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AMERICAN SOCIETY  
OF MAMMALOGISTS

ACCEPTABLE FIELD METHODS IN MAMMALOLOGY:  
PRELIMINARY GUIDELINES APPROVED  
BY THE AMERICAN SOCIETY OF MAMMALOGISTS

*Ad hoc* Committee on Acceptable Field Methods in Mammalogy



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The American Society of Mammalogists historically has prepared guidelines to encourage its members to maintain high professional standards. Previous guidelines have dealt with curation of systematic collections (Advisory Committee for Systematic Collections in Mammalogy, 1974; Committee on Systematic Collections, 1975, 1978), scientific permits (unpublished report of Committee on Legislation and Regulations, 1977), and the use of animals in research (ad hoc Committee for Animal Care Guidelines, 1985).

Members of the ad hoc committee who contributed to preparation of guidelines pertaining to acceptable field methods in mammalogy were J. R. Choate (chairman and editor), R. J. Baker, G. W. Barrett, E. C. Birney, R. C. Dowler, J. F. Eisenberg, M. L. Johnson, T. L. Kunz, A. T. Linzey, J. H. Shaw, J. M. Taylor, and B. Wunder. Numerous other mammalogists provided input on earlier drafts, and the final working draft was approved for publication by the officers and directors of the American Society of Mammalogists.

The objective of these guidelines is to identify field methods in mammalogy that meet the standards of the American Society of Mammalogists. As such, the guidelines are preliminary and may be revised in the future. They were formulated with consideration for both animal welfare and research needs in field investigations, for which guidelines for laboratory animal care generally do not apply. Similar guidelines pertaining to mammals have been established by other organizations (for example ABS/ASAB, 1986) and should be consulted as

needed. The American Society of Mammalogists' guidelines are intended not to obstruct ingenuity in research design or to stifle the quest for newer, better research methods or materials; ultimate responsibility for design of research and selection of techniques must rest with the investigator. Although the guidelines have been prepared by mammalogists primarily for use by mammalogists (broadly defined as anyone studying any aspect of mammalian biology), they also may be of interest to governmental agencies that establish, administer, or enforce policies and regulations relating to mammals and to agencies responsible for funding scientific research on mammals.

## INTRODUCTION

### Explanation of Field Work in Mammalogy

Field investigations conducted by mammalogists result in accumulation of knowledge on the biology of mammals. These studies thereby enhance our understanding of the complexities of mammalian relationships in time, space, within and among species, and with other components of the biotic and abiotic environment. This knowledge provides a basis for prudent decisions regarding the welfare and survival of all mammals, including ourselves.

In its simplest form, field work may consist merely of direct observation of mammals. However, many species of mammals are secretive, nocturnal, or both and, thus, not suited for study by direct observation. Besides, most kinds of information cannot be obtained by simple observation. Therefore, the objectives of most studies mandate that individuals be captured one or more times. Hence, these guidelines for field methods in mammalogy apply to virtually all research involving mammals.

### Why Mammalogists Collect Specimens

Mammalian research typically involves the judicious collection or live capture of mammals in the field. Information thus obtained enables accurate

identification of species and understanding of systematic and evolutionary relationships, genetic phenomena, population dynamics, community structure and dynamics, comparative anatomy and physiology, behavior, parasites and diseases, economic importance, geographic and microhabitat distributions, ecology of mammals in their natural or managed environments, and other scientifically important phenomena. Knowledge in the science of mammalogy promotes knowledge in other sciences, and vice versa, and helps facilitate promulgation of management policies for game and nongame species, endangered species, economically important species, conservation of habitats, ecosystem analysis, control measures for pest and disease-bearing species, predator control, and the domestication of species.

Many mammals (or parts thereof) that are removed from the field eventually are deposited in natural history museums or biological banks. Museums are managed repositories for whole specimens and their parts, whereas biological banks are collections of histologically or cryogenically preserved organs, tissues (including live cultures), cells (including gametes), or embryos. Both kinds of repositories permit qualified researchers to study these collections. Such collections are invaluable as sources of mammalian research materials for use in current and future scientific investigations. It is highly recommended that voucher specimens be retained at the conclusion of all field investigations, and that these specimens be deposited in museum collections that meet the minimal standards of maintenance (Committee on Systematic Collections, 1978) established by the American Society of Mammalogists so that they will be available for use by future investigators.

