TOS PROTOCOL AND PROCEDURE: SMALL MAMMAL SAMPLING

PREPARED BY	ORGANIZATION	DATE
Katherine M. Thibault	FSU	01/19/2017
Kim Tsao	FSU	10/25/2016
Yuri Springer	FSU	01/15/2015
Liz Knapp	HR	12/31/2013

APPROVALS	ORGANIZATION	APPROVAL DATE
Andrea Thorpe	SCI	02/06/2017
Mike Stewart	SYS	02/15/2017

RELEASED BY	ORGANIZATION	RELEASE DATE
Judy Salazar	CM	02/17/2017

See configuration management system for approval history.

The National Ecological Observatory Network is a project solely funded by the National Science Foundation and managed under cooperative agreement by Battelle. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A_DRAFT	07/11/2012	ECO-00469	Draft release
B_DRAFT	01/24/2014	ECO-01181	Draft release. Will finalize in next rev.
C	03/31/2014	ECO-01671	Production release, template change, and other changes as detailed in Appendix C. Merged with rodent-borne pathogen sampling protocol.
D	04/10/2014	ECO-01792	Updated Appendix D with site-specific information. Updated References. Added Appendix D, Bleed Grid Designation.
E	12/05/2014	ECO-02530	Migration to new protocol template
F	03/23/2015	ECO-02644	Decreased sampling bout duration for diversity grids from three nights to one. Changed cold temperature thresholds for trapping. Removed retro-orbital bleeding technique. Removed Heteromyidae from bleeding list and added Muridae. Added prioritization of processing steps. Added equipment and protocol modifications for D04, D19, D20. Added sp codes. Removed datasheet column references due to changes in datasheet; updated datasheet quick references.
G	05/04/2015	ECO-02890	Added IACUC requested language regarding cervical dislocation training and GRSM-specific IACUC instructions. Added back in anesthesia instructions, and added euthanasia instructions per the IACUC-approved protocol.
H	01/29/2016	ECO-03660	Baseline edits. Effective starting 2016 field season: added tick monitoring to data collection, clarified priority of data collection in decision tree. Revised instructions for pathogen grid selection, added instructions for blood sample processing and intentional voucher collection. Added alternative anesthesia delivery method. Clarified trap cleaning rules and added language to discourage dumping of seed on the ground when pulling a grid. Clean up of SOPs E and H.
J	02/17/2017	ECO-04445	Clarified priorities re: trapping nights per grid when time is limited, and pathogen grid selection guidelines. Alter processing prioritization scheme, including limiting blood samples to 20 per plot. Added additional guidelines for selecting blood samples for testing (Appendix D, E), and revised blood sample limit based on current budget. Updated dominant genera and species lists in Appendix E. Clairified ear tag replaced field; added date to the untagged voucherID format; ear sample collection using

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
			scissors; use of 'X' in trap coordinate to denote uncertainty; decreased seed sterilization temperature; added 'Unknown' option to reproductive fields; updated quick reference to reflect updates to datasheet; added language to accommodate mobile data entry application; updated shipping inventory instructions; changed data entry instruction to NOT enter any data if no traps were set on a given plot. Added guidance for entering identification references info at the level of the individual – no longer being collected at the level of the plot.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1 OVERVIEW

1.1 Background

Small mammals are widespread, sensitive to local environmental changes, and known to carry and transmit zoonotic agents; therefore, they have been chosen as sentinel taxa for the Terrestrial Observation System (TOS) of NEON. From NEON's perspective, species-specific demography and population sizes, prevalence of pathogens important to public health, species richness, and relative abundances can be monitored simultaneously and ultimately linked to land use and climate changes, and therefore provide useful metrics of responses in biodiversity to these and other drivers (Kao et al. 2012). Small mammals as primary and secondary consumers interact significantly with plants and ground invertebrates (other NEON sentinel taxa), and generally represent size classes, life histories, and home range sizes that are distinct from the other NEON taxa (Kao et al. 2012). NEON will use mark-recapture methods to assess the dynamics of small mammal diversity and disease across time and space (Ostfeld and Parmenter 2008).

NEON small mammal sampling will assess the abundance and diversity of the nocturnal small mammal communities of North America, including the population dynamics of species that are competent reservoirs for infectious disease, at dozens of sites (depending on study design and associated logistics) throughout North America, Hawaii, and Puerto Rico for a period of 30 years. This represents a significant increase in the number and diversity of long-term datasets involving small mammals, and will also be unique in the degree of standardization across studies, as well as the availability of the data and archived samples to the scientific community and the public. This will allow NEON and the scientific community to address a diversity of questions, and the associated vouchering of specimens and tissue samples will provide critical resources for external PI-driven research to address an even wider range of questions.

1.2 Scope

This document provides a change-controlled version of Observatory protocols and procedures. Documentation of content changes (i.e. changes in particular tasks or safety practices) will occur via this change-controlled document, not through field manuals or training materials.

1.2.1 NEON Science Requirements and Data Products

This protocol fulfills Observatory science requirements that reside in NEON's Dynamic Object-Oriented Requirements System (DOORS). Copies of approved science requirements have been exported from DOORS and are available in NEON's document repository, or upon request.

Execution of this protocol procures samples and/or generates raw data satisfying NEON Observatory scientific requirements. These data and samples are used to create NEON data products, and are documented in the NEON Scientific Data Products Catalog (RD[03]).

1.3 Acknowledgments

Many thanks to Jesse Dulberger, who wrote the first version of this protocol. Best practices are based on recommendations in Wilson et al. 1996, as well as the small mammal abundance and diversity working group (Guy Cameron, Bob McCleery, Bill McShea, Rebecca Rowe, Rob Swihart, Beatrice Van Horne).

All procedures described in this document have been reviewed and approved by the NEON's Institutional Animal Care and Use Committee (IACUC), in accordance with the policies and procedures described in the NEON Policies and Procedures for the Care and Use of Animals (AD[08]).

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain higher-level information that is implemented in the current document. Examples include designs, plans, or standards.

AD[01]	NEON.DOC.004300	EHSS Policy, Program and Management Plan
AD[02]	NEON.DOC.004316	Operations Field Safety and Security Plan
AD[03]	NEON.DOC.000724	Domain Chemical Hygiene Plan and Biosafety Manual
AD[04]	NEON.DOC.050005	Field Operations Job Instruction Training Plan
AD[05]	NEON.DOC.000915	TOS Science Design for Small Mammal Abundance and Diversity
AD[06]	NEON.DOC.004104	NEON Science Performance QA/QC Plan
AD[07]	NEON.DOC.000911	TOS Science Design for Vectors and Pathogens
AD[08]	NEON.DOC.002665	NEON Policies and Procedures for the Care and Use of Animals
AD[09]	NEON.DOC.002979	NEON Animal Care and Use Program: Training Plan for Personnel Working with Live Vertebrate Animals

2.2 Reference Documents

Reference documents contain information that supports or complements the current document. Examples include related protocols, datasheets, or general-information references.

RD[01]	NEON.DOC.000008	NEON Acronym List
RD[02]	NEON.DOC.000243	NEON Glossary of Terms
RD[03]	NEON.DOC.002652	NEON Level 1, Level 2 and Level 3 Data Products Catalog
RD[04]	NEON.DOC.001271	NEON Protocol and Procedure: Manual Data Transcription
RD[05]	NEON.DOC.001585	Datasheets for TOS Protocol and Procedure: Small Mammal Sampling
RD[06]	NEON.DOC.001025	TOS Protocol and Procedure: Plot Establishment
RD[07]	NEON.DOC.001244	NEON Algorithm Theoretical Basis Document: TOS Small Mammal Abundance and Diversity - QA/QA of Raw Field Data.

RD[08]	NEON.DOC.001907	Field Operations Key to the Small Mammals in NEON Domain 01
RD[09]	NEON.DOC.001908	Field Operations Key to the Small Mammals in NEON Domain 02
RD[10]	NEON.DOC.002167	Field Operations Key to the Small Mammals in NEON Domain 03
RD[11]	NEON.DOC.003135	Field Operations Key to the Small Mammals in NEON Domains 04 & 20
RD[12]	NEON.DOC.001909	Field Operations Key to the Small Mammals in NEON Domain 05
RD[13]	NEON.DOC.003136	Field Operations Key to the Small Mammals in NEON Domain 06
RD[14]	NEON.DOC.001910	Field Operations Key to the Small Mammals in NEON Domain 07
RD[15]	NEON.DOC.001911	Field Operations Key to the Small Mammals in NEON Domain 08
RD[16]	NEON.DOC.001912	Field Operations Key to the Small Mammals in NEON Domain 09
RD[17]	NEON.DOC.001913	Field Operations Key to the Small Mammals in NEON Domain 10
RD[18]	NEON.DOC.003137	Field Operations Key to the Small Mammals in NEON Domain 11
RD[19]	NEON.DOC.003138	Field Operations Key to the Small Mammals in NEON Domain 12
RD[20]	NEON.DOC.003139	Field Operations Key to the Small Mammals in NEON Domain 13
RD[21]	NEON.DOC.003140	Field Operations Key to the Small Mammals in NEON Domain 14
RD[22]	NEON.DOC.001914	Field Operations Key to the Small Mammals in NEON Domain 15
RD[23]	NEON.DOC.003143	Field Operations Key to the Small Mammals in NEON Domain 16
RD[24]	NEON.DOC.003141	Field Operations Key to the Small Mammals in NEON Domain 17
RD[25]	NEON.DOC.003142	Field Operations Key to the Small Mammals in NEON Domains 18 & 19

2.3 Acronyms

Acronym	Definition
CDC	Centers for Disease Control and Prevention
NIOSH	National Institute for Occupational Safety and Health
PIT	Passive Implant Transponder
PPE	Personal Protective Equipment
HEPA	High-efficiency particulate air
IACUC	Institutional Animal Care and Use Committee

2.4 Definitions

Small mammal: Any mammal that is (1) nonvolant; (2) nocturnally active; (3) forages predominantly aboveground; and (4) is greater than 5 grams but less than approximately 600 g. In North America, the target species include cricetids, heteromyids, small sciurids, and introduced murids. It does not include shrews, large squirrels, pocket gophers, rabbits, or weasels, despite the fact that individuals of these species may be incidentally captured.

Opportunistic vs. Non-target Species (terms and definitions modified from the National Park Service)

Non-target species: Any non-study animals directly or indirectly affected by the research. Examples include the potential to live-capture or kill non-target individuals (e.g., loss of offspring due to taking of one or both parents) or disturb/harass other species during the research activity (e.g., during sampling that employs airplanes and/or boats).

