Chapter 10

Attracting Animals to Detection Devices

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For wildlife research purposes, an attractant is any substance, material, device, or technique used to attract a target species. Attractants are used with most of the survey methods described in this book, excluding natural sign surveys (chapter 3), some track stations (chapter 4), remote cameras on trails (chapter 5), hair collection from natural rub objects or along travel routes (chapter 6), and scat detection dogs (chapter 7). Indeed, the selection of an attractant is often an integral part of the survey-planning process. This chapter describes the various substances and methods used to draw North American carnivores to noninvasive sampling devices—from historical, scientific, and traditional perspectives. Further, it provides practical recommendations on how to acquire, apply, and store baits, lures, and other attractants and describes scientific efforts to test their efficacy.

Although the terms *bait* and *lure* are often used interchangeably, each has a unique meaning in the context of surveying wildlife:

- *Bait* is a food item or other substance that attracts an animal by appealing to its sense of taste and smell. Baits are typically intended to be consumed by the target species, although nonreward baits (discussed later in the chapter) may preclude consumption.
- *Lures* include scent lures, visual lures, and sound lures. A *scent lure* is any substance that draws animals closer via their sense of smell. *Visual lures* engage an animal's sense of sight, while *sound lures* elicit a curiosity approach by simulating noises made by prey species or conspecifics.
- *Natural attractants* are objects in the existing environment (e.g., trees, snags, or latrine sites) that are regularly used by target animals as part of their behavioral repertoire.

Background

Over thousands of years, humans developed various trapping methods to capture animals for food and hides, and to protect themselves and their property from predators. Through trial and error, trap effectiveness was increased by the refinement of methods to entice animals into traps. Many historical fur trappers had their own "secret formula" for attracting target species, and were reluctant to share the lists of ingredients with others because of competition and the potential loss of income (Geary 1984).

As a result, multiple baits and scent lures were developed for each furbearing species.

This traditional knowledge base—accumulated from the combined experience of indigenous peoples, hunters, trappers, and naturalists—has been incorporated into modern efforts to attract animals for wildlife research. Unfortunately, most attractants have not been scientifically tested and are used on the basis of tradition rather than proven effectiveness. Numerous researchers have endeavored to evaluate and standardize traditional attractants (e.g., Graves and Boddicker 1987; McDaniel et al. 2000; Stanley and Royle 2005), but the predominant reliance on unverified methods to draw animals to survey devices underscores the need for additional and rigorous scientific testing (see *Evaluating the Effectiveness of Baits and Lures* later in this chapter).

The use of attractants in carnivore surveys has a long history (e.g., Cook 1949; Wood 1959). Early attempts to evaluate attractants were directed at the development of a reliable method to estimate coyote (*Canis latrans*) abundance using scented track stations (see chapter 4). Natural scent lures were tested with captive animals (Roughton 1979) and in the field (Linhart and Knowlton 1975; Linhart et al. 1977; Roughton and Bowden 1979), and efforts were soon expanded to include synthetic scents (Turkowski et al. 1979; Martin and Fagre 1988). A synthetic fatty acid scent (FAS) was ultimately selected as a standard lure for coyotes by the US Fish and Wildlife Service (Roughton 1982), and a standardized delivery method was developed in the form of an inexpensive plaster disk saturated with this scent (Roughton and Sweeny 1982). FAS continues to be used today, primarily for canid and felid scent station surveys (e.g., Harris and Knowlton 2001; Zoellick et al. 2004). More often, however, researchers employ commercially available scent lures (e.g., Caven's Gusto, Carman's MegaMusk) for noninvasive carnivore surveys (Romain-Bondi et al. 2004; Zielinski et al. 2005; Gompper et al. 2006; also see appendix 10.1). Although many such lures are created based on traditional recipes—and at least some yield positive results—most have not been rigorously tested (see *Evaluating the Effectiveness of Baits and Lures*).

Valuable information about attractants can be found in unpublished reports produced by fish and wildlife agencies at the national, provincial, state, and local levels. Private wildlife groups (e.g., World Wildlife Fund, Wildlife Conservation Society) are also rich sources of relevant research. Many of these unpublished reports can be accessed via the internet (e.g., Henschel and Ray 2003; Uresk et al. 2003; Kendall et al. 2004). Traditional attractants are further discussed in furbearer trapping "how-to" books (e.g., Carman 1975; Wyshinski 2001) and popular outdoor magazines (e.g., *Fish and Fur, Field and Stream, Outdoor Life*). Last, trapping supply distributors usually include information on attractants both in print catalogs and on their websites (see appendix 10.2).

Description of Attractants

This section describes various types of attractants that can be used individually or in combinations. A list of recommended attractants for each target species or group is presented in table 10.1.

Baits

Baits are typically composed of food, and fall into several general categories, including both natural dietary items and less customary consumables. Fresh or decomposed meat, poultry, and fish are often used as bait, as are canned fish and canned or dried pet foods. Live animals are also occasionally deployed as bait or lures (e.g., Zezulak and Schwab 1979; Caso 1994; Dillon 2005); researchers wishing to use live animals should follow Institutional Animal Care and Use Committee guidelines (ACUC 1998; IACUC 2006). Some carnivores respond to nonmeat baits such as fruits or vegetables, fruit jams, seeds and nuts, baked goods, and cheese (table 10.1; appendices 10.1, 10.3). It is also possible to combine several types of bait at a single detection device to

Table 10.1. Recommended attractants for carnivore surveys, in order of preference, listed by target species or group

Species or group	*Baits*	*Scent lures*	*Visual lures*	*Sound lures*
Canids (except foxes)	Raw chicken (pieces or whole) Meat or whole carcasses[c] Fish (whole or canned)	FAS[a] Canid glands or urine Catnip[d] oil Raw wool Commercial lures[e, f, g, h]		VR[b]
Foxes (except arctic fox)	Raw chicken (pieces or whole) Fish (whole or canned) Dog or cat food (dry or canned) Meat or whole carcasses[c] Nuts, raisins, other fruits	FAS[a] Fox glands or urine Catnip[d] oil Commercial lures[e, f, g, h, i]		
Tropical felids[j]	Live animals[k] Fish (whole or canned) Raw chicken (pieces or whole)	Felid glands or urine Commercial lures[f, g, l, m] FAS[a] Catnip[d] (oil, dried, or fresh)	Flashers	VR[b]
Temperate felids[n]	Meat or whole carcasses[c] Fish (whole or canned) Raw chicken (pieces or whole)	Catnip[d] (oil, dried, or fresh) Commercial lures[f, g, l, m] Beaver castoreum FAS[a] Felid glands or urine	Flashers	VR[b]
Mephitids	Raw chicken (pieces or whole) Fish (whole or canned) Rabbit or beaver meat Chicken eggs	Commercial skunk-scented lure[o] FAS[a] Fish oil		
Mustelids				
Wolverine	Meat or whole carcasses[c] Fish (whole or canned) Raw chicken (pieces or whole) Rotten meat	Commercial skunk-scented lure[o] Fish oil Beaver castoreum	Flashers	
North American river otter	Fresh, whole fish			
American marten, fisher, weasels (*Mustela* spp.)	Raw chicken (pieces or whole) Fish (whole or canned) Rabbit or beaver meat	Commercial skunk-scented lure[o] Fish oil	Flashers	
American mink	Fresh, whole fish Fresh meat[p] (rabbit, beaver, muskrat, birds)	Mink glands and urine Fish oil		
American badger	Raw chicken (pieces or whole) Fresh meat (rabbit, beaver, muskrat, birds)	Commercial skunk-scented lure[o]		
Procyonids				
Ringtail	Raw chicken (pieces or whole) Dog or cat food (dry or canned) Fish (whole or canned) Rabbit or beaver meat Fruit jam	Commercial skunk-scented lure[o] Ringtail glands or urine FAS[a] Fish oil		
White-nosed coati	Dog or cat food (dry or canned) Fish (whole or canned) Live animals[k] Marshmallows	FAS[a] Fish oil Commercial lure[g]		

Table 10.1. (Continued)

Species or group	*Baits*	*Scent lures*	*Visual lures*	*Sound lures*
Raccoon	Raw chicken (pieces or whole) Fish (whole or canned) Dog or cat food (dry or canned) Rabbit or beaver meat Fruit jam	Commercial skunk-scented lure[o] Fish oil FAS[a]		
Ursids	Raw chicken (pieces or whole) Fish (whole or canned) Meat or whole carcasses[c] Fish food pellets Molasses, maple syrup, or honey (diluted with water) Livestock blood Fruit jam Fruits and vegetables (apples, corn) Stale pastries (e.g., bagels, donuts, cookies) Rotten meat	Commercial skunk-scented lure[o] Liquid fish fertilizer Fish oil Anise oil or vanilla extract		

Note: Attractants were selected based on a synthesis of those used in the surveys included in appendix 10.1, and on the author's experience and professional opinion. Actual attractant(s) chosen should depend on survey goals, season, and availability.
[a]Synthetic fatty-acid tablets.
[b]Vocalization recording.
[c]E.g., wild ungulate, domestic livestock, beaver.
[d]*Nepeta cataria*.
[e]E.g., any commercial liquid fox lure, liquid coyote lure, or fox gland lure, such as Caven's Fox #1, Caven's Fox #2, Caven's Canine Force.
[f]E.g., Marak's Bobcat Lure, Marak's Coyote Lure, Marak's Gray Fox Lure, Marak's Raccoon Lure.
[g]E.g., Carman's Canine Call, Pro's Choice, Bobcat Gland Lure, Trophy Deer Lure, and Mega Musk.
[h]E.g., Carman's Canine Call.
[i]E.g., Trailing Scent.
[j]*Leopardus* spp., *Puma yagouaroundi, Panthera onca*.
[k]E.g., chickens or chicks, rabbits, quail, pigeons.
[l]E.g., Hawbaker's Wildcat #2.
[m]E.g., Weaver's Cat Call.
[n]*Lynx* spp., *Puma concolor*.
[o]E.g., Caven's Gusto.
[p]Do not use rotted fish or meat.

increase the probability of detecting a given species or to attract multiple species (see *Target Species*). Proprietary commercial baits are available, but their superiority to commonly available meat or fish baits has not been demonstrated.