#### What is an Adequate Sample?

An adequate sample may be defined as the number of specimens or other data necessary to ensure empirical and statistical validity. The sample size required for a study thus depends on the nature of the investigation and the

extent of variation in the parameters being studied. In general, field studies require larger samples than laboratory studies because field investigators have less control over conditions (both biotic and abiotic) that produce variation. For certain anatomical studies, one or two specimens, or parts thereof, may comprise an adequate sample; for environmental monitoring and computer modeling studies, much larger samples may be necessary.

Computer modeling, simulation, and appropriate statistical methods sometimes can reduce the number of mammals required for an adequate sample, as can use of pre-existing specimens in museum collections. Nevertheless, the objectives of most research require that additional specimens be collected. For this purpose, the investigator should collect no more specimens than needed and should be prepared to explain why a particular sample size is required.

#### COMPLIANCE WITH LAWS AND REGULATIONS

It is the responsibility of each mammalogist to comply with relevant laws and regulations pertaining to the field collection of mammals. Ignorance of the law or even inadvertent violation of regulations may result in prosecution (as reported by Choate and Genoways, 1975).

Federal regulations pertaining to collection, import, export, and transport of scientific specimens of mammals previously were reviewed by Genoways and Choate (1976). Permits issued by various federal agencies are required for at least the following purposes: 1) to import or export specimens of non-endangered species through a non-designated port of entry; 2) to import injurious wildlife; 3) to import, export, ship interstate, take, and possess endangered species and parts thereof for research or propagation; 4) to take, harass, possess, or transport marine mammals; 5) to import or transfer etiological agents or vectors of human disease and living non-human primates; 6) to collect scientific specimens on national wildlife refuges; 7) to import

ruminants and swine, including parts, products, and by-products; and 8) to import organisms or vectors, tissue cultures, cell lines, blood, and serum. Mammalogists should ascertain whether additional permits are needed when they review the state and federal laws and regulations that relate to their planned field investigations. Investigators especially must be familiar with the current list of mammalian species deemed rare or endangered and must comply with all rules and regulations pertaining to capture of these and all other categories of mammals. A current list of rare and endangered species is available from the Office of Endangered Species, U.S. Department of Interior, Fish and Wildlife Service, Washington, DC 20240. The rules are published in the Code of Federal Regulations, Title 50, Chapter 1. The Federal Register publishes amendments to regulations under Title 50.

Most states now require scientific collecting permits, and mammalogists must comply with this requirement and other regulations imposed by agencies in the states in which they do field work. Lists of all mammals (as well as other animals and plants) that are regarded as threatened or endangered or are controlled by wildlife regulations in each of the 50 states and the Virgin Islands are published periodically (Berger and Neuner, 1981) together with the addresses and telephone numbers of conservation officers who can respond to questions regarding regulations and permits.

Some cities, counties, agencies, and other organizations in the United States and most foreign countries have rules regarding scientific uses of wildlife on lands under their jurisdiction. Compliance with these is essential. Finally, the permission of the owner, operator, or manager of privately-owned land must be obtained before commencing field work thereon.

## METHODS FOR COLLECTING SPECIMENS

### Killtrapping and Shooting

Humane scientific methods of killtrapping and shooting are those that kill the mammal quickly and avoid injury to body parts required for the investigation. Killtrapping methods that meet these requirements include various kinds of snaptraps (such as Victor rat traps and Museum Special mouse traps) for small, terrestrial mammals, Macabee and comparable traps for pocket gophers, harpoon traps and similar devices for moles, and Conibear traps and similar devices for medium-sized mammals. Killtraps should be positioned with care so as to ensure the highest probability of capture of the "target" mammal(s) and the lowest probability of capture of other animals. They should be secured well and marked conspicuously to prevent loss. They should be checked at least once each day to remove captured mammals. If a captured animal is not already dead, it should be killed humanely. Finally, snaptraps set for nocturnal species should be removed or sprung during the day to avoid accidental capture of diurnal animals. If used as killtraps, pitfalls should contain sufficient liquid to ensure that the captured mammals drown quickly.