Opportunistic species*:* Any animal whose capture is accidental or incidental, but whose capture can lead to valuable information. Examples include non-target species of small mammals which, if captured, will be marked and released.

Sampling bout: The three consecutive (or nearly so) nights of trapping per pathogen and the one night of trapping per abundance/diversity grid intended to occur monthly or every other month around the new moon and includes all trapping grids.

3 METHOD

Standard Operating Procedures (SOPs), in Section 7 of this document, provide detailed step-by-step directions, contingency plans, sampling tips, and best practices for implementing this sampling procedure. To properly collect and process samples, field technicians **must** follow the protocol and associated SOPs. Use NEON's problem reporting system to resolve any field issues associated with implementing this protocol.

The value of NEON data hinges on consistent implementation of this protocol across all NEON domains, for the life of the project. It is therefore essential that field personnel carry out this protocol as outlined in this document. In the event that local conditions create uncertainty about carrying out these steps, it is critical that technicians document the problem and enter it in NEON's problem tracking system.

Quality assurance will be performed on data collected via these procedures according to the NEON Science Performance QA/QC Plan (AD[07]).

The plan includes:

- Hot checks in the field by HQ staff or contractor, if funding is made available.
- DNA barcoding of a subset of samples to quantify error rates in taxonomic IDs.

3.1 Sampling Goals

NEON requires the study of live organisms in their natural setting to document the diversity, population sizes, and pathogen prevalence of small mammals through time, in relation to such critical drivers as climate change and land-use change. These parameters will be assessed through a mark-recapture live trapping study and associated tissue collection. The NEON sampling design allows for robust estimation of (1) population sizes and species diversity using standard mark-recapture techniques (AD[05]), and (2) inter- and intra-annual changes in pathogen prevalence (AD[07]). All methods conform to standard methods used in the study of wild small mammals (see Wilson et al. 1996, Sikes et al. 2016).

3.2 Trapping design

Sherman live traps (H. B. Sherman, Inc., Tallahassee, FL, folding or non-folding, 3" x 3.5" x 9" or, if kangaroo rats (*Dipodomys spp.*) or rats (*Rattus spp.*) are common, 3" x 3.75" x 12") will be used to capture animals for the study. Trapping grids will be laid out with 100 Sherman live traps (10 m spacing – 10 rows – 10 columns). In D04 and D20, collapsible wire mesh traps (Tomahawk Live Trap, Hazelhurst, WI, 5" x 5" x 16") will also be used (50 per grid, at alternate stations starting with A1; see Figure 1).). Trapping will alternate between Tomahawk and Sherman traps; Tomahawks should be set during sampling bouts that occur in odd-numbered months, whereas Sherman traps (100 per grid) should be set during even-numbered months. Up to eight grids will be trapped during each sampling period, depending on the area of the site and associated logistics. The grids will be distributed proportionally

across the dominant vegetation types, collocated with a subset of the TOS Distributed Plots (see TOS Science Design for Small Mammal Abundance and Diversity (AD[05]) for additional details).

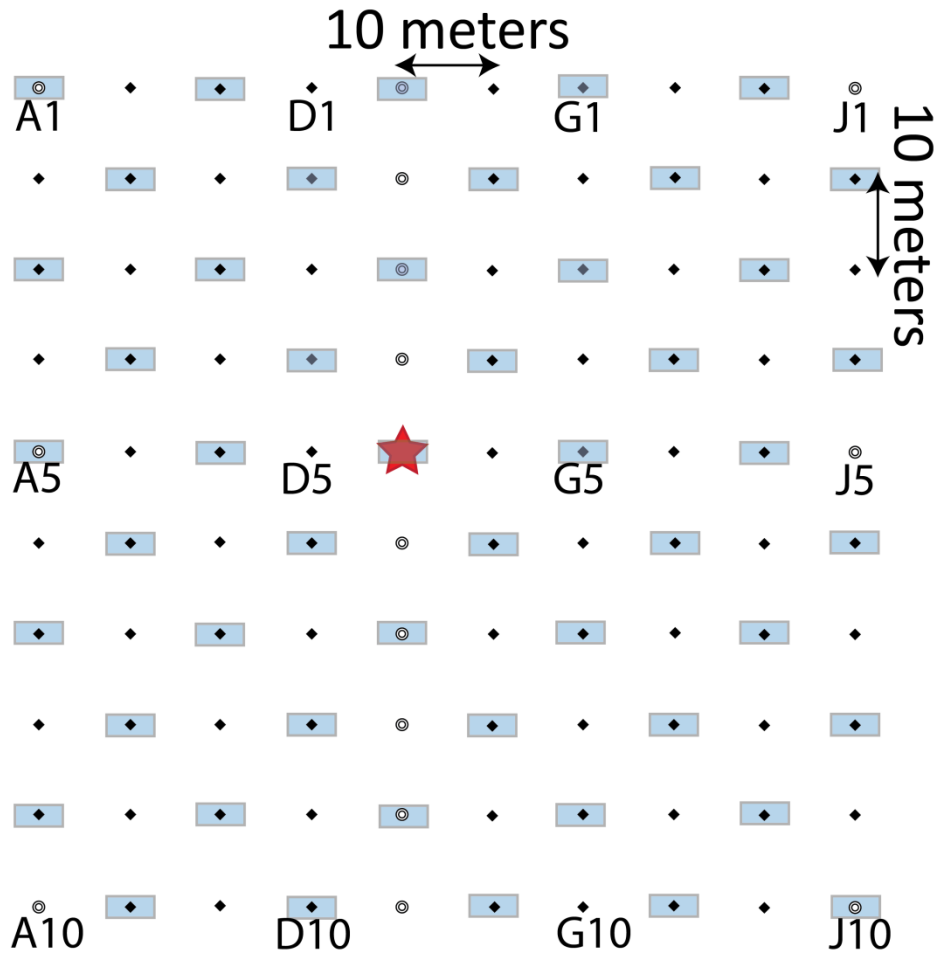


Figure 1. Schematic of trapping grids. Sherman traps, when used, are placed at all points in the grid, whereas Tomahawk traps, when used, are placed at only the stations marked by a blue box.

3.3 Grid types

Three grids at each site that occur within any or all of the dominant vegetation type(s) (see Appendix E) will be designated by domain staff as pathogen grids. The remaining grids will be designated as diversity grids.

Guidelines for selecting pathogen grids:

The primary goals in selecting pathogen grids are: 1) long-term sampling of target and opportunistic species, which requires moderate to high **average** capture rates, and 2) representation of the site's dominant vegetation type.

If there are more or fewer than 3 trappping grids that occur within the dominant vegetation type(s) and trapping data from previous years are available, the selected grids should be those with the highest combined abundances of target and opportunistic species. Otherwise, pathogen grids will be chosen at random or based on an educated assessment of habitat quality. Once a grid has been designated as a pathogen grid (after an initial assessment period of two years), that classification will apply for all subsequent trapping seasons for consistent, long-term data collection.

Exceptions: if the majority of captures in the dominant vegetation type at a site are heteromyids, then an alternate habitat type may be preferred (e.g., Moab, UT – see Appendix E). Abundance will vary by season and year, so pathogen grids will not always have the highest abundance relative to the other grids– consistent long term sampling is more important than always being the grid with the highest number of captures. However, if unusually low numbers of individuals of target and opportunistic species combined are captured on a pathogen grid per year, for two years or more, a problem ticket should be issued. A general rule of thumb for “low numbers of individuals” is 20 (total) per plot per year. High levels of disturbance may also be cause for changing a pathogen grid – when reporting disturbed sites, be sure to specify if the affected grid is a pathogen or diversity grid.

Extended sampling: When capture rates are low and resources permit, collecting blood samples from additional individuals from diversity grids is encouraged. Check Appendix E to ensure the number of animals used does not exceed the number of animals from which you will collect blood.

3.4 Personnel

It is expected that typically four (2 teams of 2) or two personnel will conduct the trap checking at each site, depending on the number of grids at a particular site and the capture rates per grid. Additional personnel can be used as needed. Each team will be comprised of at least one well-trained field technician who will be responsible for all of the handling procedures. The other technician will assist in trap setting and checking and data recording, and will assist in handling only if the technician is experienced in handling small mammals and has received all necessary training. Best practices in trapping include having the same person set and check specific traps, to decrease the odds of missing any traps during the check. That said, logistics often dictate the use of distinct teams to perform these temporally disjunct tasks. Under these circumstances, traps shall be counted and re-counted each morning to prevent traps from being missed.

3.5 Timing of trapping

Each pathogen grid will be trapped for 3 consecutive nights within a sampling period, while the remaining grids (i.e., diversity grids) will be sampled for only one night within a sampling period. Sampling will occur year-round at a monthly (at core sites only) or approximately every other month frequency (at relocatable sites), if resources are available and winter weather conditions permit (see section 4 for further details). If possible, trapping should occur as close as possible to the new moon, as

small mammal activity is thought to be restricted under high light conditions when predation risk is presumed higher (but see Prugh and Brashares 2010). Within a sampling period, timing of trap setting is generally managed so that the last trap is set as the sun is setting and the first trap is checked the following morning, as soon as it is light enough to process animals (i.e., within 30 minutes of civil twilight). Local conditions can necessitate deviations from this general plan; these deviations will be specified in the site-specific appendices for this document, if necessary. The animals to be studied are nocturnal, and this routine ensures that traps are not set longer than necessary – particularly during the hottest parts of the year. Where possible, between consecutive nights of trapping, traps will remain *in situ* but closed during the day to prevent diurnal animals entering and becoming heat-stressed. Furthermore, when temperatures will be extremely high even in the early morning (i.e., 27°C (80°F) by 10:00 am) and all traps are not shaded, one team will focus solely on checking traps and placing traps with captured individuals under the protection of shade and a heat shield, until they can be processed by the second team. This procedure reduces the amount of time animals spend in direct sunlight, which can result in lethal heat stress.