The attraction capabilities of meat or fish bait decline over time due to decomposition. At high concentrations, the wide variety of amines and sulfur compounds characteristic of microbial activity serves as a cue to the target animal, allowing it to identify a piece of meat as rotten and inedible (Janzen 1977). At lower concentrations, however, these same compounds signal the presence of edible bait (Stager 1964). Thus, the products of decay are both attractive and repulsive, depending on their concentration. The optimal condition of bait (a function of detectability and desirability) is reached when the carcass is odorous enough to be detected at a distance, but not so rotten as to discourage investigation. Because carnivores possess a more sensitive olfactory system than do humans, and are thus able to detect odors at lower concentrations (Hepper and

Wells 2005), it is impossible for researchers to accurately assess where a given bait falls along the attraction-repulsion scale for a given target species.

Bait deployed such that it can be consumed by the target species is considered a reward bait. This type of bait presentation can limit sampling to the first animal that reaches the site—a potentially desirable outcome in some instances (e.g., if genetic methods can only utilize samples collected from one individual at a time; see chapter 6)—but may contribute to repeated sampling of the same individual if the bait is regularly replaced and the animal becomes habituated to obtaining food (Brongo et al. 2005). Inaccessible or nonreward baits alleviate this problem and will continue to draw additional individuals to the site until the bait becomes unattractive. Nonreward baits also serve well as scent lures.

Carnivores usually respond best to baits comprising potential prey species (Schemnitz 1996; Cypher and Spencer 1998; Kamler et al. 2002). Ethical considerations and animal care and use protocols prohibit the harvest of prey animals for baiting purposes (Powell and Proulx 2003), but effective substitutes (e.g., commercially available meat and fish) are widely available (appendix 10.1).

Scent Lures

Scent lures (also known as long-distance lures or call lures) exploit an animal's hunger or curiosity or convey social or territorial signals. Scent lures are available in a variety of forms (e.g., solid, viscous, liquid, granulated, or powdered), and can be animal-based, vegetable/fruit-based, inorganic, or synthetic. For many carnivore species, attraction to a survey location may be maximized by using scent lures in combination with bait (Kucera et al. 1995a; Zielinski 1995). Further, some baits, such as rotten meat or fish, can effectively serve as scent lures because they release volatile compounds (Bullard 1982).

Scent lures sometimes contain plants or plant extracts, such as catnip (*Nepeta cataria*), for example (McDaniel et al. 2000; Weaver et al. 2005). Fresh or dried catnip attracts a variety of carnivores (appendices 10.1, 10.3) but is primarily used for felids (Tucker and Tucker 1988). Other ingredients used in traditional scent lure manufacture include fixatives (i.e., stabilizing agents), essential oils, and seafood essences (appendix 10.3).

Commercial scent lures are proprietary mixtures of animal blood, organs, urine, glands or other items (some trappers even add small amounts of cheap perfume to their mixtures [Schemnitz 1996]), often fermented for weeks or months. Lures may include scents from prey or nonprey species, such as American beaver (*Castor canadensis*) castoreum and muskrat (*Ondatra zibethicus*) scent glands. Every trapper or animal damage control agent has a favorite lure, and these lures work with varying degrees of success (Baker and Dwyer 1987; Graves and Boddicker 1987; Dobbins 2004). Although many lure manufacturers advertise "proven results" or that their lures have been "trapline tested," details of such tests are usually unavailable. Several commercial lures have been scientifically evaluated (e.g., Martin and Fagre 1988; Stapper et al. 1992), and a few brands have consistently been used in carnivore surveys (appendix 10.1).

Species-specific scent lures that stimulate social or territorial responses usually include urine, musk, and/or macerated scent glands from the target species (Wyshinski 2001; Dobbins 2004). These lures are often called matrix lures by trappers (Hanson 1989). Although many proprietary lure mixtures are derived from such substances, the basic ingredients can also be acquired from trapping supply distributors or from zoos and game ranches.

Most scent lures are combined with a base material or an extending medium that assists in distributing the scent and acts as an antifreeze, diluent, evaporative retardant, additional attractant, or preservative (table 10.2). Examples include lanolin, which allows a concentrated lure to be easily spread over multiple sites, and molasses, which supplements the attractant qualities of the lure. Blood lures require the use of an anticoagulant (e.g., sodium cit-

Table 10.2. Common scent lure bases and their uses

Base	*Use*
Glycerine	Antifreeze, evaporative retardant, preservative
Honey	Antifreeze, attractant, diluent, evaporative retardant
Lanolin (anhydrous)	Antifreeze, evaporative retardant
Molasses	Antifreeze, attractant, diluent, evaporative retardant
Propylene glycol[a]	Antifreeze, preservative
Sodium benzoate	Preservative, antifungal
Sodium citrate[b]	Anticoagulant for blood
Tallow fat	Antifreeze, attractant, evaporative retardant
Vegetable oil or shortening	Antifreeze, evaporative retardant
Zinc valerate	Preservative

[a]Similar to glycerine but not as viscous.
[b]Use a solution of 1:7 sodium citrate to water in a 1:9 ratio of anti-coagulant to blood.

rate) to be effective. Due to their physical character (e.g., liquid, powder), most scent lures must be deployed using absorbent materials or containers (table 10.2; see *Deployment of Attractants*).

Visual Lures

Commercial trappers and wildlife researchers frequently use visual lures (collectively known as flashers or flags; Young 1958; Geary 1984; Baker and Dwyer 1987), sometimes in concert with scent lures or baits. Flashers typically consist of a lightweight object—for example, a piece of aluminum foil or a pie pan (figure 10.1A), a whole dried bird wing or a large feather (figure 10.1B), a patch of fur, a piece of light-colored cloth, or an old cassette tape or compact disk (figure 10.1C)—suspended above the detection device with string or fishing line, and in some cases a swivel (figure 10.1D). In a slight variation, an opaque piece of cloth or burlap hung across the front of track plate stations has been shown to attract mustelids and raccoons (*Procyon lotor*; Loukmas et al. 2003). Flashers are generally designed to flutter or move in a breeze, and are effective at attracting the attention of numerous carnivore species (Zielinski 1995). Visual lures are most commonly used with felids (Mowat et al. 1999, Weaver et al. 2005), which are more responsive to visual stimuli than to scents (Kitchener 1991). In areas where dense vegetation limits visibility, scent lures can help draw target animals close enough to notice the flasher (Kucera et al. 1995a). It is not known whether any carnivores are repelled by flashers.

Sound Lures

Imitating the vocalizations of conspecifics or distress calls of prey animals will often attract predators (Wise et al. 1999; Shivik 2006). This attraction method employs mechanical or electronic sounds to engage the target species and stimulate exploration or a territorial approach. While such predator calls are often used by hunters, their application in carnivore surveys is limited because all age and sex classes are not necessarily attracted equally (Windberg and Knowlton 1990). Sound lures have been identified as a potentially effective technique for surveying felids in tropical habitats (Kitchener 1991).

Natural Attractants

Some objects in the landscape (e.g., trees, posts) naturally attract certain carnivore species. Brown bears (*Ursus arctos*) and American black bears (*Ursus americanus*), for example, are especially likely to rub on trees or other objects as they travel through an area (Kendall et al. 2004; chapter 6), leaving behind hair samples that can be easily collected and used to meet various survey objectives (Kendall et al. 1992; Kendall and Waits 2003). If natural attractants can

A

B

C

D

Figure 10.1. Examples of visual attractants (also known as flashers). (A) Researcher R. Long hangs an aluminum pie pan bent into an S shape to promote spinning. The pan is suspended from a branch with baling wire, a swivel, and monofilament fishing line (photo by P. MacKay). (B) Bird feathers suspended from a branch with monofilament fishing line (photo by F. Schlexer). (C) Compact disk suspended from a branch with the same setup as in figure 10.1A (photo by P. MacKay). (D) Close-up of the swivel used in figure 10.1A and 10.1C (after Weaver et al. 2005; photo by P. MacKay).

be identified for a given target species, these objects can be integrated into carnivore survey methods (e.g., barbed wire-wrapped trees for sampling bears; see chapter 6).

Practical Considerations

The success of a given survey depends on the selection of an effective and appropriate attractant for the target species, the detection method, and the survey area. For example, the ease with which survey stations can be accessed by researchers should be carefully evaluated when selecting an attractant. Stations located in remote areas far from roads restrict the use of large, heavy baits such as ungulate carcasses, which are often employed for remote camera surveys. Track stations and hair collection devices typically use smaller amounts of bait, providing more leeway for site placement. The replenishment of baits and lures is also constrained by difficult site access. Snowmobiles, all-terrain vehicles, pack animals, or helicopters should be considered where appropriate, although these methods of transport can add considerably to the cost of a project. A number of additional practical considerations for integrating attractants into a survey protocol are discussed here.

Target Species

Knowledge of the natural history, ecology, and behavior of the target species is essential when selecting attractants for a survey. For example, does the species prefer fresh or rotted bait, and in the form of small pieces or whole carcasses? Is it attracted to scent lures, or are flashers a better choice? Is the species less active in winter? What age and sex classes will likely be drawn to the attractant? A solid understanding of these and other species-related questions should help researchers design effective surveys.

Surveys focusing on multiple species may experience greater success if several attractants are used and might also benefit from a combination of baits and lures. Researchers should keep in mind that the suite of detectable species may change over time as bait decomposes. Care should be taken to select target species–specific attractants to prevent nontarget species from being drawn to (and potentially compromising) the detection device. Further, it is important to avoid scenarios in which an attractant for one target species repels another (Doty 1986). For example, scent from fisher (*Martes pennanti*) glands placed at a device may deter American martens (*Martes americana*), which are preyed upon by fishers (Raine 1983). Other such examples of interspecific predation among carnivores are described by Palomares and Caro (1999).

For some target species, particularly those with large home ranges, detectability (see chapter 2) can be improved by prebaiting. Prebaiting involves placing consumable bait in the prospective survey area a few days to several months before the survey begins. This allows individual animals to discover and become habituated to the presence of bait. Prebaiting is a common practice for furbearer trapping (Baker and Dwyer 1987) and is effective for noninvasive surveys when time, site access, and personnel availability permit (Mace et al. 1994; Way et al. 2002; Shivik et al. 2005).