Leg-hold traps typically do not kill mammals quickly except when set underwater, where the captives drown. Mammalogists therefore should use a more humane kind of trap when any other will serve the purpose. If no other kind of trap will do, it is recommended that leghold traps be modified or padded to reduce the incidence of injury to captured mammals (Kuehn et al., 1986) and that the traps be checked very frequently, at least twice each day.

Shooting is the most effective way to collect some species and the only effective method for certain other species. Investigators who employ this technique should be experienced in the proper and safe use of firearms and must comply with laws and regulations governing their possession and use. Humane use of firearms necessitates that mammals be killed outright, so the firearm should

be appropriate for the species to be collected. Chipmunk-sized or smaller mammals can be shot with a .22 caliber pistol or rifle loaded with dust shot. Dust shot also should be used when bats are collected by shooting. A flood light used at night may attract insectivorous bats to swarms of insects and thereby facilitate shooting. A .22 caliber rifle loaded with conventional bullets or a 12, 16, 20, or .410 gauge shotgun with appropriate loads is better suited for medium-sized mammals (as large as a raccoon). The shooting of large mammals may require use of a high-powered rifle with appropriate cartridges. Shooting nocturnal species with the aid of a spotlight (when legal) demands extra safety precautions and skill because of limited visibility.

#### Livetrapping and Netting

Humane scientific methods of livetrapping and netting are those that keep the captured mammals alive, uninjured, and in a comfortable microenvironment while contained for subsequent handling. Live traps are box-like or tube-like containers, constructed of sheet metal, wood, wire mesh, or plastic, typically with one or more doors that close when a mammal triggers a door-closure mechanism. They may be purchased from such manufacturers as Sherman, Havahart, Longworth, National, and Tomahawk, or they may be home-made. For non-fossorial mammals, live traps should enclose a volume adequate for movement therein of the target species; for fossorial mammals, trap diameter typically approximates that of the burrow (for example, Baker and Williams, 1972). The trap mechanism should not inflict injury and should be effective in containing the captive so that it does not become stuck or partially held in the trap door. In certain circumstances, padded leghold traps may be appropriate for livetrapping large mammals.

Live traps must be checked frequently. Therefore, the number of traps to be set should be based on the number and energy of persons available to check



them and the conditions of the area. The type of live traps, activity patterns of the mammals to be trapped, configuration of the trapline, and climate and season determine the period between trap-set and trap-check. Typically, live traps for nocturnal species should be set before dusk and checked as soon as possible after dawn. They should be closed during the day after the morning check to prevent accidental capture of diurnal species. Live traps for diurnal species should be shaded or positioned so as to avoid full exposure to the sun and checked every few hours to prevent heat stress of captive mammals. During cold weather, the energy demands of thermoregulation require that an adequate supply of food and nesting material be placed in live traps set for small mammals.

The trapper is obligated to find and inspect every live trap each time the trapline is checked and to remove all traps from the field at the completion of the trapping period. If live traps are set randomly, they should be numbered and set sequentially or the trap sites should be tagged to ensure complete check and retrieval.

Pitfalls used as live traps also must be checked frequently and should contain adequate food to last until the next trap-check. Moreover, they should be covered to keep out rain or punctured to permit drainage. Pitfalls are not acceptable live traps in saturated soils.

Some species of mammals can be captured by hand. When done with care, this is an especially effective and humane capture technique.

Corral traps are designed to enable herding of large mammals along fences or runways into a corral. This technique commonly is used by wildlife personnel in studies or management procedures involving large mammals. As with cannon-nets, another technique of choice in the wildlife profession, care should be taken to avoid injury to captured mammals. When corral traps or nets are used,

all animals captured should be attended to as quickly as possible to prevent panic or injury.