3.6 Bait

For all domains, except D04 and D20, Sherman traps are to be set and baited with a seed mixture (sunflower seeds -35%- and millet – 65%) that has been sterilized to prevent germination of these introduced species at NEON sites. Seeds are high quality resources utilized by most target small mammal species. In cold weather conditions, polyester or wool batting for nesting will be placed in the traps, except at sites dominated by rodents in the family Heteromyidae (e.g., Central Plains Experimental Range (CPER), Jornada Experimental Range (JORN)). These are burrowing rodents which are known to urinate on batting, thereby reducing its insulating properties, rather than building nests, and who will not consume peanut butter (see below). At sites where shrews (*Soricomorpha: Soricidae*) comprise more than 20% of the captured individuals on average (e.g., Harvard Forest), a teaspoon of freeze-dried mealworms should also be added to the trap. For sites with high variability of shrew capture rates across trapping grids, mealworms can be added only to particular grids of concern. Additional, high-calorie bait, such as peanut butter can also be added in the event of extremely cold conditions at many sites, except where not permitted (see), where medium- to large- mammal (e.g., raccoons, bears) disturbance of traps has occurred, or where fire ants occur (e.g., Jones Ecological Research Center (JERC), Ordway-Swisher Biological Station (OSBS)).

For D04 and D20, Sherman traps and Tomahawk traps will be baited with "bait balls" consisting of oatmeal, peanut butter, and vanilla extract. These balls should be encased in cheesecloth and cinched into the back of a Sherman or hung from a paperclip inside a Tomahawk (B. Patterson, pers. comm.). The cheesecloth is used to decrease the mess and to reduce attractability and access to ants. Although ants are of significant concern in both of these domains, previous small mammal sampling in both Puerto Rico and Hawaii successfully used peanut butter as bait (Engeman et al. 2005, Shiels et al. 2012).

3.7 Processing

- All processing will take place in the field, to allow for quick release of captured individuals at the point of capture and to provide adequate ventilation for the technicians. Upon capture, individual small mammals will be processed according to their classification as target, opportunistic, or non-target species (see 2.4 and If the number of samples still exceeds the maximum, prioritize samples collected from adult individuals to the exclusion of juveniles and subadults.
- Distribute samples across priority species and bouts as much as possible.

Site-Specific Information for detailed species lists). Processing includes:

- Marking with a unique tag (target and opportunistic species).
- Assessing age, sex, and reproductive condition, and taking standard measurements (i.e., hind foot length and weight).
- Identification to species where possible (all captures). Additional measurements (e.g., ear length, tail length, and/or total length) shall be taken when relevant to species identification (target and opportunistic species).
- Presence of ticks by life stage (target and opportunistic species).
- Blood collection for pathogen analyses (target species in appropriate condition).
- Fecal sample collection for physiological analyses (target and opportunistic species).
- Ear tissue for genetic analyses (target and opportunistic species)
- Clipped whiskers and hair for potential isotopic analyses (individuals of the dominant genus at a site).

Some of these data may be omitted in cases of high capture rates posing time constraints. These are outlined in SOP C.4 and Appendix B.

3.7.1 Marking

Individuals are marked to allow for the study of population dynamics, reproductive condition, timing of colonization of new individuals, longevity and movement, and a variety of other aspects of life history that require permanent individual marking.

3.7.2 Animal Care

This protocol has been reviewed and approved by NEON's Institutional Animal Care and Use Committee (IACUC). Any deviations from this protocol that may impact the well-being of a capture are not permitted.

During the trapping period, it is important to do everything possible to ensure the well-being of all potential captures. This includes providing adequate bait and batting under cold conditions (outlined below) and keeping traps in the shade under hot conditions. In addition, animals should not be kept in the traps for excessive periods of time, not to exceed 16-18 hours. If capture rates are high and there is a risk of approaching this threshold, perform only the highest priority tasks during handling (see SOP C.4 for further details).

PIT tags are injected under the skin on the back of the animal, and do not impede movement. Ear tags are small, metal, and do not cause unnecessary pain when applied quickly and with sharp and correct application (using provided tool and placed in cartilage at base of external pinnae). In rare cases, if tagging is deemed undesirable considering the condition of an animal (e.g., highly stressed), an animal may be released without tagging.

Handling time per individual will be 15 minutes or less, using techniques to reduce injury, stress, and pain. While handling, the condition of all captured individuals must be monitored closely. Specifically, the rodent's rate of respiration, spontaneous movements, responses to tactile stimulation, and ability to retain sternal recumbency will be monitored, in order to gauge both the state of anesthetization (when relevant) and general condition of the animal. A small vial of 10% sugar water will always be available to revitalize stressed, dehydrated, hypothermic or heat-stressed captures; this solution should be replaced regularly to inhibit the growth of mold. Stressed individuals will be placed in a secure container containing bait and, in the case of hypothermia, a disposable hand warmer and batting. If conditions are particularly cold (< 65° F/ 18° C) overnight and into the morning, a hand warmer can be started while driving to the site and placed on the defroster vents of the work vehicle so that it is warm by the time of arrival. These individuals will be monitored every 15 minutes and released only when the animal exhibits normal behavior. If no signs of recovery are observed by the time processing a grid is complete, the animal will be euthanized with a lethal dose of isoflurane. Death will be confirmed via cervical dislocation. The specimen will then be tagged on the foot, bagged, and placed on ice as soon as possible, with ultimate disposition in a curated collection (see SOP C.9 for additional details).

4 SAMPLING SCHEDULE

4.1 Sampling Frequency and Timing

Small mammal sampling shall occur in bouts, with a bout comprised of three consecutive (or nearly) nights of trapping on pathogen grids and one night of trapping on the diversity grids. Sampling frequency, or the number of bouts per year, is determined by whether or not the trapping grid is located at a core or relocatable site (Table 1). Sampling shall occur year-round, where personnel resources and weather conditions permit, with a minimum of four bouts per year for all grids at relocatable sites and a minimum of 6 bouts per year for all grids at core sites (Table 1). Any expected deviations from this schedule are indicated in the site-specific appendices.

If the sampling schedule must be altered, the priority is to sample each grid for fewer nights (2 night minimum for pathogen grids) rather than missing entire grids. Prioritize relocatable site grids over core site grids, since relocatable sites are sampled for only four bouts per year.

Table 1. Summary of sampling frequencies by site and grid type*

Site Type	Grid Type	Sampling Frequency	Number of nights per bout	Minimum bouts per year
Core	Pathogen	Monthly	3	6

Core	Diversity	Monthly	1	6
Relocatable	Pathogen	Approximately Every Other Month	3	4
Relocatable	Diversity	Approximately Every Other Month	1	4

* Some sites will likely not be able to adhere to these guidelines given limited snow-free windows for sampling. These deviations are captured in the site-specific appendices.

4.2 Criteria for Determining Onset and Cessation of Sampling

Sampling bouts should occur as close as possible to the new moon, and the timing of sampling at each site should remain as consistent as possible with respect to the new moon over the course of NEON operations. If necessary, the sampling schedule can be modified significantly between the first and second years of operations, to account for lessons learned. Once a schedule is established, acceptable variation around this timing for the initiation of sampling from one sampling bout to the next (and year to year) is 1-5 days (relative to the new moon). Trapping at core and relocatable sites should occur within a 21-day window centered on the new moon (i.e., 10 days before the new moon – 10 days after). This schedule is based on an assumption of a logistical constraint of trapping 3-4 grids at one site at one time. An example of a sampling schedule for an average temperate site is shown in Figure 2. However, there is no scientific requirement to schedule the trapping in this way, if sufficient personnel are available to sample more grids simultaneously. These details are left to the discretion of the Field Operations Manager to be approved annually by Science Operations.

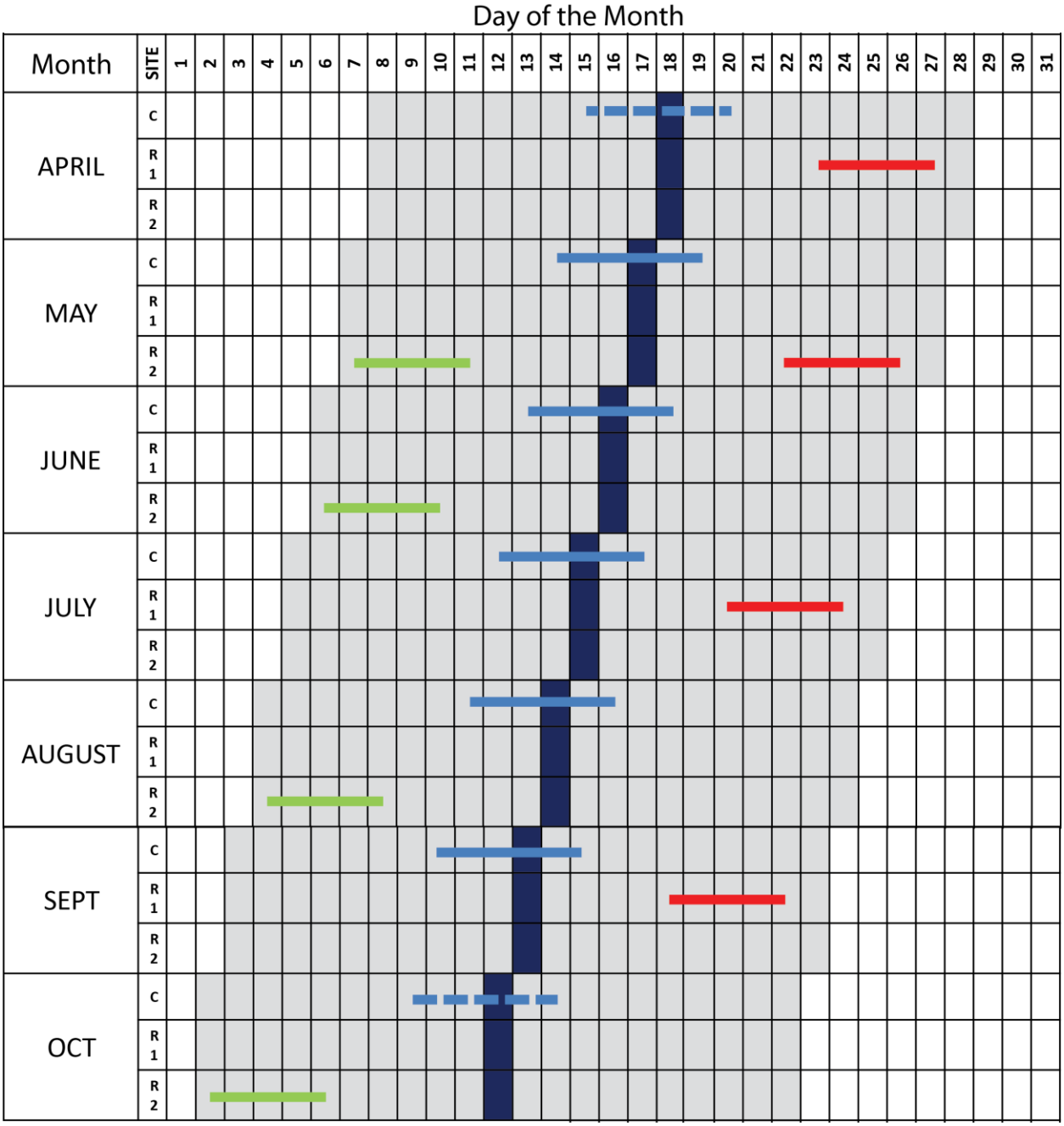


Figure 2. An example of a sampling schedule for a typical temperate site where weather conditions permit and technician resources are available only from April through October.