Deployment of Attractants

Once attractants have been selected, the next step is to determine the presentation method. Reward bait stations are easier to set up than nonreward bait stations (which require additional wire and other materials to isolate the bait), but reward baits must be replenished frequently and should be used with scent lures in case the bait is consumed early in the sampling occasion (see *Survey Design Issues*).

Detection methods involving attractants have specific requirements for positioning bait or scent lures. The position and amount of attractant will vary by method and target species, but it is always critical to configure the survey station such that animals must

contact or otherwise trigger the detection device to investigate the attractant. Placing bait above a barbed wire-wrapped post or tree bole, for example, entices the target animal to climb across the wire—thus depositing hair (see chapter 6; figure 6.6). Chapters 4, 5, and 6 discuss method-specific considerations for locating attractants at detection stations.

When deploying baits and scent lures, care must be taken to avoid transferring odors to detection devices, which could potentially be disturbed or destroyed by curious or hungry animals. This is especially true for costly remote cameras, camera sensors, and sensor wires that are easily contaminated if the same person handles both the attractants and the device (chapter 5). To avoid loss of data and damage to equipment, two-person crews should be used during setups involving attractants, with one person installing the detection device and the other handling the bait and/or scent lure. Bears are particularly notorious for destroying cameras and track stations when this protocol is not followed (see chapters 4 and 5).

Baits

Bait placement can be as simple as laying a piece of chicken on a track plate (see figure 6.8A). Such a reward presentation allows the animal to remove the bait, which must then be regularly replenished until the survey is terminated. In contrast, the presentation of nonreward bait must preclude animals from stealing the bait. One common technique entails puncturing a can of fish several times and nailing it to a tree above the detection device (figure 10.2A); fish odor can escape, but the can itself cannot be removed for consumption. Frozen meat baits can be nailed directly to a tree (figure 10.2B) or wrapped against the trunk with wire (figure 10.2C; but see *Wildlife Heath and Safety*).

Another deployment strategy, especially suitable for larger pieces of bait, is to hang the bait—unprotected or inside a breathable, cloth bag that limits insect damage—from an overhanging branch above the detection device. If hanging branches are unavailable, a catenary system can be constructed using steel cable (figure 10.3), but be aware that baits presented in this way may become accessible to animals after a snowfall. Care should be taken to prevent bait removal by nontarget animals. For example, whenever possible, place large baits under a dense forest canopy or cover them to minimize visits by avian scavengers (Bortolotti 1984; Baker and Dwyer 1987; Aubry et al. 1997).

Scent Lures

Scent lures can be used in their original formulation or mixed with a viscous substance (see table 10.2) to dilute and extend the service life of concentrated lures and allow them to be spread easily on vegetation (figure 10.4A). Various materials and containers can also be used to facilitate the dispersal of lures over time (see box 10.1). Naturally occurring applicators or vehicles for dispersal, such as sticks or branches, may be found at the survey site—thus reducing material costs and the amount of supplies that must be carried into the field.

Liquid or powdered lures are often poured into containers, which are then perforated and suspended above the detection device. Some containers (e.g., film canisters, cans, bottles) can be acquired at no cost from photo labs or recycling centers. Containers can also be filled with absorbent material, such as wool or cotton, to limit evaporation (figure 10.4B). Prepared containers can be sealed for transport and then opened or perforated in the field. Additional cotton balls, pipe cleaners, or rags saturated with lure can be hung directly from vegetation using lightweight string or fishing line (figure 10.4C). Pelleted lures (e.g., fish meal) are best dispersed in breathable or mesh bags (figure 10.3), and can be mixed with liquid lures (e.g., molasses). Lures spread on vegetation should be applied at sufficient heights to prevent inadvertent contact with field personnel, and lures dispersed in containers should be placed out of reach of animals.

The effective distance of a scent lure changes with variables that can be difficult to control (e.g.,

A

B

C

Figure 10.2. Various types of nonreward bait presentations that prevent target species from immediately removing the bait. (A) Punctured can of cat food nailed to a tree above the detection device. Canned fish may also be used (photo by F. Schlexer). (B) American marten seizing frozen, raw chicken drumsticks nailed to a tree above the detection device (photo by USDA Forest Service). (C) Whole, frozen raw chicken carcass nailed to a tree above the detection device and further secured to the tree trunk with multiple wraps of baling wire (photo by F. Schlexer).

temperature, precipitation, humidity, wind speed and direction, topography, and vegetation). Such confounding factors can affect visitation rates independent of target species density (Rice et al. 2001) but can often be managed by lure placement. Generally, scent lures should be positioned to allow for maximum diffusion of the scent plume while still being close enough to the survey station to lure animals to the detection device (Carman 1975). Scent lures can be applied to tree branches or to stakes to elevate odor. Topography also affects local air flow, and can be exploited to maximize scent dispersal (see chapter 7 for a brief introduction to the movement of scent across the landscape).

The amount of scent lure required depends largely on lure viscosity and weather conditions. As the volatile molecules produced by lures form a more concentrated and localized odor signal in cool, dry, and calm air than in warm, moist and turbulent air (Vickers 2000), additional lure should be used when the former conditions prevail. Small amounts (approximately 5 cc) of liquid lure can be splashed or smeared directly onto trees and vegetation near the detection device, but it is not

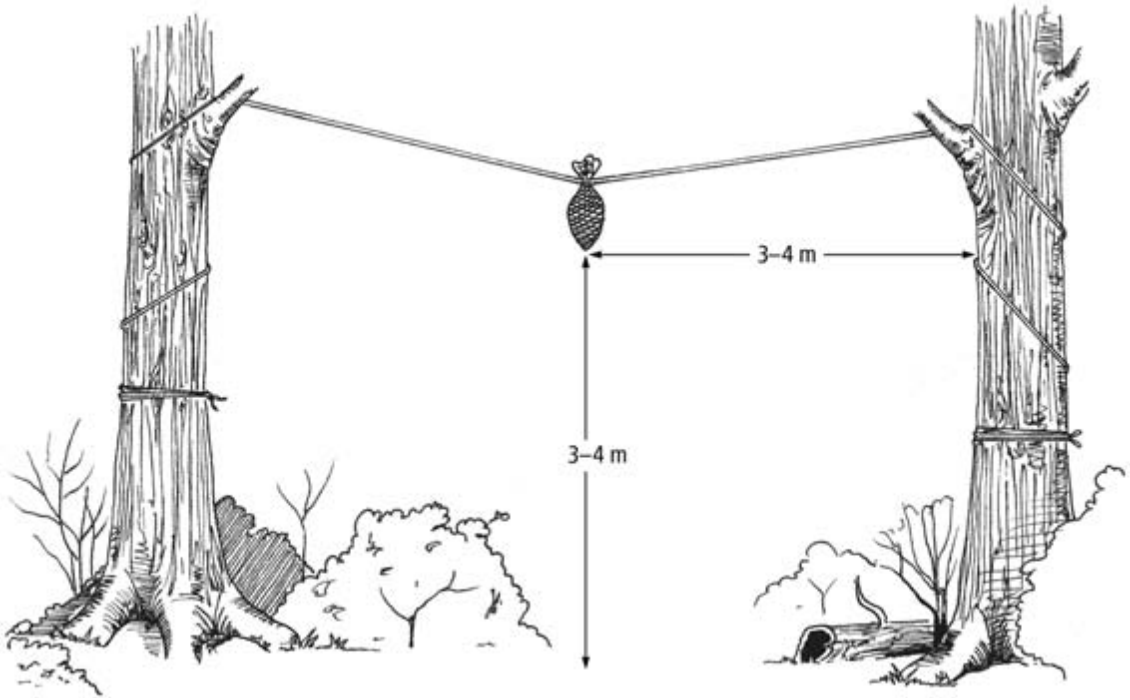

Figure 10.3. Nonreward bait presentation. A breathable mesh bag contains bait or scent lure and is suspended above the detection device—out of reach of the target species and potential scavengers. Illustration by S. Harrison.

Box 10.1

Materials commonly used to disperse scent lures

Containers

- cloth bags
- cotton stockings
- empty paint cans
- film canisters
- microcentrifuge tubes
- nylon stockings or panty hose
- plaster disks (also available pre-scented with lure)
- plastic bottles
- plastic vials or capsules
- poultry egg shells

Absorbent materials

- corn cobs
- cotton balls
- cotton lamp wicks
- cotton or felt cloth
- gauze pads
- natural sheeps' wool pads
- paper towels
- pipe cleaners
- tampons

Other materials

- naturally available sticks
- cotton-tipped swabs
- fence posts
- tongue depressors
- tree or shrub branches
- wooden or bamboo stakes

A

B

C

Figure 10.4. Methods of dispersing scent lures. (A) Paste lure applied directly to a branch (photo by F. Schlexer). (B) Perforated film canister containing cotton balls saturated with liquid lure and suspended from a branch using monofilament fishing line (photo by F. Schlexer). (C) Gauze pad saturated with liquid lure and suspended from a branch using monofilament fishing line (photo by F. Schlexer). Scent lures in figures 10.4B and 10.4C should be hung out of reach of the target species and potential scavengers.

necessary to saturate the bark. In some cases, overapplication of lures may have a repellent effect (Carman 1975; Dobbins 2004).

Visual Lures

The most important factor to consider when installing visual lures is sight distance. Vegetation may hinder both the visibility of the lure and breezes to provide motion. The lure should thus be suspended (with string or monofilament fishing line) from a branch in an opening above the detection device, at a height of 1–3 m. If string or twine is used, laid (twisted) line provides more motion than braided line. Attaching the line to a tree limb via heavy gauge wire and a fishing swivel can help to maximize lure movement and minimize twisting and entanglement with tree limbs (figure 10.1D; Weaver et al. 2005). Scent lures can be used to draw an animal within range of the visual lure and the detection device. This may not be effective or necessary for felids, however, which primarily rely on vision during foraging (Kitchener 1991) and can be readily attracted to visual lures without additional scent lures (Mowat et al. 1999). In areas of high human use, care should be taken to conceal visual lures from human view in order to minimize vandalism or theft of detection devices.

Acquisition and Storage

Baits and lures can be an expensive component of a carnivore survey. Thus, it is important to seek out low-cost sources and to employ effective storage methods. Appendix 10.4 provides cost information for some commercial baits and lures.