Mist nets, harp traps, and similar devices (Kunz and Kurta, in press) are humane and effective methods of capturing live bats. These devices are best set immediately before sunset and dismantled before sunrise. Bats captured in mist nets should be removed immediately to prevent them from damaging the net. Mist nets should be tended continuously to avoid undue entanglement of, or predation on, captured bats and should be rendered inoperative between capture efforts. Mist nets should not be deployed at sites where large numbers of bats may be captured (for example, at the entrance to a cave); in such circumstances, harp traps are recommended. Harp traps should be monitored regularly but do not require constant vigilance as do mist nets. Particular attention should be given to the time of year when bats are collected from communal roosting sites. Maternity colonies generally should be avoided during the period when young are born to reduce disturbance-related mortality. Repeated disturbance of hibernating bats also may cause depletion of critical fat stores, which can lead to high mortality.

Use of "Cap-Chur" guns or darts to shoot a sedative into the flank of a large mammal requires knowledge of proper dosage and adequate logistical support to track the mammal until the sedative takes effect. Unless the investigator has considerable experience in the use of this capture method, it is recommended that the advice of a wildlife veterinarian be obtained. Location of the mammal and time required for sedation should be considered to avoid injury or drowning of sedated mammals. Sedated mammals should be monitored closely and should not be released until they recover normal locomotor capabilities.

It is recommended that captive small and medium-sized mammals be handled by methods that restrain the body and appendages yet permit easy breathing. This can be accomplished by means of a mesh or cloth bag. The mammal usually can be

marked, measured, biopsied, or otherwise sampled through the mesh. Larger mammals may require mild sedation before they are removed from a trap for examination.

#### METHODS FOR SAMPLING TISSUE FROM LIVE MAMMALS

Both non-invasive and invasive techniques used in sampling tissues from live mammals require humane procedures and astute professional judgment aimed at obtaining maximal scientific data from a minimum of samples. The advice of a veterinarian may be helpful in planning such procedures. Only trained, experienced personnel should take tissue samples from live animals.

Judgment about the use or non-use of local anesthetics when sampling peripheral body tissue and tissue fluids, such as blood, lymph, sperm, and tissue samples from body openings, should be based on a conscious effort to avoid or minimize pain on the part of the mammal. If pain is slight or momentary, it may be judicious not to use anesthesia so that the mammal can be released immediately. Tranquilizers used to immobilize large mammals are not acceptable substitutes for anesthesia when subsequent treatment produces more than slight or momentary pain. If a mammal is destined to endure prolonged, painful effects from capture, sampling, or other treatment, euthanasia should be practiced.

Although aseptic techniques are difficult in the field, cleanliness in all surgery or puncture techniques is essential to minimize the potential for infection and to provide reliable biological samples. Under no circumstances should a mammal be removed from close observation and released until it has recovered from treatment.

Small amounts of blood can be obtained from small terrestrial mammals by clipping the tail. From bats, blood can be obtained by venipuncture in the tail membrane or along the leading edge of the wing. If larger volumes are needed,

venipuncture of the femoral or jugular vein, the orbital sinus, or any of several venous plexuses can be performed on most mammals without significant risk of mortality and sometimes without the need for anesthesia. Cardiac puncture under anesthesia may yield moderate amounts of blood with low risk of mortality. In rare instances where a large amount of blood is needed from a small mammal, terminal thoracotomy under anesthesia followed by exsanguination may be the only appropriate method.

