

Depredation Management Outside the Box: Logical Adaptations of Successful Practices with Other Species and Situations

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Abstract: Social, legal, biological, and political constraints dictate the need for new and improved methods of depredation management. One under-exploited approach to address these constraints may be the adaptation of methods from other damage management situations. We discuss several of these methods. Two examples are pre-baiting and diversionary feeding. The former is a standard feature of rodent control programs, but seldom if ever implemented with predators. We discuss preliminary evidence that pre-baiting increases the efficiency (and perhaps the selectivity) of some coyote management tools. Similarly, diversionary feeding is an integral component of black bear damage management for industrial timber in the Pacific Northwest. We are currently testing the hypothesis that diversionary feeding also reduces black bear depredation on livestock. Other plausible methods to reduce depredation include laser technologies, and habitat manipulation. Our efforts reflect the emphasis placed by USDA Wildlife Services and the National Wildlife Research Center on developing economically and ecologically sound strategies to manage predation on livestock, big game, and other wildlife species of concern.

Key Words: dilution baiting, diversionary feeding, habitat manipulation, lasers, livestock, predator management, pre-baiting, predators

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INTRODUCTION

New predation management tools and methods are being sought to address emerging concerns and situations (Mason 2001). Developments within the past few years include alternative capture devices (Mason et al. 2001), behavior-contingent frightening systems (Shivik and Martin 2000), and reproductive interference (Bromley and Gese 2001a,b; DeLiberto et al. 1998). These new tools are promising, but needs are continuing to expand, and few alternatives to traditional strategies are available for use in most situations (Knowlton et al. 1999).

The object of the present discussion is to suggest an alternative course of action for the identification and development of new depredation control techniques. In particular, strategies used to successfully manage other kinds of wildlife damage should be considered as potential tools for the management of predators and predation. To illustrate this point, we give three examples together with evidence in support of our contentions. These examples are by no means exhaustive, and we expect the reader to quickly come up with other candidate methods for evaluation and potential application.

ALTERNATIVE METHODS

Pre-baiting

This method is commonly employed to improve the effectiveness of rodent (Hygnstrom and Virchow 1994) and bird (Dolbeer 1994) control programs. Broadly, the practice involves the distribution of bait that is identical to the food items later used as the carrier for toxicant or other pharmaceutical substances. The underlying

assumption is that the target pest species becomes 'familiar' with the bait materials (i.e., neophobia for the bait is reduced), and subsequently, the pest is more likely to consume the bait when a toxicant or other pharmaceutical is added for control purposes. To our knowledge, pre-baiting has never been used as a method to improve the efficacy of predator management tools, with the arguable exception of draw stations, i.e., livestock carcasses placed to attract predators (typically coyotes, *Canis latrans*) to locations where capture devices are located or where they can be more readily shot.

During 1999-2000, we tested whether pre-baiting could improve the effectiveness of M-44 ejector units both in terms of the number of units activated and the time to first activation. M-44s have been used in the United States for nearly 60 years (Connolly and Simmons 1984). They are registered with the U.S. Environmental Protection Agency for the control of coyotes, red (*Vulpes fulva*) and grey (*Urocyon cinereoargenteus*) foxes and feral dogs (Connolly 1988). The 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 fires up through the capsule holder. This breaks the cyanide capsule, and sodium cyanide is sprayed from the ejector into the mouth of the animal. Typically, coyotes are enticed to pull M-44s with odor lures. Although the device is used at present only for the delivery of cyanide, it is an ideal mechanism for the delivery of other pharmaceutical substances, including

immunosterilants and vaccines (Mason et al. 1999).

For our test of pre-baiting, marshmallows scented with fatty acid scent (FAS) and dyed to contrast with background coloration were distributed in several locations seven days before we placed M-44s. We chose this bait combination for several reasons. First, captive coyotes are attracted to small items colored to contrast with background vegetation (Mason and Burns 1997), and in field tests, coyotes are more likely to activate M-44s with tops colored to contrast with the background, in the absence of any odor lure (Mason et al. 1999). Second, coyotes are strongly attracted to sweet tastes (Fagre and Ebbert 1988, Mason and McConnell 1997). This affinity for sweet (i.e., disaccharide sugars) adds a degree of species selectivity because sugars are unattractive to felids (Beauchamp and Mason 1991). Finally, marshmallows are easily distributed as pre-bait and approximately the same size and shape as M-44 tops.