Baits

Chicken is a good choice of bait because it is readily available, relatively inexpensive, and can be obtained in convenient sizes (Zielinski 1995). Chicken necks, backs, and wings, and other types of bait (e.g., canned meat or fish) can usually be purchased in bulk at a discount. Grocery stores or butcher shops can be excellent sources of free meat or fish that is outdated or spoiled. Butcher shops and meat packing plants may also be able to supply meat scraps or organs that can't be sold for human consumption, and slaughterhouses can provide livestock blood that would otherwise be discarded. Similarly, fish markets and fish packing plants will often provide free trimmings, fish heads, viscera, or rancid whole fish. These can either be used as is or rendered into fish oil. Whole fish are sometimes available from fish hatcheries or commercial fishermen. Nonmeat baits, such as rotten fruit or vegetables and stale baked goods, are often available at no charge.

Many carnivores are opportunistic and can be attracted with ungulate carcasses (Hornocker and Hash 1981) or those of other species, such as beaver. Two potential sources of carcasses are trappers/hunters and road-killed animals. Deer (*Odocoileus* sp.) are the most commonly available roadkill, but elk (*Cervus elaphus*) and moose (*Alces alces*) are obtainable in some areas. As it is often illegal to handle or transport road-killed game without permission, it is important to contact the local game agency before pursuing this type of bait. Trappers may be able to provide carcasses representing the target species' typical prey (note that trappers are occasionally paid a small fee for this service). Kucera et al. (1995a) recommend using whole carcasses when available, but hindquarters can be more manageable. Whole carcasses can also be cut into smaller pieces and frozen for future use.

Researchers should be prepared to take advantage of opportunistic sources of large amounts of bait, particularly outside of the field season (e.g., roadkill, meat sales at the local market). If storage space is limited, it may be cost-effective to rent freezer space. Bait should be cut into single-use portions and individually wrapped before freezing, thus allowing the appropriate amount of bait to be removed during the survey with minimal handling.

Whether fresh or rancid bait is ultimately chosen, storage and disposal methods should be carefully considered in advance. Meat, blood, and fish baits require refrigeration or freezing. If appropriate facilities are not available or convenient, canned baits

should be explored as alternatives. Provisions should be made to safely and lawfully dispose of unused bait. To avoid confounding survey results, uneaten or nonreward baits should be removed from the survey area and discarded in a manner compliant with local waste-disposal laws.

Scent Lures

Although certain scent lures, such as fish emulsion and cod-liver oil, can be obtained from a variety of sources (e.g., garden and farm supply stores), some researchers prefer to use commercial products or to mix their own lures using ingredients available from trapping supply companies (appendices 10.2, 10.3). Lure recipes and manufacturing methods are available from traditional trapping sources (e.g., Carman 1975; Hanson 1989), and descriptions of how to prepare livestock blood and fish oil for use as lures can also be readily found (e.g., Wyshinski 2001; USDI 2003). A few substances used in lures, such as honey and molasses, are available in bulk from discount grocery stores, canned food warehouses, and bakery suppliers—in quantities ranging from 1 gal. bottles to 55 gal. drums. Matrix lures can be acquired from trapping suppliers, and potentially from hunters, zoos, or game ranches. FAS and catnip oil can be acquired from the USDA Pocatello Supply Depot (appendix 10.2).

Given that scent lures contain volatile compounds, they should be stored in airtight containers in a dark, dry place. Sealed bottles should be stored at room temperature and can have a shelf life of up to two years (Wyshinski 2001). Opened bottles should be frozen for long-term storage but may be kept at room temperature when use is pending.

Health Concerns

Baits have the potential to cause disease—not only in wildlife, but in researchers conducting surveys. The possibility of infection in both humans and wildlife can be mitigated by the careful selection of attractants and safe handling methods. Some methods of bait presentation may also put animals at risk and should be avoided.

Safe Handling of Baits and Scent Lures

The potential risks of handling raw or rotted meat or fish are a legitimate concern, and all survey protocols involving bait should include instructions for safe bait handling. Table 10.3 lists the most common pathogens that can cause illness in humans who handle contaminated meat or fish. Some of these agents are found in the intestines of animals, but others are ubiquitous in the environment and can contaminate fresh bait after it has been deployed at the survey station, particularly in warm weather. Indeed, bait can become contaminated in as little as four hours at 20°C (USDA 2005). In a volunteer study with humans (Black et al. 1988), *Campylobacter* infection occurred in subjects who ingested as few as 800 organisms—an amount that can be present in just one drop of juice from raw chicken.

Bait should be carried into the field in containers to protect researchers from contamination. One safe transport method is to place individual pieces of bait in plastic Ziplock bags and freeze them until needed. To further prevent infection, personal protective equipment such as latex gloves or kitchen tongs should be used when handling fresh, old, or rancid bait. Hands should always be washed with soap and (preferably warm) water after handling bait, particularly before touching one's face or consuming food. If hands are not visibly soiled, disposable antiseptic wipes or waterless disinfectant may be liberally applied as an alternative. These alcohol-based hand sanitizers should contain at least 60% alcohol to be effective (Reynolds et al. 2006). Researchers with recent skin abrasions should avoid direct contact with bait. Finally, to prevent cross-contamination, clothing or other gear should not come into contact with hands or gloves used to handle bait.

In study areas where bears occur, researchers should exercise caution when carrying and handling bait to reduce the likelihood of human-bear interactions. Bait containers should be completely sealed to

Table 10.3. Common pathogens that may contaminate meat or fish baits used in noninvasive surveys

Pathogenic agent	*Source*	*Potential bait reservoirs*	*Method of transmission*	*Infective dose**
Brucella spp.	Urine, blood, and tissues of infected animals	Ruminants[a], swine[b], canids	Aspiration, ingestion, mucosal contact, dermal abrasions	Very small
Campylobacter jejuni	Feces and intestinal tracts of animals and birds	Ruminants, swine, fowl[c], rodents	Aspiration, ingestion	Small
Campylobacter coli	Feces and intestinal tracts of animals and birds	Ruminants, swine, fowl, rodents	Aspiration, ingestion	Small
Clostridium perfringens	Soil, feces, and intestinal tracts of animals	Ruminants, swine, fowl, fish	Aspiration, ingestion, dermal abrasions	Very large
Escherichia coli O157:H7	Water, feces, and intestinal tracts of mammals	Any domestic or wild mammal	Aspiration, ingestion, dermal abrasions	Unknown, but assumed to be very small
Francisella tularensis	Soil, water, blood, and tissues of infected animals	Many domestic and wild mammals and birds	Aspiration, ingestion, dermal contact	Aspiration—very small, ingestion and dermal contact—very large
Leptospira interrogans	Urine, blood, and tissues of infected animals	Ruminants, swine, rodents, reptiles, amphibians	Aspiration, ingestion, dermal abrasions	Very small
Listeria monocytogenes	Soil, water, blood, feces and intestinal tracts of animals	Any domestic or wild mammal or bird	Aspiration, ingestion, dermal abrasions	Unknown, but assumed to be small
Salmonella spp. (over 2,300 species)	Water, feces and intestinal tracts of animals and fish	Ruminants, swine, fowl, rodents, reptiles, fish	Aspiration, ingestion	Very small

Source: USDA 2005; FDA 2006; PHAC 2006.
*Infective dose is the number of organisms needed to cause disease in average healthy individuals. *Very small* indicates as few as 10–100 organisms; *Small* indicates 500–1,000 organisms; *Very large* indicates ≥ 10^8 organisms.
[a]Ruminants include deer, elk, moose, caribou, wild sheep and goats, and domestic livestock (i.e., cattle, sheep, goats, horses).
[b]Swine include wild and domestic pigs.
[c]Fowl include wild birds and domestic poultry.

minimize external odor. In brown bear habitat, field personnel should never hike alone, be aware of their surroundings, and make noise to alert bears of their presence—particularly in dense brush. Researchers should also be prepared to quickly surrender the bait container if a bear charges. Additional safety tips are available from the American Bear Association (ABA 2006).

Due to the potency and disagreeable odor of many scent lures—and in order to avoid attracting animals to anything but the detection device—care should be taken to prevent contamination of field personnel (i.e., skin and clothing), gear, and vehicles. This can be accomplished by sealing the lure in a plastic Ziplock bag or container (e.g., Loukmas et al. 2003). Military surplus ammunition cans, 5 gal. plastic tubs, or airtight plastic or aluminum camera cases are ideal for transporting both scent lures and baits—as long as they don't need to be carried a long distance.

Wildlife Health and Safety

Given that rotten meat is commonly used to attract carnivores (Bullard 1982), questions sometimes

arise regarding the potential effects of such baits on the health of target species. Many carnivores regularly consume carrion or are at least occasional scavengers; most can safely tolerate the high bacterial load in rotten meat due to having short digestive tracts and appropriate digestive enzymes and acids (DeVault et al. 2003). Harrison et al. (2006) tested for bacterial contamination of carcass meat (including deer and elk) donated to a zoo and concluded that such meat appears to be reasonably safe for carnivores.

A more serious health threat for some carnivores occurs when raw fish is used as bait. Salmon poisoning disease (SPD) and Elokomin fluke fever (EFF) are acute, infectious diseases, primarily affecting canids. Animals become infected by ingesting salmon, steelhead, or trout that contain a rickettsia-infected fluke. SPD can kill up to 90% of infected animals, while EFF usually manifests in a milder form (Aiello 1998). SPD has been commonly seen in coyotes (Foreyt et al. 1987), foxes (Cordy and Gorham 1950), and gray wolves (*Canis lupus*; Darimont et al. 2003), and has been reported in cougars (*Puma concolor*; Kistner et al. 1979) and American black bears (Farrell et al. 1973) as well. SPD microorganisms are also transmittable to domestic animals and humans (Aiello 1998). EFF has been reported in canids, ursids, procyonids, and mustelids (Aiello 1998). Infected fish are found along the northern Pacific coast and in rivers used for migration. Because the encysted flukes are resistant to freezing (Aiello 1998), fresh or frozen salmonids should only be used as bait if they are cooked or canned, or if they originate from outside infected areas.

