

CHAPTER 5: SMALL MAMMAL MONITORING

Most small mammals are primary consumers and represent the primary prey items of many carnivores, including many raptors and medium-sized mammals. They are abundant in many ecosystems and serve many important ecological roles in terms of influencing their prey and their predators. One core survey method is identified, Sherman live trapping. Supplemental survey methods, such as Tomahawk trapping and pitfall trapping are offered as methods to expand the breadth of species detected.

5.1 Core Survey Methods

Live trapping was selected as the primary protocol for small mammals because it is an effective, efficient, and benign technique for detecting the presence and estimating the abundance of most small mammal species.

5.1.1 Sherman Live Trapping

Sherman™ long (7.6 x 9.5 x 30.5 cm, model XLK) and extra large (10.2 x 11.4 x 38 cm, model XLF15) traps (H.B. Sherman Traps, Inc., 3731 Peddie Dr, Tallahassee, FL 32303) are sized to accommodate a range of small mammals including members of the families soricidae (shrews), muridae (mice, voles, rats), heteromyidae (kangaroo rats), and small-bodied sciurids such as chipmunks, ground squirrels, and tree squirrels.

Spatial Arrangement

The two sizes of Sherman traps are deployed alternately along 8 transects, each 200 m in length, arrayed in a hexagonal pattern and centered on the monitoring point (Fig. 5.1). Transects connect point count stations around the monitoring point (see Chapter 3, Landbird Monitoring protocol, Fig 3.1), with two additional transects passing through the center of the hexagon (400 m north to south). Traps are placed 20 m apart on a transect, starting at each point station and ending 20 m before the next point count station, for a total of 10 traps along each transect and 80 traps overall. Traps are placed within 2 m of the intended location at habitat features such as logs, burrows, the base of trees, runways and, always, in areas that provide cover from weather (e.g., under shrubs, in tall grass). Transects and trap locations can be established and flagged as the traps are being set. However, efficiency can be gained when the hex is first flagged for point count sampling by hanging flags every 20 m along the flag line between point count stations. These flags then mark where small mammal traps are to be placed.

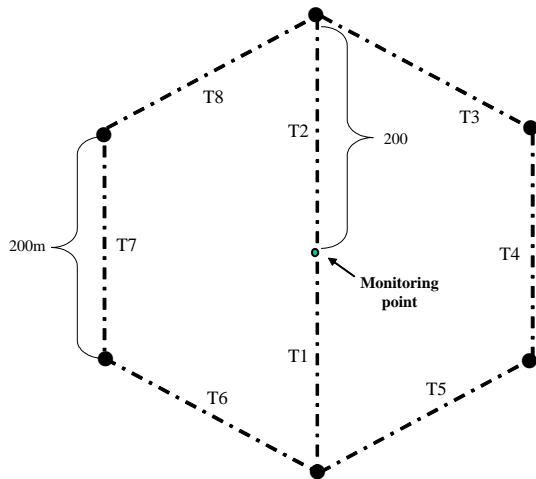


Figure 5.1. Sherman live trap array for the Multiple Species Inventory and Monitoring (MSIM) protocol. The hexagonal arrangement includes 8 transects (T), each 200 m in length.

Twenty meter spacing between traps is within the range generally recommended for rodent community inventory, and approximates the radius of a circle representing the smallest home range size of species expected to be detected (Jones et al. 1996). Thus, at least one trap would fall within each home range intersected by each transect.