At the end of the pre-baiting period, we placed M-44s in the pre-baited locations and in locations that had not been pre-baited. The M-44s were baited with colored marshmallow topping and FAS. One week later, 70% of the M-44s in the pre-baited locations were activated by coyotes, compared with only 20% in the controls areas that had not been pre-baited.

Pre-baiting may be useful with other tools and candidate methods, e.g., the Coyote Lure Operative Device or CLOD (Fagre and Ebbert 1988). Essentially, the CLOD is a thin-walled plastic container covered with black wax, attached to the top of a metal stake. The stake is driven into the ground so that the bottle is 4-5 cm above the surface. Odor attractant is applied to the outside of the bottle, with the aim of inducing coyotes to bite the bottle, exposing them to the contents. Besides using attractive chemical cues to attract coyotes to interact with CLODs, pre-baiting could be used to familiarize resident animals with the devices prior to their use as a control tool.

Dilution Baiting

This method is similar to pre-baiting, except that untreated and treated materials are distributed simultaneously, and untreated materials are distributed at relatively higher densities. The underlying assumption is that the target species will rapidly encounter baits, and develop a foraging search image or 'Umwelt' specific (Von Uexküll 1934) for the untreated and treated materials. This strategy has been employed successfully in toxicant-baiting programs for blackbirds (*Agelaius* spp., Besser 1978) and rodents (M. Fall, pers. comm.) but it has not been formally applied to depredation management. Using the example of marshmallows and M-44s, it is conceivable that placing M-44s baited with marshmallow topping, food coloring, and FAS in the field concurrent with scented, colored marshmallows could enhance M-44 success. An interesting and testable corollary is the determination of the optimal densities for marshmallow baits relative to M-44s.

Diversionsary Feeding

In the Pacific Northwest, supplemental feeding is a key element of management plans to reduce black bear (*Ursus americanus*) damage to trees in industrial timber stands (Ziegler 1994, Ziegler and Nolte 1997). Containers of a specially formulated high-protein sweet feed are placed in locations that are easily accessible to bears and where damage to timber has been documented or is anticipated. The containers remain in the field from spring through early summer. Although costly, the supplemental feeding program is an effective component of an integrated damage management plan that includes the lethal removal of problem bears and silvicultural practices that minimize damage potential. Studies have failed to find any evidence that feeding increases bear populations in problem areas or that it makes bears more susceptible to baiting (Witmer et al. 2000). There is no evidence that attracting bears to feeders increases fighting among adults or aggression by adult males against cubs (Witmer et al. 2000). Whether or not feeders might serve as a transmission point for disease remains unevaluated and a potentially important topic for investigation.

Besides damage to industrial timber, supplemental feeding may be a useful component of integrated strategies to manage black bear depredation on livestock. Black bears can be important predators of both cattle and sheep, especially during dry years when natural foods are scarce (Wade and Bowns 1984). We initiated a test of this possibility during the summer of 2001 in central Utah on a cattle allotment where bear depredation on cattle was an annual problem. In June, feeders were placed on the allotment in locations where bears had previously been trapped. A bear or bears discovered the feeder within 10 days and consumed more than 46 kg of feed during a 4-week period. Although livestock losses occurred annually in each of the 5 years preceding implementation of supplemental feeding, no loss was experienced during 2001. Tests of supplemental feeding as a bear depredation management strategy will continue in Utah as permitted by the Department of Wildlife Resources.

An important caveat is that supplemental feeding may be more useful in some settings and with some predators than in/with others. In the instances described here, bears were fed for relatively short periods of time and never for more than 3-4 months annually. Different results might prevail if supplemental feeding were practiced for longer periods of time. Likewise, the motivations for black bear damage to timber or predation on livestock may be different than the motivations for coyote depredation on sheep or grizzly bear (*Ursus horribilis*) depredation on cattle. Whether or not this is the case remains an important and interesting topic for investigation.

Habitat Manipulation

Removal of nesting and breeding cover can reduce blackbird damage to crops at the same time that it improves habitat for waterfowl (Homan et al. 2000).