An additional safety consideration for wildlife lies in bait presentation. For some survey methods (e.g., remote cameras), nonreward meat baits are routinely wrapped and fastened to trees in woven wire mesh (e.g., chicken wire) or hardware cloth to increase the duration of attractiveness. There is increasing concern among researchers that portions of wire could be incidentally consumed with the bait, posing a health risk from metal poisoning or intestinal perforation. This method of bait presentation, therefore, should be avoided. The preferred alternative is to nail small frozen bait directly to a tree (figure 10.2B)—or to wrap large bait to a tree with thin-gauge wire (figure 10.2C)—within the target area of the detection device.

Survey Design Issues

Survey objectives may constrain attractant selection. Detection-nondetection surveys might require a specific scent lure to attract a target species within a sample unit. Other types of surveys, such as those focusing on foraging behavior or habitat use, might be confounded by a strong lure if the effective sampling distance is great and animals deviate from their natural paths to investigate (Zielinski et al. 2005). Hence, the use of strong scent lures in such situations is not recommended (Gese 2001). Caution should also be applied in scat-based diet studies, which may yield unreliable results if commercial foods or atypical bait items are consumed.

Habituation and Avoidance

Some canids—particularly coyotes—are susceptible to trap-shyness and learn to recognize and avoid traps and associated attractants (Conner et al. 1998). Coyotes that have been trapped appear to make fewer visits to noninvasive scent stations (Andelt et al. 1985). Reciprocally, recent or nearby trapping efforts (either for recreational, control, or research purposes) may inflate survey detection rates if animals become conditioned to bait as a food source (Brongo et al. 2005). The use of novel attractants (i.e., those not widely used by trappers or animal control personnel) can potentially mitigate these problems. Reward-based attractants (e.g., the coyote lure operative device or CLOD; Marsh et al. 1982) can be used to attract trap-shy animals (Berentsen et al. 2006).

Reward baits can have both ethical and sampling implications. In terms of the former, some animals

become reliant on the food value of bait, potentially resulting in a caloric deficit when the survey station is removed (Brongo et al. 2005). Sampling bias is also a concern in this situation. Habituated animals may remove bait early in the sampling occasion, reducing the attractiveness of the device and thus causing undersampling. Conversely, a habituated individual can cause oversampling by repeatedly visiting the same device in hopes of obtaining food. Nonreward baits likely reduce return visits by the same individual, but can attract nontarget scavenger species when baits decompose. Bait presentation should strive to maximize the probability of detecting the target species while simultaneously minimizing multiple detections of the same individual (Zielinski et al. 1995b).

Attractant effectiveness can vary with survey duration. Martin and Fagre (1988) determined that coyote visitation rates at scented track stations were significantly lower at the end of a six-day survey period than at the beginning. In contrast, Stapper et al. (1992) found that visitation rates did not change over the course of three-day surveys, suggesting that some carnivores neither avoided nor were attracted back to a lure after their initial visit when the survey period was relatively short.

Results from studies of captive animals (Harrison 1997) and repeated scent surveys conducted over a short period (Robson and Humphrey 1985) suggest that a given population's response to scent-based attractants may decline over time. Free-ranging carnivores, however, are less likely to become accustomed to scents that they encounter only a few times each year. The concern of habituation should thus not deter the use of scent lures for long-term monitoring of carnivore populations (Harrison 1997).

Standardization of Attractants

Switching attractant types, or employing multiple attractant types, during a survey can create attraction biases, including variations in effective sampling distance, unequal detection probability, and lack of spatial independence (see chapter 2). For example, sampling distance might change depending on the strength of the odor associated with a scent lure, and switching to a bait that is less attractive to the target species could violate the assumption of equal detection probability. To minimize such issues, attractant type and quantity, and the protocol for deploying attractants, should be standardized for most surveys, particularly those comparing estimates of absolute abundance (Buckland et al. 2006) or relative abundance (Romain-Bondi et al. 2004; Gompper et al. 2006) over geographic areas or among years (Raphael 1994).

The use of standardized attractants for relative abundance surveys increases the probability that observed detection rates reflect differences in population size versus differences in methodology (Raphael 1994). Even species presence cannot be reliably inferred using nonuniform methods (McKelvey et al. 1999). A standardized, reliable set of attractants applied with consistent protocols will help to generate statistically valid data and facilitate repeatability. Standardized attractants were used in the National Lynx Detection Protocol, for example (McKelvey et al. 1999; see chapter 6). This rigorous protocol stipulated the type, proportions, and placement of lures used to attract Canada lynx (*Lynx canadensis*), allowing the pooling of data collected by a large number of agencies and administrative jurisdictions over a broad geographic area.

Attempts have been made to develop standardized attractants for particular species. The development of FAS arose from the testing and field evaluation of standardized lures intended to attract depredating coyotes (Roughton and Bowden 1979), and standardized attractants have also been proposed for some species of felids (Clapperton et al. 1994a; McDaniel et al. 2000), foxes (Steelman et al. 1998), mustelids (Clapperton et al. 1994b; Zielinski et al. 2005), and ursids (Mowat and Strobeck 2000). Attractant standardization methods for remote camera and track station surveys are respectively

recommended by Kucera et al. (1995a) and Zielinski (1995).

Seasonal Issues

Baits and lures can be used in any season, but researchers should select attractants and associated protocols based on the expected temperature and humidity during the survey season (see *Frequency of Reapplication*). The effective sampling distance will typically be greater in warm versus cold weather. Large baits, which resist decay and desiccation, may be more appropriate in warm weather. Wind and temperature not only affect scent dispersion but can influence animal behavior as well. In general, carnivores are more likely to investigate baits and scents during winter when prey availability is more limited and less diverse (Carman 1975). Conducting surveys in winter also prevents conflicts with bears, which can inflict damage to equipment (see *Safe Handling of Baits and Scent Lures*) and alter the behavior of the target species.

Some attractants are limited by seasonal availability. Whole fish or road-killed carcasses may be sporadically accessible, for example, and certain lures (e.g., cow blood) need to be aged or premixed under specific environmental conditions. Most liquid scent lures require the addition of an antifreeze agent if they are to be used in below-freezing temperatures (table 10.2). Finally, commercial trapping lures may be in high demand and difficult to obtain in quantity immediately before a trapping season.

Frequency of Reapplication

Weather conditions dictate how often bait must be replenished. Baits can be washed out by rain or desiccated by heat, leaving them odorless and ineffective. Given that baits decompose most rapidly in warm weather, summer field personnel should carry extra bait during station checks in case replacement is warranted. Zielinski (1995) recommends that reward baits be replaced at enclosed track plates every visit (i.e., every two days), although detections may occur as long as some bait remains (Raphael 1994). Frozen baits deployed in subfreezing conditions are resistant to decomposition and therefore require less frequent replacement. Such baits, however, may not be as effective as a distance lure due to the reduced release of aromatic compounds. Thus, under these conditions, rotted bait is preferred to fresh bait.

Researchers should not rely on their own sense of smell to determine if scent lures are in need of reapplication. A lure reapplication schedule should be based on scientific literature or on experimental testing and should address environmental variables such as topography, climate, and season. The reluring interval can vary from several days to several weeks (Dobbins 2004), depending on survey duration, lure type, and weather conditions. Zielinski (1995) recommends that scent lures be applied at enclosed track plates at least twice during a twelve-day survey period. As many scent lures are oil-based and therefore are not seriously diluted by rain or snow, reapplication after every weather event is unnecessary. Lures with a skunk-based scent are more effective at low temperatures (Carman 1975), but some scent lure base materials (e.g., lanolin) become unusable at temperatures below freezing.

Evaluating the Effectiveness of Baits and Lures

The majority of baits and lures used by commercial and recreational trappers and hunters are founded on tradition and time-tested success. Many of these attractants may be valid for noninvasive carnivore surveys as well and should be scientifically evaluated using rigorous, repeatable protocols. Researchers have generally used attractants based on their history of effectiveness (appendix 10.1), and the scientific testing of attractants didn't begin until the last few decades (e.g., Linhart and Knowlton 1975). Some such testing continues today, following the systematic approach of separating out the components of a given attractant and assessing each component individually (e.g., Kimball et al. 2000)—

often in collaboration with local trappers, animal control agents, or analytical chemists (Turkowski et al. 1979; Wood et al. 2005).

One common testing method involves presenting a captive animal with a variety of attractants and measuring its relative interest by recording behavioral responses. This method can quantitatively evaluate such behaviors as sniffing, scent-marking, scraping, rubbing/rolling, licking/biting, and defecating, as well as response enthusiasm (Fagre et al. 1981, Harrison 1997). Various attractants can thus be ranked according to behavioral response.

Field testing is more appropriate for assessing the effectiveness of attractants in wildlife research, as it incorporates environmental factors and population density. In such tests, visitation rate (or detection rate)—as opposed to behavioral response—is often used as a means of evaluation (Graves and Boddicker 1987). Scent stations provide an effective venue for assessing visitation. Bullard et al. (1983), for example, found that free-ranging coyote visits increased with lure type and intensity, and that widely different odors elicited similar visitation rates. Andelt and Woolly (1996) used experimental manipulation to determine the responses of urban carnivores to a variety of natural and proprietary lures at scent stations (see appendix 10.1). The randomization of attractants and the rotation of lures at a given location allow for statistical comparison with a control lure (e.g., water). Combining captive animal behavioral trials and field evaluations is another successful approach to assessing baits (e.g., Fowler and Golightly 1993).

When evaluating attractants for a noninvasive survey, it is important to consider a number of factors beyond attractiveness. These include, for instance, the survey season, study area, target species, and duration. Martin and Fagre (1988) found that such variables significantly affected outcome when testing natural and synthetic lures.

Clapperton et al. (1994a) assessed the effect of a variety of odors on captive wild and domestic cats (*Felis* spp.) and on feral cats (*Felis catus*) in field trials. These researchers identified catnip and matatabi (*Actinidia polygama*, otherwise known as Japanese catnip) as the most successful candidate lures for attracting cats. Scent station visits and behavioral responses to scent lures in captive and free-ranging Central American felids were evaluated by Harrison (1997), who found that behavioral scores were more effective at evaluating lures than were investigation times. A randomized test of natural and proprietary lures found that beaver castorium and catnip oil were most effective at attracting Canada lynx (McDaniel et al. 2000). And the USDA Forest Service is evaluating a broad spectrum of scent lures to assess their potential for attracting wolverines (*Gulo gulo;* Copeland et al. 2004). Nearly thirty individual compounds have been tested, and wolverine urine and anal gland secretions show promise (Wood et al. 2005).