The days of the month are found at the top of the figure, with the months on the left. Within each month, each site in a domain is listed: C = core site; R1 = relocatable site 1; R2 = the other relocatable site. The hypothetical new moon dates are indicated by the dark blue cells, and the grey cells demarcate the sampling window each month that includes 10 days before and after the new moon. Be sure to use new moon dates estimated for the current year of sampling. The sampling bout durations for the core sites are indicated by the horizontal blue lines. These lines span 5 nights of trapping – an assumed duration to cover 3 nights of trapping on 3 grids and 1 night of trapping on the remaining 3-5 grids. The lines for April and October are dashed, as only one of these bouts is needed to meet the 6-bout minimum. The red and green horizontal lines span 4 nights of trapping at relocatable sites – assuming 3 nights of trapping on 3 grids and 1 night of trapping on the remaining 3 grids, where available.

Small mammal sampling can be performed under a variety of weather conditions. Care must be taken, however, to prevent conditions such that the trapped individual cannot thermoregulate properly, either in hot or cold conditions. Such conditions will result in the death of the trapped individuals. **Each mortality must be reported to the Field Operations Manager within 24 hours** of processing, to help ensure that all state- and site-specific permit requirements are followed. Please be aware that there are state- and site-specific permitting requirements detailed on permits provided by NEON Permitting for reporting both live captures, as well as mortalities, of vertebrates captured, including either all species or, in some case, just the species with state status. It is imperative that the technician(s) leading the small mammal trapping is (are) familiar with the guidelines detailed in the permits for the sites and states in their jurisdiction.

If, for any reason, ≥ 5 individuals (regardless of species) on any given trapping grid during a single night die, either in the trap or in hand**, the trapping on that grid should be discontinued** until the next scheduled sampling bout, and a problem ticket should be issued detailing the locations, species, sex, and ages of the mortalities**.** If weather or any other circumstances cause one night of trapping within the sampling bout to be missed, consult section 4.4.

Given acclimation and regional variation in the conditions that threaten the survival of trapped rodents, guidelines for preventing mass mortality in cold and hot conditions will be provided in the site-specific appendices, as necessary. The following guidelines are generally applicable across sites, and can also be found as a Quick Reference in Appendix B.

Cold conditions:

- Bedding (i.e., polyester or wool batting) should be used when low temperatures are expected to be < 18°C (65°F), except at sites where heteromyids dominate.
- Extra bait should be added to traps on nights when temperatures are expected to be < 7°C (45°F)
- Trapping should not occur on nights when **both** very cold temperatures (< 5.5°C (42°F)) and (a) precipitation in the form of rain are expected (>20% chance at sites with bedding; >5% chance at sites that cannot use bedding) or (b) dew is expected (i.e., if humidity is >75% and the projected minimum temperature is below the dew point).
- Due to the added logistical burden, trapping should not occur when snow cover exceeds 15 cm (6 inches) at the time of trap setting. Snowfall is not inherently problematic for trapping; therefore, a few inches (<=6 inches) of snow already fallen or predicted to fall during the trapping bout should not prevent trapping. Do not set traps if >6 inches of snow are predicted to fall overnight, as this will significantly increase the effort required to locate and check traps.

Hot conditions:

When ambient temperatures are expected to exceed 80 degrees Fahrenheit by 10 a.m.:

- Extra effort must be made to ensure that all traps containing captured individuals are processed or placed in the shade as soon as possible. Work can continue past 10 a.m. or when temperatures exceed 80 degrees Fahrenheit, but care should be taken to ensure the well-being of the captures. Ice packs can be placed with the shaded traps in exceptionally hot conditions.
- If you are unable to arrive at a site due to unforeseen circumstances prior to 8 - 9 am, field technicians should open all traps to release animals and avoid heat-induced mortality. Work should start over that night by resetting the traps.
- Heat-stressed individuals can be cooled by wetting them down, particularly around their head and inguinal regions.

All conditions:

If there is any chance (i.e., >0%) that traps cannot be checked the following morning at dawn, traps shall not be set. For example, if trap locations are accessed via dirt roads that become impassable when wet, do not set traps if there is a possibility of rain overnight.

Windy conditions:

If winds are very strong (> 35 mph) and there is little vegetation to protect the traps, trapping is not recommended. A mechanism to secure traps could prove useful for moderately windy conditions. For example, bending wire to fit snuggly over traps has proven effective at some sites (Denise Stetson, pers. comm.).

Predators:

If predators destroy (i.e., damage beyond repair) >15 traps on a single grid on any given night, traps should be removed from the grid and that sampling bout terminated prematurely for that grid. The Field Operations Manager shall be informed as soon as possible, and a problem ticket should be issued.

If predators disturb (i.e., not damaging but closing trap doors, moving traps, etc.) > 30 traps on a single grid on any given night (or the combination of destroyed and disturbed traps > 30), traps should be removed from the grid and that sampling bout terminated prematurely for that grid. The Field Operations Manager shall be informed as soon as possible, and a problem ticket issued.

Cattle:

If cattle disturbance is significant, issue a problem ticket. A mechanism to secure traps could prove useful (see Windy Conditions above).

Documentation of Issues:

1. Data from animals that die during the course of handling or trapping should be recorded on the datasheet, with a 'D' marked in the appropriate column (fate). The 'D' supersedes the Non-target (N) option for the fate field.
2. If traps are not set on a particular grid as scheduled or if no individuals are captured, this should be recorded in the NOTES field (Table 2), as a line on the datasheet for that given date, grid, and bout combination. These notes can also be used on a trap by trap basis, if there is variation within the grid.
3. If traps are damaged or disturbed overnight, note trap locations and code the nature of the disturbance on the datasheet in the NOTES field (Table 2), with any other known details described in the 'add'l notes' cell.

Table 2. Descriptions and prescriptions of codes used in Notes field of small mammal datasheet.

Definitions	Application Rules
1 – traps not set	Used at the level of the entire trapping grid, or, if some traps on a grid were set and others were not, can be used to indicate which ones were not set
2 – trap disturbed/door closed but empty	Used per trap coordinate, when necessary
3 – trap door open or closed with feces left behind	Used per trap coordinate, when necessary
4 – >1 capture per trap	Used per trap coordinate; in the rare event of multiple captures per trap; enter this note code for each individual
5 – single capture in trap	Used per trap coordinate, when necessary
6—no captures	Used ONLY at the per grid level; there is no need to write down every trap that has been set but is empty

4.3 Timing for Laboratory Processing and Analysis

Process all frozen samples immediately upon returning to the lab. Once samples are frozen, they must remain frozen; plan accordingly. Please note that all subsequent instruction in this SOP pertain to the blood samples only; instructions will be added for the remaining samples whenever institutions for archiving those samples have been identified. A subset of the ear tissue samples will be used in SOP G.

4.4 Sampling Timing Contingencies

If weather or any other circumstances cause a night of trapping within the sampling bout to be missed, trapping may be resumed and continued as normal within 5 days of the latest night of trapping. If this is not possible, sampling should be resumed as soon as possible, while maintaining the timing of trapping relative to the new moon for the sites.

Table 3. Contingent decisions

Delay	Action	Outcome for Data Products
Hours	If traps are set, the traps must be checked and any captured individuals processed or released without processing AS SOON AS POSSIBLE. Do whatever it takes (within safety limitations) to prevent mortality of study animals.	Trapping-induced mortality violates the assumptions of the mark-recapture models that are used to estimate density. In addition, high mortality rates from trapping threaten the scientific and ethical integrity of the study.
1-10 days	Add additional days of sampling as soon as possible to sample all points.	Fewer sampling points could result in less precise estimation of richness, diversity, or density. Capture-recapture models require recapture data from >1 night of sampling per bout to estimate densities. If additional time is not available, fewer samples will be collected. Although densities cannot be calculated if recapture data are insufficient, any night of trapping produces valuable data regarding relative abundances of species, reproduction and persistence of local populations, and species presence/absence.
11 or more days	Do not sample. Resume sampling as scheduled during the next month.	1. Species richness or demography due to changes in seasonal phenology could be influenced by significant changes in temporal sampling window. 2. Not completing sampling on all plots impacts diversity metrics and target sample size.

4.5 Criteria for Permanent Reallocation of Sampling Within a Site

Small mammal sampling will occur on the schedule described above at up to 8 plots per site. Ideally, sampling will occur at these sampling locations for the lifetime of the Observatory (core sites) or the duration of the site's affiliation with the NEON project (relocatable sites). However, circumstances may arise requiring that sampling within a site be shifted from one particular location to another. In general, sampling is considered to be compromised when sampling at a location becomes so limited that data quality is significantly reduced. If sampling at a given plot becomes compromised, a problem ticket should be submitted by Field Operations to Science.

There are two main pathways by which sampling can be compromised. Sampling locations can become inappropriately suited to answer meaningful biological questions (e.g., a terrestrial sampling plot becomes permanently flooded or a stream moves after a flood and the location is no longer within the stream channel). Alternatively, sampling locations may be located in areas that are logistically impossible to sample on a schedule that is biologically meaningful.

For small mammal sampling, a given plot must be able to be sampled (minimum of 75 traps per plot-night) on a minimum of 80% of scheduled plot-nights per calendar year over a two-year period. Plots that cannot be sampled on this schedule should be considered compromised.

5 SAFETY

This document identifies procedure-specific safety hazards and associated safety requirements. It does not describe general safety practices or site-specific safety practices.

Personnel working at a NEON site must be compliant with safe field work practices as outlined in the Operations Field Safety and Security Plan (AD[02]) and EHSS Policy, Program and Management Plan (AD[01]). Additional safety issues associated with this field procedure are outlined below. The Field Operations Manager and the Lead Field Technician have primary authority to stop work activities based on unsafe field conditions; however, all employees have the responsibility and right to stop their work in unsafe conditions.