Likewise, there may be situations in which habitat manipulations can decrease risks of livestock depredation while simultaneously improving habitat for large and small game, or threatened and endangered species. For example, invasive exotics, such as tamarack (*Tamarix ramosissima*) or undesirable native vegetation, such as dense stands of juniper (*Juniperus communis*), can negatively impact certain species of concern (e.g., sage grouse, *Centrocercus urophasianus*) and provide cover for predators (Mason 2001). Removal of this vegetation by prescribed burning or other methods (e.g., chaining, herbicide application) can simultaneously improve habitat for native species and diminish predation risk (S. Horn, pers. commun.). Application of this strategy is situation and context specific. Whether or not benefits obtain depends on a variety of factors, including the possibility that the removal of the vegetation for depredation management could have negative (rather than positive) impacts on other wildlife species (Mason 2001).

Laser Frightening Devices

Lasers have been used to effectively to disperse roosting by a variety of avian species (Soudat-Soucaze and Ferri 1997, Glahn et al. 2000). Typically, dispersal lasers employ red light at wavelengths between 660-665 nm. Not surprisingly, these same lasers are ineffective against mammalian pests, since mammals are generally insensitive to red light. However, blue-green lasers (at wavelengths of approximately 500 nm) could potentially be very effective against mammals, particularly crepuscular species including coyotes. Psychophysical evidence suggests that canid predators are exquisitely sensitive to light at the blue-green end of the visual spectrum (Horn and Lehner 1975). The intriguing possibility exists that argon (blue) lasers could be used to create 'barriers' between predators and livestock or implemented as a non-invasive method to disperse predators in campgrounds or at dumps. Deterrence might be further enhanced by pairing laser presentations with other frightening devices, including sonic-effigy systems.

DISCUSSION

While many effective bird and rodent management methods may be applicable to depredation management, there are other strategies that may not readily transfer. A case in point are conditioned taste aversions, the mechanism underlying the effectiveness of a variety of commercially available repellent chemicals including thiram, ziram, anthraquinone, and methiocarb (Conover 1982, Reidinger and Mason 1983, Thomson 1995). Conditioned aversions can occur after a single experience, particularly when the intensity of sickness is great and the taste, food, or flavor is novel (Beauchamp and Mason 1991, Pelchat et al. 1983, Riley and Tuck 1985).

Taste-based aversion learning has been investigated as a means of reducing depredation by coyotes, resolving nuisance feeding by black bears (Ternent and Garshelis 1999), and curtailing egg predation by raccoons (*Procyon*

lotor), skunks (*Mephitis mephitis*), mongooses (*Herpestes nyula*), ravens, and crows (*Corvus* spp., e.g., Nicolaus and Nellis 1987; Nicolaus et al. 1982, 1983; Semel and Nicolaus 1992). In general, when the object is to prevent consumption or gnawing, this strategy is effective. However, killing (as opposed to consumption) is often unaffected, and ranchers who have tried aversion learning as a depredation control strategy have rejected the method as ineffective (Conover and Kessler 1994).

CONCLUSION

Depredation management is technically complex and socially controversial. Despite considerable research effort and impressive technical advances (Fall and Mason 2002), much remains to be done. Despite growing needs for new methods, few tools are available, particularly when non-lethal management solutions are desired. A largely unexplored possibility is the application of methods from other fields of wildlife damage management to predator control. We have suggested several obvious possibilities here, but other unexplored possibilities undoubtedly exist. An important caveat is that predation management, like other forms of wildlife management, is context and situation specific. Care must be taken to assure that empirical data are collected prior to the recommendation of any method for depredation control.