Capture rates of small mammal species vary with trap size, type and locality (Quast and Howard 1953, Williams and Braun 1983, Lawrence 1992, Slade et al. 1993, Whittaker et al. 1998, Whittaker and Feldhamer 2000), and a combination of trap types and sizes is thought to be most effective at determining small mammal community composition. Thus, two different sizes of Sherman live traps are prescribed for sampling small mammals. Although wooden box traps can be a successful alternative for some small mammals (e.g., larger sciurids, rabbits) they can be more difficult to transport in quantity. Transects are used rather than a grid because they appear to be more effective and efficient at detecting the composition of small mammals at a site, given similar trap effort (Petticrew and Sadleir 1970, Steele et al. 1984, Read et al. 1988, Pearson and Ruggiero 2003). Further, transects have a greater effective sampling area, and the large hexagonal array has a greater probability of intersecting a variety of habitats/microhabitats containing different species compared to a grid (Pearson and Ruggiero 2003). The hexagonal transect configuration corresponds with the spatial array of most of the primary survey methods (e.g., point count stations, visual encounter surveys).

Survey Methods

Live trapping is conducted primarily during the summer breeding season in temperate zones, but it could be informative to conduct multiple times per year in warmer climates; specific timing depends on latitude and local climatic conditions. In locations with year round mild weather (e.g., southern U.S.) special considerations, such as timing of activity

cycles, may preclude summer sampling. In areas with over 1000 m of topographic relief, visits at lower elevations are conducted first in order to control for the delayed activity cycles at higher elevations. Locations within the survey area (National Forest) that are likely to have early breeding (e.g., east or south side of mountain ranges) should be surveyed earliest in the season relative to other locations. Trapping should be avoided during periods of unseasonably cold, hot or wet conditions to avoid unnecessary mortalities. Surveys conducted at the same locations in different years should maintain similar survey conditions and timing across years (e.g., same survey months).

Traps are covered with 'coroplast' (corrugated plastic) covers (not black) to regulate temperatures within traps, and particularly to reduce maximum temperatures. Polyester batting (e.g., Dacron™) is placed in traps (~2 in diameter ball at back of trap) to provide warmth in locations where temperatures are likely to drop near or below freezing. Trapping during weather extremes increases metabolic stress on animals, increasing their risk of mortality, hence precautions to reduce stress and mortality are critical (Animal Care and Use Committee 1998).

Sherman traps are baited with a mixture of rolled oats and mixed bird seed (containing sunflower seeds and millet); a good rule of thumb to follow in proportions is one gallon rolled oats to one gallon mixed bird seed. Oats provide carbohydrates, and sunflower seeds are a high protein and fat food. Other items may be added, but bait should be consistent throughout the Region. Bait type can influence capture rates of small mammals (Jones et al. 1996, Weihong et al. 1999), so whatever mixture is used for monitoring should be used consistently throughout the season and over time. Mealworms are a recommended addition, as they provide a high protein food source for shrews, and are freezer killed prior to use in order to keep them from leaving traps after baiting. Likewise, the addition of peanut butter is recommended primarily to aromatize the bait, although in some areas this can be problematic (e.g., attracts fire ants in southeastern U.S.). Bait for each trap may be placed in a small piece of folded plain paper to improve efficiency of baiting and avoid fouling the trap mechanism.

Trap locations along transects are uniquely numbered in groups of 100 corresponding to each of the eight transects (transect 1 = 101-110, transect 2 = 201-210, etc.). Trap locations may be marked in any number of ways. In pilot testing (Manley et al. 2002, Roth et al. 2004), the transect lines were flagged every 20m where traps were to be placed, and wooden clothes pins were then used to indicate the exact location (within 2 m of flag) and number of each trap. Clothes pins were spray painted bright pink and numbered with permanent black ink. This technique proved to be simple and efficient.

All traps are set, opened and baited in the late afternoon of the first day, and checked a minimum of twice daily starting on the morning of the second day, for a minimum of three consecutive 24-hour days. That is, if traps are set Monday afternoon they are checked and removed on Thursday afternoon (three nights).