5.1 Working with Small Mammals

Personnel working with small mammals should familiarize themselves with the Zoonotic Diseases section of AD[02]. The incidence of these diseases in humans is extremely rare, with the exception of Lyme disease in certain regions of the country, and is typically associated with working outside in vegetated areas. Although rodents and other small mammals and their ectoparasites (e.g., ticks and fleas) are critical to the lifecycle of many of these disease-causing organisms, there is no evidence that the handling of small mammals significantly increases risk of exposure to many of these diseases beyond other types of field work. One possible exception to this is Hantavirus Pulmonary Syndrome (HPS), which is believed to result from inhalation of contaminated, aerosolized urine and feces, as well as through bites. Most of the known cases of HPS have resulted from inhalation of aerosolized virus present in cabins and other remote buildings in which small mammals are nesting (Kelt et al. 2007, 2010).

There are a number of Hantavirus species in North America, and most of the cricetid rodents in North America appear to be competent reservoirs for these pathogens. Of these cricetids, *Peromyscus maniculatus* is the primary reservoir for the Sin Nombre virus, the hantavirus most often linked to HPS. This species is widespread throughout North America, but, according to Centers for Disease Control and Prevention (CDC) data, HPS cases are more numerous in western states. The highest incidence of HPS is found in California, Arizona, New Mexico, and Colorado. Consequently, NEON is using a tiered approach to personal protective equipment (PPE) that reflects HPS incidence reported by the CDC (AD[02]).

Leptospirosis is a zoonotic disease found worldwide, and is particularly common in tropical and subtropical climates of the United States and in Puerto Rico. It is commonly carried by rats, which may show no signs or symptoms of the disease and which may continue to spread the disease for months or years.

According to the CDC, humans can become infected through:

- Contact with urine (or other body fluids, except saliva) from infected animals.
- Contact with water, soil, or food contaminated with the urine of infected animals.

- The bacteria can enter the body through skin or mucous membranes (eyes, nose, or mouth), especially if the skin is broken from a cut or scratch.
- Person to person transmission is rare.

6 PERSONNEL AND EQUIPMENT

6.1 Clothing and PPE

According to the NEON Operations Field Safety and Security Plan (AD[02]), whenever directly handling small mammals or working with equipment/supplies that have been in contact with small mammals, personnel are required to wear, at a minimum:

- Eye protection
  - Safety glasses with ventilation to minimize fogging up in humid environments
  - Intended to discourage rubbing of the eyes with potentially contaminated hands and protect from the unlikely occurrence of extreme splashes during blood collection
  - At all NEON sites
- Gloves
  - Latex and/or nitrile – disposable - to provide a barrier against infectious excreta and body fluids during small mammal handling
  - NEON Safety strongly recommends that reusable cloth gloves with rubber-tipped fingers be worn for handling to provide additional protection from bites (latex/nitrile gloves must be worn over these to allow for effective decontamination).
  - Reusable cloth gloves with rubber-tipped fingers should be worn when checking traps
  - At all NEON sites
- Clothing
  - Long-sleeved shirt
  - Long pants
  - Close-toed shoes with socks
  - Optional: a disposable or reusable (cotton) laboratory coat or apron
  - At all NEON sites
- Respiratory protection
  - Disposable respirators with N95 (HEPA-equivalent) particulate filter
    - Required: all sites in CO, NM, AZ, CA
    - Recommended: all sites in KS, TX, UT, MT, NV, ID, OR, and WA
    - Optional at all other sites
  - Optional half-face disposable dust mask with P100 filters at all sites
  - Please note that a NEON safety fit test and medical evaluation by licensed provider is required prior to wearing a respirator.

Any items of clothing that have or may have been in contact with small mammal excreta or bodily fluids should be sterilized to ensure safety. According to the Centers for Disease Control and Prevention, decontamination can be accomplished by exposing contaminated clothing to UV (i.e., sunlight) for 4-6 hours or laundering in a washing machine using hot water and any commercially available laundry detergent. Spot treatment of personal attire or protective equipment using a spray bottle filled with quat cleaner should be performed in the field during sampling. Contaminated clothing should not be washed with other personal or with family laundry. If decontamination cannot be performed immediately, potentially contaminated clothing should be stored in a closed bag.

Other personal protective equipment will be cleaned throughout each sampling day. Eye protection and shoes will be wiped down with disinfectant, quat cleaner or 70+% alcohol. Gloves will be cleaned and disinfected. Disposable gloves and respirators will be discarded if they become torn or damaged while sampling. At a minimum, gloves should be replaced after captures from each sampling grid have been processed. If used, half-face respirators will be fully cleaned in accordance with the NEON EHS Safety Policy and Program Manual (AD[03]).

Safety Data Sheets (SDS) shall be reviewed prior to use and readily available for chemicals used in this protocol (Isoflurane, Dry Ice, Ethanol, etc.).

6.2 Equipment

The following equipment is needed to implement the procedures in this document. Equipment lists are organized by task. They do not include standard field and laboratory supplies such as charging stations, first aid kits, drying ovens, ultra-low refrigerators, etc.

A significant amount of specialized equipment is required to conduct surveys of small mammals. Therefore all field personnel must be familiar and comfortable with using all the equipment before heading into the field.

Table 4. Equipment list – Flagging the grid, one bout

Item No.	R/S	Description	Purpose	Quantity	Special Handling
Durable Items					
MX100322	R	Laser Rangefinder, ½ foot accuracy	Set Traplines	1	N
MX100320	R	Compass with mirror and declination adjustment	Set and Follow Traplines	6	N
MX100318	R	Measuring tape, 100 m	Set Traplines	4	N
	R	Survey marking flag, wire, PVC or fiberglass stake	Set Traplines	100+	N
MX100703	R	GPS receiver, recreational accuracy	Navigate to Traplines	2	N
MX104361	S	Chaining pins or other suitable anchor	Anchor measuring tapes	10	N
Consumable Items					
	S	AA battery	Spare battery for GPS receiver	4	N

Item No.	R/S	Description	Purpose	Quantity	Special Handling
	S	CR123A battery	Spare battery for laser rangefinder		
	R	Permanent marker, chisel tip	Label flags	6	N

R/S=Required/Suggested

Table 5. Equipment list – Trapping, one bout

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
Durable Items						
MX100320	S	Compass with mirror and declination adjustment	Follow traplines	All domains	6	N
MX100703	S	GPS receiver, recreational accuracy	Navigate to traplines	All domains	2	N
MX100324	S	2-way radio	Communication	All domains	6	N
MX106060	R	Sherman trap, small folding, 3"x3.5"x9"	Trap rodents (D01, D02, D03, D05, D06, D07, D08, D18, D19)	Domains D01-D08 (excluding D04), D18, D19	1200	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
MX100702	R	Sherman trap, x-large folding, 3"x3.75"x12"	Trap rodents (D04, D09, D10, D11, D12, D13, D14, D15, D16, D17, D20)	Remaining domains (including D04 and D20)	1200	N
MX109264	R	Tomahawk trap, 16” x 5” x 5”	Trap rodents (D04 and D20 only)	Domains D04 and D20 only	300	N
MX109265	S	Tomahawk trap cover 16” x 5” x 5”	Trap rodents (D04 and D20 only)	Domains D04 and D20 only	300	N
MX101632	S	Headlamp	Hands-free lighting at dusk and dawn	All domains	6	N
MX105391	S	Storage bin, 26 gal rolling	Store seed	All domains	1	N
MX104507	S	Tree planting bag	Carry traps	All domains	8	N
MX104510	S	Lumbar bag	Carry bait	All domains	8	N
MX100504	S	Storage bin	Store extra supplies in truck	All domains	2	N
Consumable Items						
MX105097	R	Seed, black oil sunflower	Bait traps (not D04 or D20)	All domains except D20 and D04	20 lb	N
MX100683	R	Seed, whole millet	Bait traps (not D04 or D20)	All domains except D04 and D20	2 lb	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
	R	Freeze-dried mealworms	Supplement bait for shrews	Sites where shrews are abundant	25 lb	N
	R	Peanut butter	Bait traps (D04 and D20 only)	D04 and D20		N
	R	Rolled oats	Bait traps (D04 and D20 only)	D04 and D20		N
	R	Unbleached cheesecloth	Bait traps (D04 and D20 only)	D04 and D20		N
	R	Paper clips, jumbo	Secure bait balls in mesh traps (D04 and D20 only)	D04 and D20	300	N
MX100673	R	Batting, polyester	Nesting material	All domains	500	N
MX104521	R	Gusseted plastic bag, 2 gal	Contain traps during collection for Sherman traps	All domains	1 lb	N
MX109412	R	Gusseted plastic bag, 5 gal	Contain traps during collection for Tomahawk traps (D04 and D20 only)	D04 and D20	1 lb	N
MX107194	R	Talstar EZ	Control fire ants (D02, D03, D04, D07, D08, D11)	Order for domains D02, D03, D04, D07, D08, D11	1	Y
	S	Biohazard warning sticker	Label traps	All domains	1200	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
	S	Resealable plastic bag, minimum 1 gal	Carry batting, secure to lumbar bag with carabiner	All domains	6	N
	S	Permanent marker, chisel tip	Label traps	All domains	6	N
	S	Wet erase markers, fine tip	Label traps	All domains	6	N
	S	Field notebook	Record field notes	All domains	1	N
	S	Pencils - #3	Label traps	All domains	6	N
	S	AA battery	Spare battery for GPS receiver	All domains	4	N
	S	Battery, AAA, Rechargeable	Headlamp or GPS	All domains	12	N
	S	Bathtub crayons	Marking traps	All domains	6	N

