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Effectiveness of color as an M-44 attractant for coyotes

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Abstract Coyotes (*Canis latrans*) rely on visual cues to detect prey, but the practical impact of such cues on the effectiveness of lures and attractants is poorly understood. We designed the present experiment to test whether color would increase detection and activation of sodium cyanide ejectors (M-44s) by free-ranging coyotes. At each of 4 study locations, we selected 6–14 experimental sites and then deployed unarmed M-44s at each site. We cleared a 1-m-diameter circle around each device so that we could record wildlife tracks. We placed 2-cm pieces of white-painted, rubber soaker hose over the cyanide cartridge sleeves of half of the M-44s. We placed sections of black-painted, rubber soaker hose over the cartridge sleeves of the remaining M-44s. We visited each site at 2-day intervals to record whether M-44s had been tripped. We also recorded species of wildlife that left tracks at each site, and general weather conditions. We categorized both visits and pulls by color and background type. Although number of visits did not significantly differ among sites, number of pulls did. Pulls were most frequent for white-topped M-44s against a no-snow background. Pulls were next most frequent for black-topped M-44s against either snow or no-snow backgrounds. White-topped M-44s against snow were not pulled. When the species visiting M-44s were examined, we found that more species visited sites and pulled M-44s in Ohio than Utah. We conclude that distinctive colors can be used to enhance M-44 pulls. Our finding that a number of species activate M-44s is inconsistent with other reports, and a topic for future research.

Key words attractant, *Canis latrans*, color, coyote, non-target species

Although chemical and auditory cues are important (Wells and Bekoff 1982, Gese et al. 1996), coyotes (*Canis latrans*) typically rely on visual cues to detect prey (Wells and Lehner 1978). However, the practical impact of visual cues as components of lures and attractants remains poorly understood (Fagre et al. 1983). This lack of formal investigation is surprising because visual stimuli (e.g., plastic strips, bones, feathers) are used to orient coyotes in relation to traps, snares, and other devices (Turkowski et al. 1983).

Recently, Mason and Burns (1997) showed that color could affect the distance at which captive coyotes would detect wooden dowels, as well as the likelihood that coyotes would approach and pull dowels from the ground. Colors that contrasted with the background were more effective than cryptic colors. We designed the present experiment to determine whether color would increase detection and activation rates of sodium cyanide ejectors by free-ranging coyotes.

Ejectors (hereafter referred to as M-44s) have been used in the United States for nearly 60 years (Connolly and Simmons 1984). They are registered to control coyotes, red (*Vulpes vulpes*) and gray (*Urocyon cinereoargenteus*) foxes, and feral dogs

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Table 1. Incidence of white and black M-44 pulls against snow and no-snow backgrounds.

Location	Background: Snow				Background: No-Snow			
	Black M-44		White M-44		Black-M-44		White M-44	
	n	%	n	%	n	%	n	%
Utah 1	4	50.0	0	0.0	2	20.0	8	27.6
Utah 2	0	0.0	0	0.0	1	10.0	5	17.3
Utah 3	3	37.5	0	0.0	1	10.0	1	3.4
Ohio	1	12.5	0	0.0	6	60.0	15	51.7
Total	8	100.0	0	0.0	10	100.0	29	100.0

(Connolly 1988). M-44s are purportedly selective for killing canids (Robinson 1943, Beasom 1974, United States Fish and Wildlife Service 1978, Dorrance 1980, Connolly 1988) and are more efficient (Robinson 1943) than steel leghold traps not modified with pan-tension devices. Devices consist of a hollow metal tube crimped closed at the bottom, a spring-activated plunger, and a sodium cyanide capsule holder (Andelt 1996). When the top of the ejector unit is pulled, the plunger is released, and it springs up through the capsule holder. The plunger breaks a container holding 0.78 g of cyanide, and the cyanide granules spray from the ejector into the mouth of the animal (Dolbeer et al. 1994). Typically, animals are enticed to bite M-44s with odor lures.

Study areas

Study locations were a ranch in Box Elder County, Utah, and the National Aeronautics and Space Administration's Plum Brook Research Station in Huron County, Ohio. We partitioned the Box Elder ranch into 3 sections of approximately 640 ha each. We considered each section to be a different location. We considered the Plum Brook facility as a single location.

Methods

Testing began during the first week of March and continued through April 1997. At each of the 4 locations, we randomly selected 6–14 experimental sites. All sites were approximately 40 m perpendicular to an access road and ≥0.75 km apart. We deployed an unarmed M-44 at each site. A 1.0-m-diameter circle around each M-44 was cleared of debris so that wildlife visits could be recorded and species identified by tracks.

We randomly assigned prepared sites to 2 groups (n=3–7/group/study location). We placed a 2-cm piece of white-painted, rubber soaker hose (2.5 cm diameter, Tenkor Apex Manufacturing, City of Industry, Calif.) over the cyanide cartridge sleeve of M-44s in the first group. We placed sections of black-painted, rubber soaker hose over the cartridge sleeve of M-44s in the other group. We selected white and black as test colors following Mason and Burns (1997), and because anecdotal reports (O'Gorman 1990) suggested that white attracts coyotes to M-44s in summer and black attracts them in winter.