Length of the trapping session (i.e., number of days) can influence the number of species detected (Olsen 1975, Steele et al. 1984). Three consecutive days is the minimum

trapping period required for sampling small mammal communities to determine species richness. This trapping period was chosen based on data analysis from pilot testing in the Sierra Nevada, which suggested that the largest gains in the detections of small mammal species occurred over the first three days, when an average of 84% of the small mammal assemblage likely to occur at each site was detected (Manley et al. 2002). A 3-day trapping period equates to a 40-hour work week for field crews. The fourth night of trapping only increased the estimated proportion of the assemblage detected by 2%, and required at least 5 hours of overtime per person each week to accomplish. The addition of a fourth night of trapping is recommended for abundance estimates, where traps would be collected Friday morning as opposed to Thursday afternoon (see section 5.2.1, Sherman Trap Array Augmentation).

Morning trap checks are completed before temperatures rise, potentially stressing the trapped animal (by 10 a.m. is recommended), and afternoon checks are completed before dark. Traps are re-baited as necessary. All non-functional traps (e.g., trap door closed but no animal captured, bait gone from trap without an animal being captured, or trap missing) are noted on data sheet, reset and re-baited, or replaced, so they become functional (Nelson and Clark 1973).

Releasing trapped animals into a plastic (shrews and mice) or cloth (squirrels) bag then working them into a corner makes grasping the nape area easier. Holding small mammals in this manner is the most efficient method for examination. Capture cones, hand-crafted mesh cones with a cloth entryway, are also an option, particularly for larger species (see Chapter 6, section 6.2.2). Each observer should carry a thick leather glove in the event a mustelid (e.g., weasel) is captured.

Captured animals are identified to species, sexed, aged (as juveniles, sub-adults or adults), examined for breeding status (e.g., pregnant, lactating, enlarged testes or non-breeding), marked by cutting a patch of hair near the base of the tail, weighed and released. Additional information is recorded in order to discern similar species within genera (e.g., *Tamias*, *Peromyscus*, *Microtus*, and *Sorex*), including relevant body measurements such as the lengths of the hind foot, ear, tail, and head/body. Marking animals enables the calculation of relative abundance estimates for capture data. If at all possible, any trap capturing a mustelid should be replaced and then cleaned before reuse because the strong smell can negatively affect subsequent rodent captures. Trap mortalities are collected and frozen as soon as possible, labeled with date of collection, county and state of capture, collector's name, project name, agency office of contact, description of habitat type at the trap location and a description of the specific locality where the animal was collected (e.g., edge of dry creek bed at north end of meadow). Species identification is confirmed and animals are donated to a local museum collection. Deer mouse (*Peromyscus maniculatus*) and other known vectors of Hantavirus (e.g., *P. leucopus*, *P. gossypinus*, *Sigmodon hispidus*) should not be routinely collected due to the associated risk.

All traps are cleaned and disinfected after sampling is completed at each location. Traps are emptied of all loose bait, organic material and polyester batting before being placed

into a mild bleach/water (CDC recommends 3 T/1 gal) solution or 5% Lysol solution where they remain for approximately 10 minutes. Heavily soiled traps are scrubbed with brushes while submerged in the mild bleach or Lysol solution until clean. Traps are then rinsed with water and allowed to dry fully before being used for the next survey.

Polyester batting is also soaked in mild bleach or Lysol solution for 10 minutes and placed in plastic bags before disposal. Cleaning traps with mild bleach or Lysol solution is recommended after each site survey is conducted where species that are hosts for Hantavirus are captured (Mills et al. 1995). A mild bleach solution does not appear to affect subsequent captures of small mammals (Yunger and Randa 1999).

Equipment Needed

Per site: 84 Sherman traps (80, plus replacements), trap bait, polyester batting, 1 gallon plastic bags for bait (Ziploc bags preferred), scales (30, 50, 100, and 300 grams), field rulers, small scissors, clipboard, mammal field guides or keys, rubber gloves, leather gloves (for weasels and larger squirrels), backpacks for carrying traps (one per transect), hand lens (shrew identification), cloth face masks or respirators (as needed) and hand sanitizer (the latter two for protection from Hantavirus). *Equipment clean-up:* two 30-gallon garbage cans, water supply, bleach, hose with nozzle, scrub brush, protective eyewear, large flat area to spread out traps while drying.