R/S=Required/Suggested

Table 6. Equipment list – Checking traps and processing captures, one bout

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
Durable Items						

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
MX104715	R	Amber bottle, 30 ml with dropper	Administer isoflurane	All domains	2	N
MX100729	S	Tea infuser spoon	Administer isoflurane	All domains	2	N
MX108277	S	Tube, Centrifuge, Sterile, Conical, 50mL (30 mm diameter)	Administer isoflurane	All domains	2	N
MX104774	S	Tube, Centrifuge, Sterile, Conical, 15mL (17 mm diameter)	Administer isoflurane	All domains	2	N
MX110556	S	Tube, Centrifuge, Sterile, Conical, 175mL (60 mm diameter)	Administer isoflurane	D04 and D20	2	N
MX104506	R	Ear tag applicator, size monel #1	Affix ear tag	All domains	4	N
MX104821	R	PIT tag portable reader capable of reading ISO 11784/11787 FDX-B and HDX PIT tags, simple data retrieval via USB port, Bluetooth	Read PIT tag number (not D04 or D20)	All domains except D04 and D20	2	N
MX100326	R	Ruler, 12" plastic, mm gradation	Measure	All domains	2	N
MX100724	R	Ruler, 6", flexible clear plastic	Measure	All domains	2	N
MX104442	R	Spring scale, tareable, capacity 30 g max	Weigh individuals	All domains	2	N
MX100704	R	Spring scale, tareable, capacity 100 g maximum	Weigh individuals	All domains except D04 and D20	2	N
MX100705	R	Spring scale, tareable, capacity 1000 g maximum	Weigh individuals	All domains	2	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
MX106661	S	Storage box, 81 position with lid	Organize cryovials during blood collection	All domains	4	N
MX104724 MX106667	R	Cryovial freezer storage box with dividers	Organize samples	All domains	10	N
MX106990 MX100730	R	Ear tissue punch	Collect ear tissue	All domains	2	N
	R	Cooler, 16qt	Chill perishable samples in field	All domains	2	N
MX100696	R	Digital camera, 12 megapixel	Capture images of rodents for species identification	All domains	2	N
MX101866	R	Camera bag	Protect digital camera	All domains	2	N
	S	Ventilated tupperware or cardboard container	Care for hypothermic animals	All domains	5	N
MX100574	S	Bottle, 250 mL wide-mouth HDPE	Store sugar/water solution for animal care	All domains	2	N
	S	Shelter/tent	Shade collected traps, provide shelter while processing	All domains	2	N
	S	Backpack	Transport field equipment	All domains	2	N
	S	Organizer boxes with lid	Organize equipment	All domains	4	N
Need mx#	S	Mesh wash bag	Restrain larger species	All domains	20	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
MX104448	S	Restraint bag	Restrain larger species	All domains	20	N
MX100723	S	Multi-tool	Marking	All domains	2	N
MX104462	S	Diagonal plier, 4 in	Remove ear tags	All domains	2	N
	S	Short (< 6 inches) piece of rope (550 paracord works well) for 1000 g scale	Attaching to scale, in place of alligator clip, to weigh larger animals in plastic bags	All domains	2	N
	S	Iris scissors	Collect ear tissue	All domains	2	N
MX100661	S	Forceps, cushing dissecting	Collect sample	All domains	4	N
MX100659 MX100660	S	Forceps, dissecting microforceps	Collect sample, check for ticks	All domains	4	N
MX100717	S	Cuticle clippers	Remove ear tags	All domains	2	N
MX106656	S	Magnifier hand-lens, 10X	Aid in species identification (not D04 or D20)	All domains except D04 and D20	2	N
MX103931	S	Plastic tray	Alternative or additional mammal processing surface	All domains	2	N
MX106652	S	Thermohygrometer	Monitor weather conditions	All domains	2	N
Consumable Items						

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
MX103942	R	All weather copy paper	Print datasheets	All domains	25 sheets	N
MX109413	S	Clear plastic disposable restraint cones for large rats (≤450g)	Restrain Rattus norvegicus (D04 and D20 only)	D04 and D20	100	N
MX109414	S	Clear plastic disposable restraint cones for rats (≤225g)	Restrain Rattus rattus and R. exulans (D04 and D20 only)	D04 and D20	300	N
MX100591	R	Cotton ball	Administer isoflurane	All domains	150	N
MX100672	R	Isoflurane	Anesthesia/euthanasia	All domains	25 mL	Y
MX100678	R	Hand warmer	Care for hypothermic animals	All domains	2	N
	R	Sugar	Care for hypothermic animals	All domains	2	N
	R	Freeze-dried mealworms	Care for stressed animals	Sites where shrews are abundant	2 lb	N
MX100688	R	Styptic Powder	Slow/stop bleeding (in case of open wound)	All domains	1 pack, 42 g	N
MX100676	R	Cotton swab	Apply styptic powder	All domains	50	N
MX100727	R	Ear tag, numbered	Tag captured individuals	All domains	200	N
MX104419	R	PIT tag and implanter	Tag captured individuals (not D04 or D20)	All domains except D04 and D20	50	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
MX109424	S	Veterinary tissue adhesive	Gluing tissue at PIT tag implant (not D04 or D20) location	All domains except D04 and D20	3 mL	?
	S	Permanent marker (>1/2 inch), red, blue, or green preferred	Mark–captured shrews (not D04 or D20)	All domains except D04 and D20	4	N
MX108572 MX108573	R	Lancet, 4mm and 5mm	Collect blood	All domains	1000	N
MX108574	R	Lancet, 5.5mm and 6mm	Collect blood	All domains	300	N
MX109415 MX109416	R	Lancet, 7mm and 8mm	Collect blood (D04 and D20 only)	D04 and D20	1000	N
MX109422	S	Sterile artificial tears ointment	Aid in blood collection	All domains	7 grams	N
MX100714	R	Alcohol wipe	Collect ear punches	All domains	1000	N
MX108576	R	Gauze pad	Apply pressure to bleeding	All domains	1000	N
MX103485	R	Microcentrifuge tube, 1.5 mL with external threads	Contain blood, fecal samples, ear punches	All domains	1000	N
MX107195	R	Artifact identification tag	Label vouchers	All domains	10	N
MX105073	R	Thread	Attach tags to voucher specimens	All domains	2 rolls	N
MX104801	R	Coin envelope, small	Contain whisker and hair samples	All domains	150	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
MX100212	R	Dry ice, pelletized	Freeze blood samples	All domains	50 lbs	N
MX104844	S	Resealable plastic bag, 1 gal, 2 mil	Restrain captured individuals	All domains	200	N
MX100592	S	Resealable plastic bag, 1 gal, 4 mil	Restrain captured individuals (not D04 or D20)	All domains except D04 and D20	100	N
MX109419	S	Resealable plastic bag, 12 x 15", 4 mil	Restrain Rattus spp. (D04 and D20 only)	D04 and D20	500	N
MX104766	S	Heat shrink tubing	Cover clamp teeth on spring scales	All domains	1 package	N
MX104432	S	Cryogenic label	Label sample	All domains	1000	N
MX100593	S	Resealable plastic bag, 1 qt, 4 mil	Organize collected samples (coin envelopes, filled vials, and voucher specimens)	All domains	20	N
	S	Battery for thermo-hygrometer	Spare battery for thermo-hygrometer	All domains	2	N
	S	Digital camera battery	Spare battery	All domains	2	N
MX109418	S	Plastic sheeting, 3 x 50ft, 4 mil, clear	Provide mammal processing surface	All domains	10	N
	R	Permanent marker, ultra-fine tip	Label sample	All domains	2	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity	Special Handling
MX104422	R	Permanent marker, archival ethanol-safe	Label sample	All domains	2	N
MX110071	R	Preserved mice	Cervical dislocation training	All domains	1 per handler	N
Resources						
	R	Field guide, regional dichotomous key	Identify unknown species	All domains	2	N
	R	Field guide, mammals	Identify unknown species (not D04 or D20)	All domains except D04 and D20	2	N
RD[05]	R	Small mammal field datasheets	Record data	All domains	10	N

R/S=Required/Suggested

Table 7. Equipment list – Cleaning and sterilization, one bout.

Item No.	R/S	Description	Purpose	Conditions Used	Quantity*	Special Handling
Durable Items						
MX103202	R	Butane lighter	Sterilize tools	All domains	2	N
MX104772	R	Spray bottle	Disinfect tools and work area	All domains	2	N

Item No.	R/S	Description	Purpose	Conditions Used	Quantity*	Special Handling
MX103240	R	Portable Sharps container	Contain Sharps waste	All domains	2	N
MX104741	S	Narrow mouth jug, 1 gal	Transport quaternary ammonia	All domains	2	N
MX104449	S	3 cup container	Contain quaternary ammonia for disinfecting tools	All domains	2	N
	S	Mason jar	Transport used quaternary ammonia	All domains	2	N
Consumable Items						
	R	Alcohol wipe	Disinfect tools	All domains	50	N
MX100586	R	Quaternary Ammonia 5% solution	Disinfect tools, gloves and work surfaces	All domains	10 L	N
	R	Trash bag, large	Contain and transport waste	All domains	20	N
	R	Resealable plastic bag	Contain Sharps container	All domains	2	N
	R	Paper towels	Dry tools	All domains	2 rolls	N

R/S=Required/Suggested

* Quantities are generous estimates per bout per site

Table 8. Equipment list – Cleaning traps, per bout

Item No.	R/S	Description	Purpose	Quantity	Special Handling
Durable Items					
MX104772	S	Spray bottle	Wash traps	1 pack, 6	Y
	S	Scrub brush, long and short handle	Scrub traps	6	Y
MX104429	S	Bottle brush, 19"	Scrub traps	1	Y
	S	Chemical-resistant glove	Protect hands	1	Y
MX100379	S	Graduated cylinder, 25 ml, plastic	Measuring quaternary ammonium for dilution	2	Y
MX100526	S	Plastic bucket, 5 gal	Wash traps	6	Y
MX100639	S	Carboy, 20 L	Wash traps	1	Y
Consumable Items					
MX100586	R	Quaternary disinfectant	Disinfect traps	1 bottle, 1 gal	Y

R/S=Required/Suggested

Table 9. Equipment list – Preparing blood samples

Item No.	R/S	Description	Purpose	Quantity	Special Handling
Durable Items					
MX104724 MX106667	R	Cryovial freezer storage box with dividers	Organize samples	5	N
MX106668	R	Cryogenic gloves	Protect hands while handling dry ice	1 pair	N
Consumable Items					
MX103942	R	All weather copy paper	Print datasheets	5 sheets	N
Resources					
RD[05]	R	Small mammal datasheet (shipping manifest)	Datasheets	5 sheets	N

R/S=Required/Suggested

Table 10. Equipment list – Shipping blood samples

tem No.	R/S	Description	Purpose	Quantity*	Special Handling
Durable Items					
MX106668	R	Cryogenic gloves	Protect hands while handling dry ice	1 pair	N
Consumable Items					
	R	Corrugated fiberboard or insulated shipper, UN packing group III	Package samples for shipment	3	N
	R	Watertight inner shipping container, certified for UN3373	Package samples for shipment		N
	S	Dry ice shipping label	Label shipments containing dry ice	3	N
	S	Biological Substance Category B shipping label	Label shipments containing diagnostic specimens	3	N
MX100212	R	Dry ice, pelletized	Keep samples frozen during shipment	5 lbs	Y
	R	Packaging tape	Package samples for shipment		
		Absorbent material (i.e. cellulose wadding, cotton balls, super-absorbent packets or paper towels)	Package samples for shipment		
Resources					

tem No.	R/S	Description	Purpose	Quantity*	Special Handling
	R	Shipping manifest	Inventory of specimens being shipped	1	N