We visited sites at 2-day intervals to record whether M-44s had been tripped. We recorded species of wildlife that left tracks in the circle around each M-44. Tripped M-44s were reset, and the dirt or snow around each unit was smoothed to obliterate animal tracks. We recorded general weather conditions (e.g., snow cover, cloud cover, rain, wind, ambient temperature).

We categorized both visits and M-44 pulls by color (black, white) and background type (snow, no-snow) for each species. Our operational definition of "no-snow" was less than 50% snow cover on the study area, or no snow within a 2-m-diameter circle of an M-44 (i.e., within a circle twice the size of the circle that was cleared for tracks around each device). We used single-factor analyses of variance to test for significant differences among categories. We used Tukey post-hoc tests to isolate significant differences among means.

Results

Although number of visits did not significantly differ (F=1.5; df=3,32; P<0.23) among M-44 color-background combinations, number of pulls

Figure 1. Black-topped and white-topped M-44s against substrate in Utah. When deployed, only the top protrudes from the soil surface.

Table 2. Incidence of visits to white and black M-44 pulls against snow and no-snow backgrounds.

Location	Background: Snow				No-Snow			
	Black M-44		White M-44		Black-M-44		White M-44	
	n	%	n	%	n	%	n	%
Utah 1	10	25.0	8	42.1	2	2.3	8	7.2
Utah 2	12	30.0	4	21.1	1	1.2	6	5.4
Utah 3	10	25.0	3	15.8	1	1.2	1	0.9
Ohio	8	20.0	4	21.0	81	95.3	96	86.5
Total	40	100.0	19	100.0	85	100.0	111	100.0

did differ (F=7.6; df=3,12; P<0.005). Pulls were most frequent for white-topped M-44s against a dirt (no-snow) background (Table 1). Pulls were next most frequent for black-topped M-44s against a no-snow background or black-topped M-44s against a snow background. White-topped M-44s against a snow background were not pulled. Numerically, visits appeared to follow the same pattern as pulls; however, excessive variability prevented detection of significant differences (Table 2).

Number of species visiting M-44 sites at the single experiment location in Ohio exceeded number of species visiting all 3 locations in Utah (Table 3). Ohio visitors were white-tailed deer (*Odocoileus virginianus*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), coyote, fox squirrel (*Sciurus niger*), red fox (*Vulpes vulpes*), house cat, and opossum (*Didelphis marsupialis*). Utah visitors were coyotes, mule deer (*Odocoileus hemionus*), bobcat (*Lynx rufus*), red fox, and black-tailed jackrabbit (*Lepus californicus*).

M-44s were activated by several species (Table 4). In Ohio, M-44s were pulled by raccoons, white-tailed deer, coyotes, skunks, and a house cat. In Utah, M-44s were pulled by coyotes and mule deer. Tooth marks in the soaker hose covering the cartridge holders suggested that most pulls were probably by mouth, regardless of species.

Discussion and management implications

Our results are consistent with the notion that distinctive colors may enhance M-44 pulls. White M-44s were more likely to be pulled against a no-snow background in either Utah or Ohio. Black M-44s were next most likely to be pulled; to us, the black tops contrasted with either the dirt or the snow background. White M-44s against a snow background were not pulled, presumably because of crypticity. Osterholm (1964) reported similar results for red foxes, which were attracted to colors that contrasted with the background. In particular, white strips of paper placed within 10 cm of meat baits enhanced bait discovery by foxes, especially on moonlit nights.

Although our data do not directly address the issue, size also may influence attraction. Studies suggest that small, strange objects (e.g., M-44s protruding from the soil) attract coyotes (Roughton and Sweeny 1982), whereas larger objects (e.g., 16 x 16 x 16-cm. wooden blocks) are avoided (Harris 1983, Windberg 1996). Approach and avoidance also may be influenced by the location of an object in relation to the territory of an animal. Coyotes are more susceptible to capture in unfamiliar areas of their home range (Woodruff and Keller 1982, Windberg and Knowlton 1990). Harris (1983) found that coyotes visit scent stations more readily in less familiar areas, and also that captive

Table 3. Species visiting white and black M-44s against snow and no-snow backgrounds.