Staffing, Skills and Training

Field crews are comprised of a minimum of four people, with one designated as field crew leader (GS-7/9). A crew of four individuals can be expected to sample four points per week (each crew of two can sample two sites per week). Four people are a minimum crew size because many sites require more than two people to transport traps in and out. Trappers will often need at least one additional person on the days that traps are set and pulled at sites. The crew leader should have at least two years of experience capturing and handling small mammals and the ability to effectively train and supervise field crews. Crew members can be GS-3/4/5 biological technicians, preferably with academic training in mammalogy and some experience handling animals. Inexperienced individuals can perform well, but potential problems include lack of attention to detail in implementing the protocol, and difficulty coping with stress imposed on some individual animals.

Prior to any data collection, an expected species list is generated based on range maps, guides to local fauna, and local occurrence records. When in doubt, consider the species as potentially occurring in the area and include it in the species list. The distinguishing features of each species should be noted (e.g., strongly bi-colored tail, hind foot length), with particular attention called to species that could be easily confused in the field.

Two weeks of training are recommended and should include the following as a minimum: 1) work with study guides that identify and discuss the defining features of each species, 2) visit University museums to observe and study the variability of defining characteristics that could be encountered in the field, and 3) practice trap setting and animal handling in a variety of environmental conditions. Oversight of surveys at the

Forest or multiple-Forest level should be conducted by a journey-level GS-11 or higher grade employee with at minimum two years of relevant field and supervisory experience.

Crews should work in teams of two whenever possible because of the dangers of hiking cross-country with heavy backpacks and the potential for injury from handling animals. Each crew should have at least one radio, and it is recommended that each crew also have a cell phone. Cell phones facilitate rapid and efficient communication with supervisors and co-workers. Safety precautions recommended for handling possible vectors of Hantavirus followed that of Mills et al. (1995), however, crew leaders should check specific Regional recommendations for handling small mammals. Animal handling follows guidelines defined by the American Society of Mammalogists (Animal Care and Use Committee 1998).

Management Quality Objectives

Protocols for the use of baited live traps for small mammal surveys are well established, with recognized sources of bias that can affect data quality. Factors affecting data quality that should be discussed in detail with crew members include: 1) setting traps so they are effective at capturing animals and animals have a high probability of survival once captured, 2) observer care in handling animals to minimize escape prior to marking or mortality of stressed animals, and 3) observer error in species identification and the identification of marked animals. Ideally, all traps are fully functional and set properly to capture animals; it is reasonable to expect < 1% of all traps to be improperly placed and set. Proper trap placement and function can be determined subjectively through field reviews by supervisors. Mortalities should be < 1%, and reported to the field supervisor at the end of each day. Mortality rates can be determined by examining field data. Escapes rates can be reasonably expected to be < 1% of all animals captured. It may be difficult to meet this objective for individual species, specifically for larger and more difficult to handle animals (e.g., weasels). However, escapes rates can be kept at < 5% even for these animals with the proper gear and training. Escape rates per species and across all animals can also be determined by examining field data. Species identification and correct classification of marked animals is difficult to quantify. Swapping observers among sites and transects in the course of a trapping period can help reveal and reconcile differences in species identification among observers.

Data Management and Analysis

Data sheets are checked by fellow crew members at the end of each day to make sure that all fields are filled out correctly and legibly. This also serves to identify discrepancies in species identification among observers and alert observers to unusual species or situations that they may encounter the next day. Field supervisors check all data sheets at the end of each week to review species identification, escape rates, trap function, mortalities, and legibility.

Minimally, data analysis consists of creating species lists for each monitoring point and estimating the proportion of points occupied based on the program PRESENCE (see

Chapter 2, section 2.5.2). Relative abundance of species across points each year can be estimated by counting the number of unique individuals captured for each species (based on the number of first captures per species). Sampling adequacy can be evaluated by estimating the probability of detection per unit effort, and estimating the power to detect a trend of a given magnitude and precision given the existing sample effort. Sample effort may then be adjusted if indicated by the analysis.