R/S=Required/Suggested

* Quantities are generous estimates per batch

Table 11. Equipment list – Genetic analysis

Item No.	R/S	Description	Purpose	Quantity	Special Handling
Durable Items					
MX100660 MX100659	R	Forceps, jewelers	Remove tissue	3	N
MX103202	R	Butane lighter	Sterilize ear tissue punch	1	N
MX103487	R	Chill block and microplate cooler	Prepare well plates	1	N
Lab supplied	R	96-well microwell plates	Store tissue to be barcoded	3	N
Lab supplied	R	96-well microwell caps	Cover microwell plates	285	N
MX104772	S	Spray bottle for ethanol	Disinfect bench space and gloves	1	N

Item No.	R/S	Description	Purpose	Quantity	Special Handling
MX106668	R	Cryogenic gloves	Protect hands while handling dry ice	1 pair	N
Consumable Items					
MX100213	R	Ethanol, 190 proof (95%)	Disinfect bench space and gloves	1 L	Y
	S	Corrugated fiberboard or insulated shipper, UN packing group III	Package samples for shipment	1	N
	R	Watertight inner shipping container, certified for UN3373	Package samples for shipment	Variable	N
	S	Biological Substance Category B shipping label	Label shipments containing diagnostic specimens	Variable	N
	R	Packaging tape	Package samples for shipment	1 roll	N
	R	Nitrile gloves, powderless	Prevent contamination of samples	Variable	N
	R	Address labels	Address shipments	1	N
MX100212	R	Dry ice, pelletized	Preserve samples during shipment	2 lbs	Y

R/S=Required/Suggested

6.3 Training Requirements

All technicians must complete required safety training and protocol-specific training for safety and implementation of this protocol as required in the Field Operations Job Instruction Training Plan (AD[04]) and the NEON Animal Care and Use Program: Training Plan for Personnel Working with Live Vertebrate Animals (AD[09]).

The training plan for small mammal abundance and diversity will include the following components:

- A classroom session will be conducted prior to the field sampling to provide an overview of the procedure and the goals of the sampling.
- Within each domain, the lead mammal technician will provide a review of the sampling equipment and the small mammal species of each site within that domain to seasonal staff.
- Personnel performing cervical dislocation must be properly trained and qualified in vertebrate cervical dislocation.
- Domains in the first year of sampling (i.e., while in construction) will receive laboratory-based training in handling and bleeding techniques prior to the onset of sampling.
- Prior to the start of operational field sampling, technicians new to small mammal trapping will gain experience with these techniques in the field with wild-captured mammals through a trapping exercise on 1-2 training grids (depending on availability). NEON HQ or domain staff or contractor will conduct this hands-on training in the field. All methods will be the same as proposed for operational sampling, except for the potential for additional voucher specimen collection (see SOP C.9), but will occur off of the long-term trapping grids and does not need to be organized with respect to the new moon. Each training grid will be sampled a maximum of four nights per month, yielding approximately 20 – 100 individuals (reflecting capture rates between 5 and 25%) per grid. These training grids will be permitted throughout the duration of the study, to provide opportunities for training whenever a new technician joins the study. It is expected that the training grids will be sampled up to a maximum of 3-4 times per year.
    - Please note that data from training grids should only be captured on paper datasheets and do not get entered into the NEON database. Samples, but not voucher specimens, collected from these grids should be discarded.
- NEON HQ or domain staff or contractor will perform hot checks of species ID on the NEON technicians involved in the data collection, if funding is made available.

All of the technicians will have access to the following materials:

- Field guide to Mammals of North America
- Electronic field guide to mammals of each particular domain
- Dichotomous keys for small mammal species at each site (see RD[08] through RD[25]).
- Guidelines of the American Society of Mammalogists for the Use of Wild Mammals in Research (Sikes et al. 2016)

6.4 Specialized Skills

6.4.1 Trapping

Technicians responsible for setting and checking traps must be willing and able to carry traps in bundles up to 40 pounds and wear the mandatory personal protective equipment (PPE) described in the NEON Operations Field Safety and Security Plan (AD[02]). Technicians who are responsible for checking traps but not handling captured animals must also be willing and able to (1) record data in neat, legible hand-writing, and (2) assist the mammal handler in any way (e.g., preparing tags for marking, handling or labeling blood samples after collection).

6.4.2 Handling

The technicians employed to handle and process the small mammals must have prior experience handling wild small mammals or receive sufficient training prior to sampling, and must be able to correctly identify and safely process all small mammals potentially found within the domain. An identification key based on external features and summary description of species expected in the study area will be available for technicians for reference. All personnel shall thoroughly review the Guidelines of the American Society of Mammalogists for the Use of Wild Mammals in Research (Sikes et al. 2011) prior to field sampling.

6.5 Estimated Time

The time required to implement a protocol will vary depending on a number of factors, such as skill level, system diversity, environmental conditions, and distance between sample plots. The timeframe provided below is an estimate based on completion of a task by a skilled two-person team (i.e., not the time it takes at the beginning of the field season). Use this estimate as framework for assessing progress. If a task is taking significantly longer than the estimated time, a problem ticket should be submitted. Please note that if sampling at particular locations requires significantly more time than expected, Science may propose to move these sampling locations.

An experienced two-person team will require approximately 30 - 60 minutes to set and bait one trapping grid (100 traps), depending on the difficulty of the terrain and the visibility of trap markers, if allowed at a given site. Checking the grid for disturbance and captures and transporting these traps to the processing station will require approximately 45 – 90 minutes per trapping grid per experienced two-person team. Processing time per trapping grid will vary with the number of captures on a grid. Each capture must be processed in less than 15 minutes; however, most captures should be able to be processed in less than 5 minutes. The final step in the process is to return captures to the point of capture, which should require approximately 45 – 90 minutes per trapping grid per experienced two-person team.

7 STANDARD OPERATING PROCEDURES

SOP A Flagging the Grid

Small mammal traps are arrayed in a 10 x 10 grid, with 10 meter spacing (Figure 3). Plot establishment for small mammal trapping grids as described in RD[06] must be completed prior to or concurrently with this procedure. During plot establishment, a primary marker is placed at the E5 trapping station and secondary markers at the corners, if permitted. Placing pin flags marked with the corresponding trap coordinate at each trapping location immediately prior to each sampling season or bout (depending on permitting guidelines for each site) is critical to ensure timely and accurate trap setting and checking. If permitted, permanent markers suited to domain-specific conditions can be used in place of pin flags.

↑ NORTH	A	B	C	D	E	F	G	H	I	J
1	A1	B1	C1	D1	E1	F1	G1	H1	I1	J1
2	A2	B2	C2	D2	E2	F2	G2	H2	I2	J2
3	A3	B3	C3	D3	E3	F3	G3	H3	I3	J3
4	A4	B4	C4	D4	E4	F4	G4	H4	I4	J4
5	A5	B5	C5	D5	**E5**	F5	G5	H5	I5	J5
6	A6	B6	C6	D6	E6	F6	G6	H6	I6	J6
7	A7	B7	C7	D7	E7	F7	G7	H7	I7	J7
8	A8	B8	C8	D8	E8	F8	G8	H8	I8	J8
9	A9	B9	C9	D9	E9	F9	G9	H9	I9	J9
10	A10	B10	C10	D10	E10	F10	G10	H10	I10	J10

Figure 3. The grid coordinate system, consisting of 100 trap stations 10 meters apart. Trapping grids are permanently marked at the E5 trap station during plot establishment, at sites that allow permanent markers. Grids may also be marked with secondary markers at the corners, if also permitted.

PROCEDURE

1. Using a recreational GPS, navigate to either the permanent plot marker at E5, or, if available, to a secondary marker at one of the corners.

    - **Remember** that foot traffic should be restricted to paths along the North – South lettered traplines and along traplines 1 and 10, as much as possible.

2. Stretch a 100 meter tape along the trapline from a previously marked point, heading due south or due north from the marked point. Use chaining pins or similar stake at each end to hold the tape in place.

    - Use one of the high accuracy marked points (A1, J1, A10, J10 or preferably E5; see Figure 3) from plot establishment to begin flagging.

- The tape-based grid and the corners established during plot establishment will only agree in a perfectly flat environment. Unlike in other protocols, the tape-based measurements should take priority over the established points, although variation between these will most often be within several meters.
- The TruPulse 360R Laser Range Finder can be used as an alternative to the measuring tape in dense habitats where stretching tape is onerous.
  - See RD[06] for details on using the TruPulse rangefinder.
  - Using the TruPulse to meter out the 10m spacing between traps in dense or steep environments requires measuring both azimuth and distance with the rangefinder to maintain the straight line measurement (RD[06]).

3. **Place a pin flag** every ten (10) meters along the trapline. Traps will be set within 1 m of these pin flags during each sampling bout.

- For easier navigation in low light conditions, alternate flag colors along trapline rows (e.g., use orange flags in Rows A, C, E, G, I and blue flags for the remaining rows).

4. **Write the trap coordinate** (e.g., A2) with a permanent maker on each pin flag.

SOP B Preparing for Sampling

B.1 Technician Readiness

Field technicians should be prepared to identify all small mammal species in the area, but should also carry the appropriate dichotomous keys, lists of state and federally listed species, and the specified field guide in the event of the capture of a rare species. Technicians also need to be very familiar with the grid coordinate system, so that capture locations are accurately documented.

B.2 Preparing for Data Capture

Mobile applications are the preferred mechanism for data entry. Mobile devices should be fully charged at the beginning of each field day, whenever possible.

However, given the potential for mobile devices to fail under field conditions, it is imperative that paper datasheets are always available to record data. Paper datasheets should be carried along with the mobile devices to sampling locations at all times.

B.3 Field Equipment and Materials

A significant amount of specialized equipment is required to conduct surveys of small mammals. Therefore all field personnel must be familiar and comfortable with using all the equipment before heading into the field. See Section 7.2 (Equipment) for a list of equipment necessary to complete this SOP.

B.4 Equipment and Supplies Readiness

A checklist version of this list can be found in Appendix B.

- ☑ Ensure **traps** and sampling equipment are functioning and sanitized.
- ☑ Ensure safety gear (**PPE**) is available in sufficient quantities, clean, and functioning.
- ☑ Prepare pre-printed **labels** and materials for handwriting on the sample containers in the field.
- ☑ Print the NEON template (sMammalVoucherTagTemplate) provided on the NEON intranet (on the FOPs – TOS landing page) onto specimen tags in the event of voucher specimens.
- ☑ Prepare a small vial of **10% sugar** in water to revitalize stressed, hypothermic or heat-stressed captures. Change solution often to prevent mold growth.