External tissue samples, such as skin clips, may require sterile conditions or anesthesia. Internal tissue samples, obtained by large-bore needle biopsy, generally require immobilization and anesthesia but can be performed in the field if careful protocol and sterile instruments are used (consultation or collaboration with a veterinarian or physician is essential in such field procedures). NIH guidelines define surgery as any penetration of a major body cavity and recommend that all such surgery be done under aseptic conditions in the laboratory. Mammalogists should be familiar with regulations promulgated by the Secretary of Agriculture (CFR, Title 9, Subchapter A, Parts, 1, 2, 3, and 4) with respect to the care, handling, and treatment of vertebrate animals held or used for research, teaching, or other activities supported by Federal grant awards and the Animal Welfare Act (P.L. 89-544, 1966), as amended (P.L. 91-579 and P.L. 94-279). Moreover, mammalogists are expected to follow guidelines described in NIH Publication No. 85-23 (revised 1985), Guide for the Care and Use of Laboratory Animals, and to comply with the "U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training" (included as an appendix to the NIH Guide). Finally, mammalogists should be familiar with the American Society of Mammalogists' "Guidelines for the use of mammals in research (ad hoc Committee for Animal Care Guidelines, 1985).

#### METHODS FOR MARKING AND TRACKING

The objective of marking a mammal is to permit its reidentification in the field, either upon recapture or from a distance. Therefore, the method employed should be as painless as possible and should not restrict the normal activity and well being of the mammal.

The objectives of the investigation and the species under study determine the most appropriate marking method. Temporary marking with fluorescent powder or non-toxic dye, by spot-shaving, or by injection of low dosages of short half-life radioisotopes should be employed when practical, if the study is short-term or seasonal. More permanent marking methods, such as tagging, collaring, banding, ear-punching, toe-clipping, tattooing, and freeze branding, may be suitable for long-term studies.

To ensure the comfort of the marked mammal and easy reidentification, marking methods should be appropriate for the size, body form, and habits of the species. Metal or plastic tags should be properly applied and should not burden the mammal or make it vulnerable to injury. Sequentially numbered or color-coded markers can be inserted into the ear, around the neck or leg, or into loose body skin (using topical anesthesia if necessary).

Bats are best marked with wing bands or bead-chain necklaces (Barclay and Bell, in press). Generally, wing bands should be applied loosely so they slide freely along the forearm. If young bats are to be banded, the bands should be large enough to allow for continued growth. The wing membrane of some species may need to be slit to accommodate the band properly. If bead-chain necklaces are used, extreme care should be taken to ensure proper fit.

When no other marking methods are feasible, ear-punching and toe-clipping are quick, long-term marking methods that cause only brief and minor discomfort to small mammals (mouse- or rat-sized). Clipping should be performed with a

sharp instrument. When practicable, no more than one toe per foot should be clipped. These methods should not be used on bats because of the important roles of the pinna in echolocation and the toes in roosting.

Radiotelemetry is an especially useful method of locating and tracking medium-sized and large mammals whose wanderings are difficult or impossible to monitor by frequent livetrapping. The method is appropriate for use on mammals that can carry the transmitter and antenna without encumbrance. The transmitter normally is incorporated into a collar or harness that, like any other tagging device, should be secured without restricting or abrading the body parts. For terrestrial mammals, the transmitter normally should not exceed 10% of body mass. Small bats (less than 70 g) should not be fitted with radiotransmitters that exceed 5% of the animal's body mass. For bats, transmitters are most successfully attached to the mid-dorsal region using surgical adhesive (Barclay and Bell, in press). In studies on some mammals, the transmitter may be implanted surgically. The investigator is obliged to monitor the condition of the marked mammal and, if practical, remove the transmitter at the completion of the study. Collars placed on young, growing mammals should be of an expandable or break-away type if there is a low probability of recapturing the mammal to remove the collar before it becomes too tight.

Other acceptable tagging methods involve use of low-level radioactive tags, light-emitting diodes (LEDs), Beta lights, and chemical light tags. Radioactive tags are especially valuable for studies of fossorial species for which radiotelemetric methods may be impractical. All relevant federal, state, local, or university procedures must be followed if this method is used. When the study is completed, marked animals should be captured so the radioactive material can be removed and all contaminated materials should be disposed of according to established safety standards (Code of Federal Regulations, Title 10, Part 20).

#### HOLDING AND TRANSPORTING CAPTIVE MAMMALS

Captured mammals to be retained for brief periods (no more than a few hours) or transported to a laboratory should be placed in appropriate holding cages, which can include live traps if those traps are provided with adequate ventilation, food, and a source of water, and they encompass sufficient space to ensure the comfort of the captive mammals. Acceptable holding devices for bats were described by Kunz and Kurta (In press).