5.2 Supplemental Survey Methods

Sherman trapping is an effective method to detect most small mammal species. Supplemental survey methods should be directed at detecting species not readily detected by the core Sherman trapping method. The list of species expected to occur in the area should be consulted and species most likely to be detected with a modest level of additional effort should be targeted by supplemental survey methods.

5.2.1 Sherman Live Trapping Augmentation

Trap session duration - While 3 days and 80 traps are the recommended effort for the primary method, a longer trapping period may be desired for detection of a greater percentage of the small mammal community or to obtain more precise estimates of abundance (Olsen 1975, Steele et al. 1984). Trapping for one additional night, and removing traps on Friday morning will improve estimates of species richness, composition, and relative abundance. Additional traps are not as likely to yield additional benefits as one additional night (e.g., Manley et al. 2004). Species accumulation curves can be produced from preliminary data collected on any forest, region or eco-region to determine the level of survey effort at which various percentages of the small mammal community are detected (Cam et al. 2002).

Trap grids - The addition of trapping grids in association with the primary method may be warranted in cases where population densities or other additional population data are desired for one or many species. The addition of a grid will increase the proportion of individuals using the area that are captured. Trap grids of 50 or more additional traps may be established on either side of the center trap line. An option that resembles a typical grid pattern is to establish three transects on each side of the center line – 15 m apart, 200 m long, for a total of 60 additional traps placed 20 m apart, creating a trap grid of 80 traps.

Trap placement - Placement of traps at various heights above ground (i.e., placement of traps in trees) has been shown to be effective at detecting arboreal small mammals (Lawrence 1992), such as flying squirrels (Risch and Brady 1996, Loeb et al. 1999). Therefore, monitoring programs established in areas with arboreal species of interest should consider the placement of an additional extra long or extra large Sherman trap along each transect at 3-4 m above ground in nearby trees to increase the capture frequency of such species.

5.2.2 Tomahawk Traps

Tomahawk™ traps (Tomahawk Live Trap Co., PO Box 323, Tomahawk, WI 54487) can be effective at increasing detection rates of larger rodents such as ground squirrels and woodrats, however the additional cost of using Tomahawk traps is not typically warranted for simply increasing squirrel detections. Tomahawk traps are most effective at detecting medium-sized mammals, and if they are used for that purpose, squirrel detections are likely to increase (see Chapter 6, section 6.2.2). However, during pilot testing, trackplate and camera surveys were more effective at detecting a wider array of medium-sized mammals compared to Tomahawk traps (Manley et al. 2002).

5.2.3 Pitfall Traps

Pitfall traps can be more effective at detecting some of the smaller-bodied rodents compared to Sherman trapping, particularly shrews and gophers which are typically not well sampled with Sherman traps (Szaro and Belfit 1988). However caution is recommended in using pitfall traps for monitoring because they are often lethal to captured mammals, particularly shrews, and thus have the potential to impact local populations. If pitfall traps are configured to capture mammals, options for minimizing impacts on local populations include shorter sample periods and truncating sampling once all species potentially occurring at the site are detected. See Terrestrial Amphibian and Reptile Monitoring (Chapter 8) for a detailed description of pitfall trapping.

5.2.4 Trackplate and Camera surveys

Trackplate and camera surveys are identified as a primary protocol for medium and large mammals (see Chapter 6, Medium and Large Mammal Monitoring protocol), but they can also be effective at detecting smaller mammals. Tracks of many of the larger squirrel species can be identified to species, and a variety of tree and ground squirrels are attracted to bait at cameras, particularly when bait consists of a mixture of animal and vegetable matter. Trackplate and camera surveys are too expensive relative to their effectiveness for small mammals to be used to augment Sherman trapping alone. However, detections of many species of small mammals will be enhanced when trackplate and camera surveys are used to target detections of other taxa.

5.3 Literature Cited

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