Species	Background: Snow				No-Snow			
	Black M-44		White M-44		Black-M-44		White M-44	
	n	%	n	%	n	%	n	%
Deer	13	32.5	14	73.7	45	52.9	49	44.2
Skunk	0	0.0	0	0.0	5	5.9	7	6.3
Raccoon	1	2.5	1	5.3	22	25.9	22	19.8
Rabbit	0	0.0	1	5.3	0	0.0	0	0.0
Coyote	21	52.5	3	15.7	0	0.0	9	8.1
Fox	1	2.5	0	0.0	2	2.3	0	0.0
Cat	1	2.5	0	0.0	2	2.3	3	2.7
Opossum	0	0.0	0	0.0	0	0.0	2	1.8
Squirrel	0	0.0	0	0.0	3	3.5	3	2.7
Bobcat	3	7.5	0	0.0	0	0.0	0	0.0
Unknown	0	0.0	0	0.0	6	7.2	16	14.4
Total	40	100.0	19	100.0	85	100.0	111	100.0

coyotes are neophilic in unfamiliar enclosures but neophobic in familiar settings. Laundre and Keller (1981, 1983) reported similar observations. Collectively, these data suggest that coyotes are more neophilic in unfamiliar locations.

Table 4. Incidence of white and black M-44s pulled by species against snow and no-snow backgrounds.

Species	Background: Snow — Black M-44 n	Snow — Black M-44 %	Snow — White M-44 n	Snow — White M-44 %	No-Snow — Black-M-44 n	No-Snow — Black-M-44 %	No-Snow — White M-44 n	No-Snow — White M-44 %
Coyote	7	87.5	0	0.0	2	20.0	5	17.3
Deer	0	0.0	0	0.0	1	10.0	6	20.7
Raccoon	0	0.0	0	0.0	3	30.0	4	13.8
Skunk	0	0.0	0	0.0	1	10.0	3	10.3
Housecat	0	0.0	0	0.0	1	10.0	0	0.0
Unknown	1	12.5	0	0.0	2	20.0	11	37.9
Total	8	100.0	0	0.0	10	100.0	29	100.0

Our finding that a number of species activate M-44s is interesting, and inconsistent with other reports (Robinson 1943, Beasom 1974). We do not believe that using color, per se, was a determinant variable. Previous studies of M-44s have occurred in the western United States where non-target vertebrate densities are low compared with the those in the East. In the present experiment, pulls by species other than coyotes were highest in Ohio. When M-44s have been studied in locations with high non-target densities, deer and raccoons have been observed to pull them (R. Phillips, United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, personal communication). To reduce non-target pulls, specific colors or color-odor combinations might be useful. Recent studies suggest that some canids may possess dichromatic color vision (Neitz et al. 1989) with sensitivities between 429 and 555 nm. Possibly, blue or green could be used to attract canids (i.e., dogs, wolves, coyotes, foxes) without attracting deer or other species that exhibit indifference to color. This possibility is intriguing because M-44s could be used to deliver a wide range of pharmaceuticals besides toxicants, including sterilants, acaracides, and vaccines.

Figure 2. Test site in Ohio. The M-44 is positioned in the center of the raked circle.

Conclusion

Our findings are consistent with the notion that color may improve the detection and activation of M-44s. Pulls were most frequent for white M-44s against a no-snow background, and next most frequent for black M-44s regardless of background. White M-44s against a snow background were not pulled. At all study locations, M-44s were activated by species other than coyotes. In Utah, mule deer tripped devices. In Ohio, M-44s were pulled by raccoons, white-tailed deer, and striped skunks. The apparent lack of species specificity was unexpected and a topic for future research.

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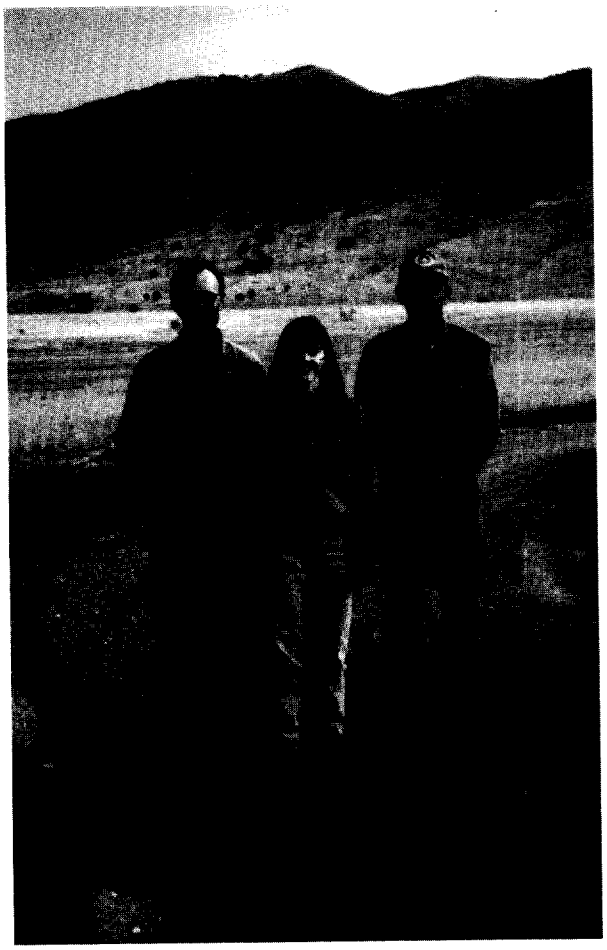

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