Cages for mammals should be kept out of the sun, wind, and rain at a comfortable temperature, and the captives should be checked frequently. It should be understood that most field vehicles are not mobile laboratories and that conditions in a vehicle cannot be maintained as they are in a laboratory facility. Rather, the precautions used for the humane transport of household pets should be applied when transporting research animals. However, if mammals returned to a laboratory are kept there for a period of time before being processed, conditions in the laboratory must comply with guidelines described in NIH Publication No. 85-23 (revised 1985), Guide for the Care and Use of Laboratory Animals, and any local regulations that may apply. Those guidelines typically also must be met if a permanent or long-term colony is maintained. However, guidelines for maintenance of animal colonies do not apply to the design of research intended to simulate nature in the laboratory, in experimental studies using enclosures or environmental manipulations in the field, or when wild mammals kept in captivity require conditions other than those permitted by the guidelines; obviously, in such instances, professional judgement must prevail. In this regard, methods for the special care and housing of bats in the laboratory were summarized by Wilson (In press).

#### RELEASING PREVIOUSLY CAPTURED LIVE MAMMALS

There are few exceptions (for example, reestablishment of previously extirpated populations) to the rule that field-caught mammals must be released only where they were captured. To do otherwise potentially would upset natural populations and reduce their chances for survival. Moreover, mammals should be released as soon as possible to minimize behavioral or physiological changes resulting from the conditions of captivity or immigration of replacement individuals. Finally, consideration should be given to releasing mammals at times coincident with their normal activity patterns.

#### HUMANE METHODS OF EUTHANASIA

Field methods used to sacrifice mammals should be quick, as painless as possible, and compatible with both the design of the investigation and the size and behavior of the species of mammal under investigation. Also, they should comply with relevant provisions of the Public Health Service Policy on Humane Care and Use of Laboratory Animals by Awardee Institutions. Use of carbon dioxide, ether, or other gases (except chloroform, which is not recommended by Public Health Service guidelines because of hazards to the investigator) for euthanasia is acceptable but sometimes is impractical under field conditions. For small mammals, thoracic (cardiopulmonary) compression or cervical dislocation are the most commonly used methods because they are quick and impart little pain. Euthanasia by shooting or traumatic means also is humane and effective if the result is instantaneous death but should not be employed except by experienced investigators. Other methods of euthanasia have been reviewed by the American Veterinary Medical Association's Panel on Euthanasia (1986).

#### HEALTH PRECAUTIONS

All wild mammals are potentially dangerous. Bubonic plague is caused by a bacterium that can be transmitted to humans through the intermediary of a flea



that occurs on certain rodents, especially sciurids. Tularemia is a bacterial disease, primarily of lagomorphs, that can be transmitted to humans by arthropods or by eating or handling infected animals. Reasonable precautions should be taken by investigators to avoid exposure to these and other arthropod-borne hazards, such as Lyme disease and Rocky Mountain spotted fever. Other diseases for which mammals may serve as vectors or reservoirs include relapsing fever, murine typhus, salmonellosis, toxoplasmosis, and pasturella, just to mention a few. Investigators who become ill should inform physicians of their potential exposure to these diseases and the various parasites that occur on or in mammals in in geographic areas where fieldwork has been conducted. Moreover, investigators who work with carnivores or bats should be especially careful to avoid being bitten and should be immunized against rabies (Constantine, In press). In studies on bats, care also should be taken to avoid breathing potentially lethal gases (present in some caves and mines), to minimize exposure to anticoagulants that have been used in buildings to kill bats, and to avoid being infected by Histoplasma capsulatum (which causes histoplasmosis).

#### PUBLIC RELATIONS IN THE FIELD

Some field methods, even though completely legal and humane, may be misunderstood by the public. Therefore, it is good practice to be discreet in all activities that may affect the sensibilities of laymen. In general, it is good practice to take the time to explain field activities to interested or otherwise affected laymen.

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