LITERATURE CITED

- ANDELT, W. F. 1996. Carnivores. Pp.133-155 in: P. R. Krausman (ed.), Rangeland Wildlife. Society for Range Management, Denver, CO.
- BEAUCHAMP, G. K., and J. R. MASON. 1991. Comparative hedonics of taste. Pp. 159-183 in: R. C. Bolles (ed.), The Hedonics of Taste. Lawrence Erlbaum Associates, Los Angeles, CA.
- BESSER, J. F. 1978. Birds and sunflower. Pp. 263-278 in: J. F. Carter (ed.), Sunflower Science and Technology. American Soc. of Agronomy, Crop Science Soc. of America, and Soil Science Soc. of America, Madison, WI.
- BROMLEY, C., and E. M. GESE. 2001a. Surgical sterilization as a method of reducing coyote predation on domestic sheep. *J. Wildl. Manage.* 65:381-390.
- BROMLEY, C., and E. M. GESE. 2001b. Effects of sterilization on territory fidelity and maintenance, pair bonds, and survival rates of free-ranging coyotes. *Can. J. Zool.* 79:386-392.
- CONNOLLY, G. E. 1988. M-44 cyanide ejectors in the Animal Damage Control program. *Proc. Vertebr. Pest Conf.* 13:220-225.
- CONNOLLY, G. E., and G. D. SIMMONS. 1984. Performance of sodium cyanide ejectors. *Proc. Vertebr. Pest Conf.* 11:114-121.
- CONOVER, M. R. 1982. Behavioral techniques to reduce bird damage to blueberries: methiocarb and hawk-kite predator models. *Wildl. Soc. Bull.* 10:211-216.
- CONOVER, M. R., and K. K. KESSLER. 1994. Diminished producer participation in an aversive conditioning