Much effort has been expended to develop palatable baits for delivering poison or fertility control drugs to "pest" (e.g., coyotes; Robinson 1962) and nonnative species (e.g., stoats [*Mustela erminea*]; Clapperton et al. 1994b). Similar research has been aimed at developing bait-based methods for administering rabies vaccines to Arctic foxes (*Vulpes lagopus*; Follmann 1988), gray foxes (*Urocyon cinereoargenteus*; Steelman et al. 1998), and raccoons (Wolf et al. 2003). This category of research has employed rigorous methods for testing the efficacy of baits and lures (see also Turkowski et al. 1979; Graves and Boddicker 1987; Mason et al. 1999).

Advanced statistical methods can validate experimental manipulations of attractants. Stanley and Royle (2005) used Poisson and negative binomial models to evaluate retrospective data quantifying the effect of bait supplementation at scent stations (Hein and Andelt 1994). Both studies showed that coyotes used scent stations baited with a supplemental deer carcass more often than stations without supplemental bait.

Among the many salient questions pertaining to the use and evaluation of attractants for noninvasive surveys, three stand out: Why are such a wide variety of carnivores attracted to skunk-based scent lures? Which species prefer rotten bait to fresh bait? What is the sampling radius (effective distance) over

which specific lures are able to attract particular species?

Addressing these questions would do much to enhance the reliability and repeatability of carnivore survey efforts. Meanwhile, the studies presented here illustrate how carnivore surveys can benefit from the systematic testing of attractants. Although folk tradition should not be ignored, this field will be handicapped until quantifiable and repeatable testing of traditional attractants supplants anecdotal conjecture. The identification of scientifically valid and effective baits and lures will conserve scarce research funds and provide standardized and defensible results for surveys designed to inform the conservation of carnivores in a changing world.

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Appendix 10.1

Baits and lures (scent, visual, and sound) that have been used in carnivore surveys, by target species

Bait or lure by species	*Reference*
Coyote	
Baits	
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
deer carcasses	Aubry et al. 1997
black-tailed prairie dogs	Kamler et al. 2002
black-tailed jackrabbits	Kamler et al. 2002
cottontail rabbits	Kamler et al. 2002; Way et al. 2002
gray squirrels	Way et al. 2002
woodchucks	Way et al. 2002
supermarket meat scraps	Way et al. 2002
lamb meat	Shivik et al. 2005
jackrabbit meat	Shivik et al. 2005
deer meat	Shivik et al. 2005
raw chicken	Way et al. 2002; Gompper et al. 2006
deer meat (2–5 kg)	Gompper et al. 2006
beaver meat (2–5 kg)	Aubry et al. 1997; Gompper et al. 2006
Scent lures	
FAS[a]	Harrison 1997*; Sargeant et al. 1998
catnip[b] oil	Harrison 1997*
bobcat urine	Harrison 1997*
commercial lure[c]	Harrison 1997*
wool	Shivik et al. 2005
unspecified commercial lure	Shivik et al. 2005
commercial lure[d]	Gompper et al. 2006
Sound lures	
vocalization recordings	Knowlton and Stoddart 1984
Gray wolf	
Baits	
meat	Van Ballenberghe 1984
Scent lures	
wolf urine	Van Ballenberghe 1984
unspecified commercial lure	Van Ballenberghe 1984
FAS[a]	Sargeant et al. 1998
Gray fox	
Baits	
raisins and other fruits	Fuller 1978; Trapp 1978; Hallberg and Trapp 1984
honey-based commercial bait	Berchielli and Leubner 1981
fish	Smith and Brisbin 1984
dog food	Weston and Brisbin 2003
raw chicken	Zielinski et al. 2005; Gompper et al. 2006
deer meat (2–5 kg)	Gompper et al. 2006
beaver meat (2–5 kg)	Smith and Brisbin 1984; Gompper et al. 2006
Scent lures	
fox gland lure	Berchielli and Leubner 1981
fox urine	Berchielli and Leubner 1981
FAS[a]	Harrison 1997*
catnip[b] oil	Harrison 1997*
bobcat urine	Conner et al. 1983; Harrison 1997*
commercial lure[c]	Harrison 1997*
commercial lure[e]	Weston and Brisbin 2003
commercial lure[d]	Zielinski et al. 2005; Gompper et al. 2006
Island fox	
Baits	
dry cat food	Kohlmann et al. 2005
canned cat food	Kohlmann et al. 2005
Scent lures	
loganberry paste commercial lure	Kohlmann et al. 2005
Arctic fox	
Baits	
fish	Garrott and Eberhardt 1987
Kit fox	
Baits	
carrion (especially lagomorphs)	O'Farrell 1987
birds[f]	O'Farrell 1987
small mammals[f]	O'Farrell 1987
sardines	O'Farrell 1987
cooked chicken parts	O'Farrell 1987
cheese	O'Farrell 1987
canned mackerel	O'Farrell 1987; Cypher and Spencer 1998; Koopman et al. 2000; Warrick and Harris 2001
black-tailed jackrabbits	Zoellick and Smith 1992
leporids	Cypher and Spencer 1998; Koopman et al. 2000
Scent lures	
FAS[a]	Warrick and Harris 2001

Bait or lure by species	*Reference*
Swift fox	
Baits	
chicks[f]	Scott-Brown et al. 1987
rabbits[f]	Scott-Brown et al. 1987
deer	Scott-Brown et al. 1987
raw chicken	Covell 1992
beef scraps	Harrison et al. 2002
black-tailed prairie dogs	Kamler et al. 2002
black-tailed jackrabbits	Kamler et al. 2002
desert cottontails	Kamler et al. 2002
canned mackerel in oil	Uresk et al. 2003
Scent lures	
cod-liver oil-mackerel commercial lure[g]	Harrison et al. 2002; Harrison 2003
Red fox	
Baits	
honey-based commercial bait	Berchielli and Leubner 1981
raw chicken	Zielinski et al. 2005; Gompper et al. 2006
deer meat (2–5 kg)	Gompper et al. 2006
beaver meat (2–5 kg)	Gompper et al. 2006
Scent lures	
fox gland lure	Berchielli and Leubner 1981
fox urine	Berchielli and Leubner 1981
FAS[a]	Sargeant et al. 1998
commercial lure[d]	Gompper et al. 2006
Ocelot	
Baits	
live chickens or chicks	Tewes 1986; Emmons 1988; Crawshaw and Quigley 1989; Laack 1991; Caso 1994; Horne 1998; Harveson et al. 2004; Dillon 2005
live rabbits	Tewes 1986; Caso 1994
live quail	Caso 1994
live pigeons	Horne 1998
sardines in oil	Trolle 2003; Trolle and Kery 2003; Dillon 2005
chicken parts	Dillon 2005
Scent lures	
ocelot, bobcat, and fox urine	Laack 1991
FAS[a]	Harrison 1997*
commercial lure[h]	Boddicker et al. 2002
catnip[b]	Shinn 2002; Weaver et al. 2005
cod-liver oil	Trolle 2003
commercial lure[j]	Shinn 2002; Weaver et al. 2003; Weaver et al. 2005
commercial lure[i]	Dillon 2005
Visual lures	
pie plate flasher	Shinn 2002; Weaver et al. 2005

Bait or lure by species	*Reference*
Margay	
Scent lures	
FAS[a]	Harrison 1997*
catnip[b] oil	Harrison 1997*
bobcat urine	Harrison 1997*
commercial lure[c]	Harrison 1997*
commercial lure[h]	Boddicker et al. 2002
Canada lynx	
Baits	
chicken	Zielinski 1995
carrion	Kucera et al. 1995a
deer (> 5 kg)	Kucera et al. 1995a
fish	Kucera et al. 1995a
rabbit	Shenk 2001
Scent lures	
unspecified commercial lure	Zielinski 1995; Kucera et al. 1995a
skunk musk/essence/ tincture	Kucera et al. 1995a
beaver castoreum	McDaniel et al. 2000*
catnip[b] oil	McDaniel et al. 2000*
Visual lures	
flasher	Young 1958; Baker and Dwyer 1987; Zielinski 1995; Kucera et al. 1995a
Bobcat	
Baits	
fresh meat	Kitchings and Story 1979; Zezulak and Schwab 1979; Smith and Brisbin 1984
live chickens	Kitchings and Story 1979; Zezulak and Schwab 1979; Fischer 1998; Horne 1998
live rabbits	Kitchings and Story 1979; Zezulak and Schwab 1979
fish	Smith and Brisbin 1984
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
beaver meat	Aubry et al. 1997
deer carcasses	Aubry et al. 1997
live pigeons	Horne 1998
raw chicken	Long et al. 2007b
commercial lure[j]	Long et al. 2007b
Scent lures	
FAS[a]	Roughton 1979*; Diefenbach et al. 1994; Sargeant et al. 1998
bobcat urine	Morrison et al. 1981; Conner et al. 1983
commercial lure[j]	Shinn 2002
commercial lure[d]	Long et al. 2007b

