODs but no deliveries to raccoons were indicated for W-U lure treated CLODs during the same test.

DISCUSSION

CLODs have significant potential as a new delivery system because syrup mixture doses were effectively delivered to coyotes in these tests. Data indicated CLODs worked as well on the ranch (table 1) and better on the WMA than the M-44s (table 2). Therefore, CLODs are not inherently aversive to coyote populations, even those targeted by control programs. Because effectiveness and selectivity of CLODs werecomparatively better than for the M-44 device, the CLOD merits further attention and development.

The W-U lure proved to be a highly effective coyote attractant when used with M-44s and CLODs. More deliveries occurred with W-U lure than Mast's #6 because it attracted more coyotes to scent stations and elicited essential responses. Ratios of ingestions to visits for either device were similar for each odor. Additionally, the W-U lure appears to be more selective for coyotes since there were fewer nontarget wildlife visits to, and deliveries by, devices treated with W-U lure.

Coyote visitation rates differed greatly between the ranch with a predator control program and the WMA, possibly because of a lower coyote density and/or because coyotes on the ranch were inhibited from approaching the devices or attractants. In either case, when coyotes visited stations, the probability of them puncturing CLODs and ingesting the contents were similar to those on the WMA, the area not subject to predator control.

The effectiveness of W-U lure when used with a CLOD was greatest at the 0.50 cc level, not only because it was most effective in attracting coyotes to stations over a 5-day period, but also because it had a greater probability of ingestion. However, the 0.10 cc level of W-U lure was effective for a few days. Lesser amounts were ineffective. In other tests[5] 1.0 cc seemed repellent to some coyotes and visitation rates increased over several days as the lure dissipated. Bullard et al. (1982) concluded that odor quantity influenced a synthetic lure's attractiveness, and Turkowski et al. (1983) also found that abbreviated SFE was more effective at lower levels.

Apparently, both odor intensity and type are important attributes for attracting coyotes to devices, but in our tests, did not affect the probability of inducing deliveries to coyotes during visits. This is reaffirmed by the odor type test. If the lure was highly attractive, it worked well with the CLOD. One synthetic attractant (W-U) was more effective than another (SFE). One fermented trap attractant (CDCL) was more effective than another (Mast's #6). Although rates of coyote visitation and ingestion were similar for CDCL and W-U lure, species selectivity differed. The CDCL attracted more nontarget wildlife, which is undesirable both from the standpoint of potentially affecting other wildlife and reducing the CLOD's delivery rate to coyotes. At this time, W-U lure appears to be an excellent choice to use with the CLOD system in south Texas.

The CLOD system has many possible advantages over the M-44 device. CLODs have no moving parts and do not rely upon precise manufacturing to function properly. Unlike with leg-hold traps or M-44 devices, the angle iron stakes may be driven into hard ground, soft mud or sand to securely anchor the CLOD without risking malfunction of the device. The CLOD system's simplicity may make it more reliable.

Because CLODs need directed, specific, and persistent behavioral responses from coyotes to deliver active ingredients, other wildlife may be at less risk of exposure to the active ingredients. Generally, an upward pull on the M-44 capsule holder is necessary to trigger an M-44, whereas this type of distur-

bance alone would not be sufficient to activate a CLOD. The CLOD's bulb must be bitten hard enough to cause a puncture before the mixture is exposed. Incidental investigation of M-44s by other animals may have a higher probability of springing M-44s, resulting in nontarget deliveries or making devices inoperable when approached by coyotes.

The M-44 device depends upon a forcible delivery mechanism, which probably causes an aversion to the device or odor used if the coyote survives. The CLOD system, however, relies upon voluntary ingestion of the sweet syrup and so it can be used with substances needing multiple deliveries to be effective. Once punctured, the syrup in the CLOD insures ingestion by coyotes, but other wildlife, such as felids, may not respond as positively to very sweet tastes (Boudreau and White 1978).

Furthermore, the dosage of active ingredients inside CLODs may be calibrated so complete ingestion of the mixture is needed to achieve the desired effect. Several times in the field it was noted rodents and lagomorphs had successfully gnawed through the plastic bulb but apparently ingested very little of the contents. If the plastic-dipped device and synthetic odor is not perceived by animals as a potential food item, it generally may be less attractive to wildlife than other control methods.

Finally, the active ingredients are sealed inside a plastic bulb which minimizes external contamination. Undisturbed CLODs are easily removed from the field intact, and this facilitates retrieval of chemicals used in coyote control efforts.

SUMMARY

The CLOD system warrants further research development as an additional delivery system to use for coyote management. If odors can attract coyotes, the CLOD's design will encourage further interaction. Further improvements may be accomplished by varying the CLOD's physical aspects, such as size, shape, and structure.

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