- program to reduce coyote depredation on sheep. *Wildl. Soc. Bull.* 22:229-233.
- DELIBERTO, T. J., E. M. GESE, F. F. KNOWLTON, J. R. MASON, M. R. CONOVER, L. MILLER, R. H. SCHMIDT, and M. HOLLAND. 1998. Fertility control in coyotes: is it a potential management tool? *Proc. Vertebr. Pest Conf.* 18:144-149.
- DOLBEER, R. A. 1994. Blackbirds. Pp. E25-E32 *in*: S. E. Hygnstrom, R. M. Timm, and G. E. Larson (eds.), *Prevention and Control of Wildlife Damage*. Cooperative Extension, University of Nebraska, Lincoln.
- FAGRE, D. B., and S. M. EBBERT. 1988. Development and testing of the coyote lure operative device. *Proc. Vertebr. Pest Conf.* 13:235-240.
- FALL, M. W., and J. R. MASON. 2002. Developing methods for managing coyote problems— another decade of progress, 1991-2001. *Proc. Vertebr. Pest Conf.* 20:194-200.
- GLAHN, J. F., G. ELLIS, P. FIORNELLI, and B. S. DORR. 2000. Evaluation of moderate- and low-powered lasers for dispersing cormorants from their night roosts. *Proc. Wildl. Damage Manage. Conf.* 9:34-45.
- HOMAN, H. J., G. M. LINZ, R. L. WIMBERLY, and B. D. PEER. 2000. Cattail management: developing, implementing, and refining a nonlethal method to reduce sunflower damage by blackbirds. *Proc. Sunflower Workshop* 22:183-185.
- HORN, S. W., and P. N. LEHNER. 1975. Scotopic sensitivity in coyotes (*Canis latrans*). *J. Compar. Physiol. Psychol.* 89(9):1070-1076.
- HYGNSTROM, S. E., and D. R. VIRCHOW. 1994. Prairie dogs. Pp. B85-B92 *in*: S. E. Hygnstrom, R. M. Timm, and G. E. Larson (eds.), *Prevention and Control of Wildlife Damage*. Cooperative Extension, University of Nebraska, Lincoln.
- KNOWLTON, F. F., E. M. GESE, and M. M. JAEGER. 1999. Coyote depredation control: an interface between biology and management. *J. Range. Manage.* 52:398-412.
- MASON, J. R. 2001. Management alternatives relative to predators. Pp. 17-28 *in*: T. F. Ginett and S. E. Henke (eds.), *The Role of Predator Control as a Tool in Game Management*. Texas Agricultural Extension Service, Texas A&M University, San Angelo.
- MASON, J. R., A. E. BARRAS, J. W. GUTHRIE, and J. BELANT. 1999. Effectiveness of color as an attractant on M-44s for coyotes (*Canis latrans*). *Wildl. Soc. Bull.* 27:86-90.
- MASON, J. R., and R. J. BURNS. 1997. Coyote responsiveness to novel visual stimuli. *J. Wildl. Res.* 2:6-8.
- MASON, J. R., and J. A. MCCONNELL. 1997. Hedonic responsiveness of coyotes to 15 aqueous taste solutions. *J. Wildl. Res.* 2:21-24.
- MASON, J. R., J. A. SHIVIK, and M. W. FALL. 2001. Chemical repellents and other aversive strategies in wildlife management. *Endangered Species Update* 18:175-181.
- NICOLAUS, L. K., J. F. CASSEL, B. B. CARLSON, and C. R. GUSTAVSON. 1983. Taste-aversion conditioning of crows to control predation on eggs. *Science* 220:212-214.
- NICOLAUS, L. K., T. E. HOFFMAN, and C. R. GUSTAVSON. 1982. Taste aversion conditioning in free-ranging raccoons, *Procyon lotor*. *Northwest Sci.* 56:165-169.
- NICOLAUS, L. K., and D. NELLIS. 1987. The first evaluation of the use of conditioned taste aversion to control predation by mongooses upon eggs. *Appl. An. Behav. Sci.* 17:329-334.
- PELCHAT, M. L., H. J. GRILL, P. ROZIN, and J. JACOBS. 1983. Quality of acquired responses to tastes by *Rattus norvegicus* depends on the type of associated discomfort. *J. Comp. Physiol. Psychol.* 97:140-153.
- REIDINGER, R. F., and J. R. MASON. 1983. Evaluation and exploitation of weaknesses in behavioral defenses against dietary poisoning. Pp. 20-39 *in*: D. E. Kaukeinen (ed.), *Test Methods for Vertebrate Pest Control and Management Materials*. ASTM STP 817, American Society for Testing and Materials, Philadelphia, PA.
- RILEY, A. L., and D. L. TUCK. 1985. Conditioned food aversions: a bibliography. Pp. 381-437 *in*: N. S. Braveman and P. Bronstein (eds.), *Experimental Assessments and Clinical Applications of Conditioned Food Aversions*. *Annals of the New York Academy of Sciences*, Vol. 443.
- SEMEL, B., and L. K. NICOLAUS. 1992. Estrogen-based aversion to eggs among free-ranging raccoons. *Ecol. Appl.* 2:439-449.
- SHIVIK, J. A., and D. J. MARTIN. 2000. Aversive and disruptive stimulus applications for managing predation. *Proc. Wildl. Damage Manage. Conf.* 9:111-119.
- SODAT-SOUCAZE, J. D., and M. FERRI. 1997. A means of scaring birds: the laser gun, description, and applications to cormorants and other birds. Desman S.A.R.L., France in cooperation with the Office for Wildlife Protection and Regulation of Hunting and Fishing, Modena Province, Regione Emilia Romagna, Italy.
- TERNENT, M. A., and D. L. GARSHELIS. 1999. Taste-aversion conditioning to reduce nuisance activity by black bears in a Minnesota military reservation. *Wildl. Soc. Bull.* 27:720-728.
- THOMSON, W. T. 1995. *Agricultural Chemicals, Book III: Fumigants, Growth Regulators, Repellents and Rodenticides*. Thomson Publications, Fresno, CA.
- VON UEXKÜLL, J. 1934. A stroll through the worlds of animals and men: a picture book of invisible worlds. Pp. 5-76 *in*: C. H. Schiller and K. S. Lashley (eds.), *Instinctive Behavior: The Development of a Modern Concept*. International Universities Press, New York.
- WADE, D. A., and J. E. BOWNS. 1984. Procedures for evaluating predation on livestock and wildlife. Texas Agricultural Extension Service Publication No. B-1429, College Station. 42 pp.
- WITMER, G. W., D. L. NOLTE, and W. B. STEWART. 2000. Integrated pest management of black bear reforestation damage. *Proc. Vertebr. Pest Conf.* 19:228-235.
- ZIEGLTRUM, G. 1994. Supplemental bear feeding program in western Washington. *Proc. Vertebr. Pest Conf.* 16:36-40.
- ZIEGLTRUM, G., and D. L. NOLTE. 1997. Black bear damage management in Washington State. *Proc. Eastern Wildl. Damage Manage. Conf.* 7:104-107.