Bait or lure by species	*Reference*
Visual lures	
flasher	Young 1958; Baker and Dwyer 1987; Shinn 2002
Jaguar	
Baits	
sardines in oil	Trolle 2003
Scent lures	
catnip[b]	Kitchener 1991
commercial lure[h]	Boddicker et al. 2002
cod-liver oil	Trolle 2003
Cougar	
Baits	
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
beaver meat	Aubry et al. 1997
deer carcasses	Aubry et al. 1997
sardines in oil	Trolle 2003
Scent lures	
cod-liver oil	Trolle 2003
Jaguarundi	
Baits	
live chickens	Caso 1994
live rabbits	Caso 1994
live quail	Caso 1994
Scent lures	
FAS[a]	Harrison 1997*
bobcat urine	Harrison 1997*
commercial lure[c]	Harrison 1997*
Striped skunk	
Baits	
smoked herring	Bailey 1971
fish	Smith and Brisbin 1984; Greenwood et al. 1997
deer carcasses	Smith and Brisbin 1984; Aubry et al. 1997
sardines	Rosatte 1987; Bartelt et al. 2001
chicken entrails	Rosatte 1987
dog food	Rosatte 1987
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
beaver meat	Aubry et al. 1997
chicken eggs	Greenwood et al. 1997
dry dog food	Greenwood et al. 1997
sunflower seeds	Greenwood et al. 1997
canned cat food	Baldwin et al. 2004
raw chicken	Zielinski et al. 2005
Scent lures	
various chemical attractants	Rosatte 1987
FAS[a]	Greenwood et al. 1997; Sargeant et al. 1998
mink gland and salmon oil (1:1)	Loukmas et al. 2003
commercial lure[d]	Zielinski et al. 2005
Western spotted skunk	
Baits	
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
beaver meat	Aubry et al. 1997
deer carcasses	Aubry et al. 1997
raw chicken	Zielinski et al. 2005
Scent lures	
FAS[a]	Sargeant et al. 1998
commercial lure[d]	Zielinski et al. 2005
Wolverine	
Baits	
fresh meat (1 kg)	Hash and Hornocker 1980
carrion	Kucera et al. 1995a
deer (> 5 kg)	Kucera et al. 1995a; Copeland et al. 1995
fish	Kucera et al. 1995a; Copeland et al. 1995
chicken	Zielinski 1995
beaver carcasses	Copeland 1996; Fisher 2005
rotten meat	Mowat 2001
Scent lures	
fish oil	Mowat 2001
beaver castor	Mowat 2001
unspecified commercial lure	Zielinski 1995; Kucera et al. 1995a
commercial lure[k]	Fisher 2005
Visual lures	
cloth flasher	Hash and Hornocker 1980
flasher	Zielinski 1995; Kucera et al. 1995a
North American river otter	
Baits	
whole fish	Melquist and Dronkert 1987
American marten	
Baits	
beaver carcasses	Strickland and Douglas 1987
canned sardines	Strickland and Douglas 1987; Gosse et al. 2005
strawberry or raspberry jam	Strickland and Douglas 1987

Bait or lure by species	*Reference*
beaver meat (2–5 kg)	Baker and Dwyer 1987; Aubry et al. 1997; Gompper et al. 2006
carrion	Kucera et al. 1995a
fish	Kucera et al. 1995a
deer (> 5 kg)	Kucera et al. 1995a; Aubry et al. 1997
raw chicken	Zielinski 1995; Zielinski et al. 2005; Gompper et al. 2006
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
partially decomposed chicken wings	Mowat et al. 2001
deer meat (2–5 kg)	Gompper et al. 2006
Scent lures	
beaver fat	Baker and Dwyer 1987
anise oil	Strickland and Douglas 1987
fish oil	Strickland and Douglas 1987
unspecified commercial lure	Zielinski 1995; Kucera et al. 1995a; Mowat et al. 2001
rendered fish oil	Mowat et al. 2001
skunk scent commercial lure	Gosse et al. 2005
commercial lure[d]	Zielinski et al. 2005; Gompper et al. 2006
Visual lures	
flasher	Zielinski 1995; Kucera et al. 1995a
Fisher	
Baits	
beaver carcasses	Douglas and Strickland 1987
canned sardines	Douglas and Strickland 1987
beaver meat	Baker and Dwyer 1987; Aubry et al. 1997
meat scraps	Jones and Garton 1994
carrion	Kucera et al. 1995a
deer (> 5 kg)	Kucera et al. 1995a; Aubry et al. 1997
fish	Kucera et al. 1995a
chicken	Zielinski 1995
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
raw chicken	Zielinski et al. 2005; Long et al. 2007b; Gompper et al. 2006
deer meat (2–5 kg)	Gompper et al. 2006
beaver meat (2–5 kg)	Gompper et al. 2006
Scent lures	
beaver fat	Baker and Dwyer 1987
anise oil	Douglas and Strickland 1987
unspecified commercial lure	Jones and Garton 1994; Zielinski 1995; Kucera et al. 1995a
mink gland and salmon oil (1:1)	Loukmas et al. 2003
commercial lure[d]	Zielinski et al. 2005; Long et al. 2007b; Gompper et al. 2006
Visual lures	
flasher	Zielinski 1995; Kucera et al. 1995a
Ermine	
Baits	
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
deer carcasses	Aubry et al. 1997
beaver meat (2–5 kg)	Aubry et al. 1997; Gompper et al. 2006
fresh meat	Gonzales 1997
partially decomposed chicken wings	Mowat et al. 2001
raw chicken	Gompper et al. 2006
deer meat (2–5 kg)	Gompper et al. 2006
Scent lures	
rendered fish oil	Mowat et al. 2001
unspecified commercial lure	Mowat et al. 2001
mink gland and salmon oil (1:1)	Loukmas et al. 2003
commercial lure[d]	Gompper et al. 2006
Long-tailed weasel	
Baits	
dead domestic mice	DeVan 1982; Gehring and Swihart 2004
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
deer carcasses	Aubry et al. 1997
beaver meat (2–5 kg)	Aubry et al. 1997; Gompper et al. 2006
fresh meat	Gonzales 1997
raw chicken	Zielinski et al. 2005; Gompper et al. 2006
deer meat (2–5 kg)	Gompper et al. 2006
Scent lures	
mink gland and salmon oil (1:1)	Loukmas et al. 2003
unspecified commercial lure	Gehring and Swihart 2004
commercial lure[d]	Gompper et al. 2006
Least weasel	
Baits	
live mice	Fagerstone 1987

Bait or lure by species	*Reference*
fresh meat	Henderson 1994; Gonzales 1997
American mink	
Baits	
fresh rabbit, muskrat, birds	NDFA 1997
fresh fish	NDFA 1997
Scent lures	
fish oil	NDFA 1997
mink glands and urine	NDFA 1997
unspecified commercial mink lure	Loukmas and Halbrook 2001
ranch mink scat	Loukmas and Halbrook 2001
mink gland and salmon oil (1:1)	Loukmas et al. 2003
American badger	
Baits	
raw chicken	Minta and Marsh 1988; Zielinski et al. 2005
chicken carcass	Gonzales 1997
ground squirrels	Newhouse and Kinley 2000; Apps et al. 2002
rabbits[f]	Newhouse and Kinley 2000; Apps et al. 2002
beef liver	Newhouse and Kinley 2000; Apps et al. 2002
Scent lures	
commercial lure[l]	Newhouse and Kinley 2000
unspecified commercial lure	Apps et al. 2002
commercial lure[d]	Zielinski et al. 2005
Ringtail	
Baits	
raisins	Hallberg and Trapp 1984; Kaufmann 1987
fruit jam	Kaufmann 1987
fish	Kaufmann 1987
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
beaver meat	Aubry et al. 1997
deer carcasses	Aubry et al. 1997
raw chicken	Zielinski et al. 2005
Scent lures	
ringtail urine	Kaufmann 1987
ringtail musk	Kaufmann 1987
commercial lure[d]	Zielinski et al. 2005
White-nosed coati	
Baits	
bananas	Kaufmann 1987
marshmallows	Kaufmann 1987
canned and dry pet food	Kaufmann 1987
live chickens	Caso 1994
live rabbits	Caso 1994
live quail	Caso 1994
sardines	Valenzuela and Ceballos 2000
Scent lures	
commercial lure[h]	Boddicker et al. 2002
Raccoon	
Baits	
fresh fish	Smith and Brisbin 1984; Sanderson 1987
deer meat (2–5 kg)	Smith and Brisbin 1984; Gompper et al. 2006
dry, chunk-style dog food	Sanderson 1987
canned fish	Sanderson 1987
unplucked chickens	Aubry et al. 1997
fish (salmon and steelhead)	Aubry et al. 1997
deer carcasses	Aubry et al. 1997
beaver meat (2–5 kg)	Aubry et al. 1997; Gompper et al. 2006
sardines	Bartelt et al. 2001
marshmallows	Bartelt et al. 2001
strawberry jam	Bartelt et al. 2001
raw chicken	Zielinski et al. 2005; Gompper et al. 2006
Scent lures	
bobcat urine	Conner et al. 1983; Rucker 1983; Leberg and Kennedy 1987
FAS[a]	Smith et al. 1994; Sargeant et al. 1998
mink gland and salmon oil (1:1)	Loukmas et al. 2003
commercial lure[d]	Zielinski et al. 2005; Gompper et al. 2006
American black bear	
Baits	
apples	Baker and Dwyer 1987
fish	Baker and Dwyer 1987
rotten meat (2 kg)	Woods et al. 1999
corn	Brown 2004
honey (diluted with water)	Brown 2004
maple syrup (diluted with water)	Brown 2004
stale pastries (e.g., bagels, donuts, cookies)	Brown 2004; Knorr 2004
canned sardines	Brongo et al. 2005
raw chicken	Zielinski et al. 2005; Long et al. 2007b; Gompper et al. 2006

Bait or lure by species	*Reference*
fish food pellets	Long et al. 2007b
molasses	Long et al. 2007b
deer meat (2–5 kg)	Gompper et al. 2006
beaver meat (2–5 kg)	Gompper et al. 2006
Scent lures	
liquid fish fertilizer	Woods et al. 1999
commercial lure[d]	Zielinski et al. 2005; Long et al. 2007b; Gompper et al. 2006
Grizzly bear	
Baits	
raw meat (wild ungulate, domestic livestock)	Mace et al. 1994
livestock blood	Mace et al. 1994; Boulanger et al. 2004c; Proctor et al. 2004; Romain-Bondi et al. 2004
rotten meat (2 kg)	Woods et al. 1999; Proctor et al. 2004; Romain-Bondi et al. 2004
Scent lures	
canned blueberries	Mace et al. 1994
anise extract	Mace et al. 1994
vanilla extract	Mace et al. 1994
commercial skunk scent	Mace et al. 1994
liquid fish fertilizer	Woods et al. 1999; Proctor et al. 2004; Romain-Bondi et al. 2004
fish oil	Boulanger et al. 2004c

Note: Asterisk (*) indicates studies that have empirically tested and evaluated specific lures for the target species.
† Lures available from multiple trapping supply distributors. See appendix 10.2 for names and addresses.
[a]Synthetic fatty-acid tablets (USDA, Pocatello Supply Depot, Pocatello, ID).
[b]*Nepeta cataria* (fresh and dried catnip leaves are available from pet stores and multiple trapping supply distributors; catnip oil is available from USDA, Pocatello Supply Depot, Pocatello, ID).
[c]Hawbaker's Wildcat #2 †.
[d]Caven's Gusto †.
[e]Liquid Fox and Coyote Lure, Fox Gland Lure (On Target A.D.C., Cortland, IL); Caven's Fox #1, Caven's Fox #2, Caven's Canine Force †.
[f]Bait is presumed to be dead (author did not state)
[g]Trailing Scent (On Target A.D.C., Cortland, IL).
[h]Carman's Canine Call, Pro's Choice, Bobcat Gland Lure, Trophy Deer Lure, and Mega Musk †.
[i]Marak's Bobcat Lure, Marak's Coyote Lure, Marak's Gray Fox Lure, Marak's Raccoon Lure †.
[j]Weaver's Cat Call (John L. Weaver, Wildlife Conservation Society, St. Ignatius, MT).
[k]O'Gorman's LDC Extra †.
[l]Carman's Canine Call †.

Appendix 10.2

Select commercial suppliers of baits and scent lures, lure ingredients, and other attractants

Item	*Supplier*
FAS (fatty acid scent) Plaster predator survey disks Catnip oil	USDA, APHIS, WS Pocatello Supply Depot 238 East Dillon Street Pocatello, ID 83201 208-236-6920 psdusda@qwest.net
Carnivore urines Glands, musks, and proprietary lures Botanical oils and extracts Vocalization recordings	AllPredatorCalls.com PO Box 90163 Tucson, AZ 85752 520-293-2972 www.allpredatorcalls.com/
	Adirondack Outdoor Company PO Box 86 Elizabethtown, NY 12932 518-873-6806 www.adirondackoutdoor.com/trapping.htm
	Cumberland's Northwest Trappers Supply PO Box 408 Owatonna, MN 55060 507-451-7607 www.nwtrappers.com/default.asp
	Dobbins' Products 208 Earl Drive Goldsboro, NC 27530 919-580-0621 www.trapperman.com/catalog.html
	Funke Trap Tags & Supplies 2151 Eastman Ave. State Center, IA 50247 641-483-2597 www.funketraptags.com/
	S. Stanley Hawbaker & Sons PO Box 309 Fort Louden, PA 17224
	Kishel's Quality Animal Scents & Lures, Inc. c/o Rettig's Outdoor Supplies 107 Harvey Lane Saxonburg, PA 16056 724-352-7121 www.kishelscents.com/index.asp
	Knob Mountain Fur Company 430 Monroe Street Berwick, PA 18603 570-759-7035 www.knobmountainfur.com/index.php
	M & M Furs, Inc. PO Box 15 26445 435th Avenue Bridgewater, SD 57319-0015 605-729-2535 www.mandmfurs.com/
	Minnesota Trapline Products 6699 156th Avenue N.W. Pennock, MN 56279 320-599-4176 www.minntrapprod.com/
	On Target A.D.C. PO Box 480 Cortland, IL 60112 815286-3073 www.wctech.com/ontarget/
	The Snare Shop 858 East U.S. Highway 30 Carroll, IA 51401 712-792-0601
	Sterling Fur and Tool Company 11268 Frick Road Sterling, OH 44276 330-939-3763
	Sullivan's Scents and Supplies 429 Upper Twin Blue Creek, OH 45616 740-858-4416 www.sullivansline.com/sline/slhome.htm
	Wasatch Wildlife Products PO Box 753 Magna, UT 84044 801-250-9308 www.wasatchwild.com

Appendix 10.3

Scents and oils used in traditional and commercial lure manufacture

			Target family					
Scent	*Use*	*Characteristic*	*Canidae*	*Felidae*	*Mephitidae*	*Mustelidae*	*Procyonidae*	*Ursidae*
Acorn oil	attractant	herbal						x
Almond extract	attractant	sweet			x	x	x	x
Ambergris oil (synthetic)	fixative	musky	x		x	x	x	x
Amber oil	fixative	minty	x			x		
Ambrette musk	attractant	musky, sweet	x		x	x	x	
Anise oil	attractant	sweet, licorice	x		x	x	x	x
Apple oil	attractant	sweet					x	x
Asafoetida gum	attractant	pungent	x	x				
Asfoetida tincture	attractant	pungent	x	x				
Banana essence oil	attractant, additive	floral			x	x	x	
Bergamot oil	attractant, additive	minty	x	x			x	x
Balsam oil	attractant, additive	herbal					x	
Birch oil	attractant, additive	sweet					x	
Black prune oil	additive	fruity					x	
Bleach	additive	pungent		x				
Blue cheese oil	attractant	sharp	x		x	x		
Blueberry essence	attractant	fruity	x		x	x	x	x
Calamus oil	attractant	sweet					x	x
Calamus powder	attractant	sweet					x	x
Catnip oil	attractant	herbal	x	x			x	
Catnip, dried	attractant	herbal	x	x			x	
Catnip, fresh	attractant	herbal	x	x			x	
Caramel essence	additive	sweet						x
Canton musk	fixative	musky	x	x				
Chenopodium oil	fixative	musky	x					
Cherry oil	attractant, additive	sweet					x	
Cheese essence	attractant	pungent	x				x	x
Civet oil	attractant	musky	x					
Cod liver oil	attractant	fishy				x	x	
Cumin	fixative	pungent	x					
FAS (fatty acid scent)	attractant	pungent	x	x		x	x	
Fennel oil	attractant	herbal					x	
Fig extract oil	additive	sweet					x	
Fish oil	attractant	fishy	x			x	x	x
Fish extract	attractant	fishy	x			x	x	x
Garlic essence	attractant	pungent			x	x	x	x
Grape essence	attractant	fruity	x				x	
Honey essence oil	attractant, additive	sweet	x				x	x
Honeysuckle oil	attractant	sweet, floral	x				x	
Lavender oil	attractant	floral					x	
Liquid smoke	attractant	pungent	x				x	x
Loganberry oil	attractant	fruity	x		x		x	x
Lovage oil	attractant	herbal	x					
Lovage root powder	attractant	herbal	x					
Melon oil	attractant	fruity	x				x	
Muscaro musk	attractant	musky	x				x	
Orange oil	attractant	citrus					x	

			Target family					
Scent	*Use*	*Characteristic*	*Canidae*	*Felidae*	*Mephitidae*	*Mustelidae*	*Procyonidae*	*Ursidae*
Pennyroyal oil	attractant	minty					x	
Peppermint oil	attractant	minty					x	
Persimmon oil	attractant, additive	fruity	x				x	
Phenyl acetic, crystals	attractant, additive	sweet					x	
Phenyl acetic, liquid	attractant, additive	sweet					x	
Prune oil	attractant	sweet					x	x
Raspberry oil	attractant	fruity	x				x	x
Rhodium oil	attractant	minty					x	
Rue oil	attractant, fixative	herbal	x					
Salmon oil	attractant	fishy	x			x	x	x
Spearmint oil	attractant, additive	sweet, minty	x				x	
Shellfish oil	attractant	fishy	x			x	x	x
Shrimp essence	attractant	fishy	x			x	x	
Strawberry oil	attractant	fruity	x		x		x	x
Sweetcorn oil	attractant, additive	herbal	x		x		x	
Synthetic fermented egg	attractant	pungent	x		x	x	x	
Tabasco	attractant	pungent						x
Tonka bean extract	additive	vanilla					x	x
Tonquin musk, synthetic	attractant	musky	x					
Trout oil	attractant	fishy	x				x	x
Valerian root extract	attractant	pungent	x	x			x	
Vanilla oil	additive	vanilla					x	x
Watermelon oil	attractant	fruity	x					
White thyme oil	additive, fixative	minty	x					
Wintergreen oil	attractant, additive	sweet, minty					x	
Ylang ylang oil	attractant, additive	floral, sweet	x	x	x	x	x	

Note: Musk tibetine and musk ketone, synthetic substances with a typical musky scent that are widely used as fixatives in lure manufacture and in the cosmetics industry, are priority-listed Persistent, Bioaccumulative and Toxic (PBT) chemicals (OSPAR 2004) and also cannot be recommended due to their potential carcinogenic effects (Schmeiser et al. 2001; Apostolidis et al. 2002).
Source: Trapping supply catalogs; see appendix 10.2 for names and addresses of commercial lure suppliers.

Appendix 10.4

Approximate cost of select baits, lures, and lure bases

Item	*Approximate cost* and units*
Baits	Per pound
Chicken, whole, fresh or frozen	$0.50–$1.50
Chicken quarters, fresh or frozen	$0.80–$1.30
Chicken thighs, frozen (4 lb. bag)	$0.70– $0.90
Chicken legs, frozen (4 lb. bag)	$0.70– $0.90
Chicken drumettes (wings), frozen (4 lb. bag)	$0.70–$0.90
Beef liver, heart, or other organ meat	$0.50– $1.50
Canned fish (mackerel, sardines, salmon, tuna)	$2.00–$3.00
Canned pet food (cat or dog)	$0.60–$0.80
Dry pet food (cat or dog)	$0.20–$0.40
Proprietary baits (ground animal meat)	$10.00–$20.00
Lures	Per fluid ounce
Beaver castor	$3.50–$5.00
Botanical oils	$3.00–$5.00
Carnivore glands	$3.50–$4.50
Carnivore urine	$0.10–$0.25
Catnip, dried	$2.00–$4.00
Catnip, oil	$4.00–$23.50
Cod-liver oil	$1.30–$1.50
Fatty acid scent (FAS), diluted	$9.00
Fatty acid scent (FAS), undiluted	$5.25
Fish fertilizer, liquid	$0.10– $0.20
Fish oil	$0.15–$0.30
Musk oils, natural or synthetic	$4.00–$18.00
Proprietary scent lures	$3.50–$5.00
Skunk scent, tincture	$3.50–$5.50
Skunk scent, pure	$18.00–$20.00
Lure bases	Various units
Glycerine	$22–$35/gal.
Honey	$25–$30/gal.
Lanolin, anhydrous	$10–$15/pt.
Molasses	$35–$40/gal.
Predator survey disks, scented with FAS	$0.43 ea.
Predator survey disks, unscented	$0.21 ea.
Propylene glycol	$20–$30/gal.
Sodium benzoate, powder	$35–$40/gal.
Sodium citrate	$0.30– $0.40/oz.
Vegetable oil	$5–$6/gal.
Zinc valerate, powder	$7–$15/oz.

*U.S. dollars as of July 2006. Prices may be lower if bought in quantity.