A clean eye drop bottle works well to administer the sugar solution.

- ☑ Ensure that all necessary field **datasheets** (RD[05])**, permits, identification keys,** and equipment (use Domain Lab checklist) are packed.

Dichotomous keys are the fastest and most reliable means for in-the-field identification. Knowing how to use one is critical for ecological field work.

Copies of permits and dichotomous keys should be stored in a field datum and never removed.

☑ Sterilize (bake in a thin layer for 45 - 60 minutes at 105°C; Dahlquist et al. 2007) and mix a sufficient amount of millet (65% of seed mix) and sunflower seeds (35%). In D04 and D20, prepare bait balls - small (1/2 - 1 inch) balls of oatmeal, peanut butter, and vanilla extract encased in cheesecloth.

- Use just enough peanut butter to hold the oats together.
- Place the bait ball in the center of a roughly 6"x 6" square of cheesecloth. To seal the bait ball, draw the corners up around the bait and twist to make a tight tail around the bait clump.
- Bait balls can be prepared in large quantities prior to sampling, and stored in the freezer until needed (S. Hauser, pers. comm.).

☑ When extremely cold temperatures are anticipated, and if appropriate for the site, prepare peanut butter between 2 unbleached paper towels and cut into 1-inch squares.

☑ Prepare and maintain a **list of individuals already bled** (including those in which an unsuccessful bleed attempt was made) within the current sampling bout to ensure that no individuals are bled twice within a bout. Also note any individuals with missing data that can be collected if recaptured in this bout.

☑ Prepare **quat**: if necessary, mix a batch of quat stock solution in the lab (follow manufacturer guidelines for dilution). Fill up the spray bottle(s) and field stock bottles.

☑ Prepare **isoflurane** in a fume hood or well ventilated outdoor location. Fill up the glass bottle with rubber dropper bulb and glass bottle with screw top with isoflurane.

1 – 3 ounces should suffice for both blood sample collection, if needed, and/or in the event that an animal needs to be euthanized due to a serious trapping-related injury.

Always wear gloves whenever handling isoflurane.

Please note that pregnant women may want to use a respirator when handling isoflurane.

☑ Pack **bleeding supplies**: bring enough supplies for processing at least twice as many individuals as you expect.

☑ Obtain **dry ice**: this should be done as close to departure for the field as possible and stored in a dry ice cooler (e.g., Yeti or Thermosafe) prior to use.

SOP C Field Sampling

C.1 Setting traps

Trapping grids consist of 100 Sherman traps. However, in the event that conditions prevent setting of all traps on a given night, a minimum of 75 traps should be set to constitute a night of trapping. In D04 and D20, trapping grids will also include 50 Tomahawk wire mesh traps.

TIMING

- Traps are set in the evening, not more than 2.5 to 3 hours before sunset.

Setting traps too early will increase the possibility of catching opportunistic, diurnal species such as chipmunks and ground squirrels; these captures could be subjected to heat stress if not shaded.

- Time sampling so that the last trap is set as the sun is setting.

TIPS & TRICKS

- Each person should carry enough traps at one time for at least two traplines (i.e., 20 traps plus a few extra), for efficiency.

- Always walk the traplines along the N-S axis, except when moving to the next trapline. This will constrain vegetation disturbance to narrow trails within the grids over time. Consistency is the key; E-W travel can be used if strongly preferable for a given plot.
- Whenever possible, place traps near shrubs, downed logs, burrows, or other microsites that offer shelter or potential runways. When placing traps next to runways (e.g., rocks, downed logs), set trap parallel to the runway. Be aware of drainage issues that may cause flooding of the localized area around the trap overnight.
- Use additional flagging if trap is hidden from view.
- Make sure trap is on level ground (using your foot to level an area, if necessary), and the door remains open after placement. If necessary, adjust trap sensitivity by gently pulling or pushing catch.
- Count and double count your traps, when setting or checking traps – always know how many traps you brought out to the plot and how many you removed.

PROCEDURE

1. Upon arrival at a grid location, place at least 2" of batting in trap, if needed.

When overnight lows will be <18°C (65°F), place approximately 5 cm (2 in) of batting into trap (except at sites dominated by heteromyids - see site-specific appendices).

2. Place trap within a 1 meter radius around marked point.

a. In D04 and D20, place wire trap within a 2 meter radius around the marked point.

b. At sites with red imported fire ants (*Solenopsis* spp.), application of granulated insecticide (e.g., Talstar brand) is required, if permitted. Place immediately around the trap on flat ground or both under and around the trap when in a grassy area. Reapply after heavy rains.

3. Toss bait into trap.

a. Use about 1 TBSP of the seed mix (all sites) and 1TSP of freeze-dried mealworms (at select sites where shrews comprise more than 20% of the captured individuals; see site-specific appendices).

In D04 and D20, use a bait ball placed toward the back of the trap instead. These balls should be encased in cheesecloth and cinched into the back of a Sherman or hung from a paperclip inside a Tomahawk (B. Patterson, pers. comm.). Insert the bait ball tail into the top of the back door on a Sherman trap to hang the bait ball inside the trap. Use a paper clip to hang the bait ball toward the rear of a wire trap.

b. Use more bait if nighttime temperatures will be < 7°C/45°F.

c. Toss so as to distribute seed from front to back of trap.

4. Peanut butter can also be added in the event of extremely cold conditions at many sites, except where not permitted (see), where medium- to large- mammal (e.g., raccoons, bears) disturbance of traps has occurred, or where fire ants occur (e.g., Jones Ecological Research Center (JERC), Ordway-Swisher Biological Station (OSBS)).

- To minimize the mess associated with the opportunistic use of peanut butter, place peanut butter between 2 unbleached paper towels and cut into 1-inch squares (R. Rowe, pers. comm.)

C.2 Checking traps the following morning

TIMING

- Begin checking traps the following morning at dawn, within 30 minutes after civil twilight (where applicable).

In very hot climates or if ants are causing significant disturbance to a trapping grid, trap checking can begin up to an hour before dawn.

- Check all traps in grid before processing captures.

  Counting the traps along a trapline is the best way to ensure that all traps are checked.

  At the end of the sampling bout, know precisely how many traps are being retrieved from the grid, as well as any extras that may have been brought to the processing area. A final count will then indicate whether all traps have been removed from the grid.

Any trap that is accidentally left open during the day or at the end of a sampling bout will likely result in the capture and subsequent death of an animal.

TIPS AND TRICKS

- Keep in mind that the liberal use of quat on tools and gloves, the one-time use of processing bags, and the bagging of traps prior to processing are critical to minimizing transmission of pathogens between small mammals, as well as to technicians.
- Keep in mind that very small individuals can crawl under the treadle at the back of the trap and therefore are hidden from view. Be careful handling any trap with a closed door until this possibility has been ruled out. Gentle shaking and tapping of trap should encourage the individual to surface.
- Marking traps:
  - Be sure to cross out any previous markings, if present.
  - If conditions are very dry, use a wet-erase marker directly on the trap.
  - Assigning different colors of marker to the technicians facilitates resolution of any legibility or other issues that may arise in trap marking.
  - Wet erase can be easily wiped off with alcohol wipes or during the trap cleaning process.
  - If conditions are damp, use a dry erase marker directly on the trap or a permanent marker on the plastic bag into which the trap is placed.
  - If conditions are very wet, a #3 pencil or bath crayons can be used directly on the trap.

PROCEDURE

1. Put on PPE as specified in NEON Operations Field Safety and Security Plan.
2. If trap door is closed, QUICKLY peek inside to verify there is a capture.
   - Be quick or the animal may escape.
   - Hold the trap upside down at eye level, and open the door just enough to check if feet are visible.
3. There are a variety of possible scenarios involving a closed trap (Table 12).

Table 12. Possible scenarios encountered while checking traps in the morning

Trap contents	Marking the trap	Fate of the capture	Fate of the trap
Live capture of a target or opportunistic species or dead specimen of any species	Grid coordinate	Processing station	Processing station
Live capture of a shrew	Grid coordinate, species ID, sex, fate	Mark the belly with a colored permanent marker, if not previously marked, and release*	Processing station
Live capture of a non-target species, e.g., a bird, weasel, or reptile	Grid coordinate, species (species ID, if known)	Immediate release (fate = 'N' on mobile device or datasheet)	Processing station
No capture, but feces present	Grid coordinate	NA	Processing station
No capture and no feces	NA, but grid coordinate should be recorded on datasheet with appropriate code in the Notes column	NA	Remain at trap station

*To minimize handling of *Blarina spp.,* particularly by inexperienced personnel, transfer individuals to a plastic bag and then reach into the bag with the permanent marker (rather than a hand) to mark the back or belly.

4. For all traps to be removed from grid, place trap in plastic bag and place in tree-planting bag.
   - Trap can be re-used if there is no evidence (i.e., no feces or other sign) that an animal visited. Consult with permit regulations regarding whether 'clean' traps need to be washed between sites; this is not a science requirement.
   - If feces are present in an open trap, mark and bag trap for removal to the processing station.
5. Continue checking and bagging traps in the grid.
6. Bring bagged traps to processing station once tree-planting bag is full or all traps are checked.
7. Close empty traps for the day IF another day of sampling is scheduled.

8. Remove all traps if it is the last day of sampling in a bout.

a. Avoid dumping seeds onto the ground, within reason. Uneaten seeds can be collected into a plastic bag for disposal or re-use, per the discretion of the technician.

C.3 Setting up processing station

- Divide tasks between two person team:
  - Handler: Handles captures, makes measurements, and collects blood and tissue samples.
  - Recorder: Prepares equipment and consumables, processes samples, and records data.

PREPARATION FOR PROCESSING

1. Select location for processing station that is:

a. Immediately adjacent to, but not within, the trapping grid

b. Upwind of staging area for animal processing, where possible

c. Shaded, for keeping sun off of the traps in hot weather

2. Unpack and set up processing station for data collection, animal marking/tagging, anesthetization, tissue and blood sampling, and sterilization.
3. If working directly on the ground, line the area with trash bags, plastic sheeting, or a plastic tray to allow for spraying with quat and wiping clean in between individuals.
4. Prepare a small tray filled with quat to sterilize instruments between individuals.
5. Put on the additional PPE specified in the NEON Operations Field Safety and Security Plan (AD[02]) for handling animals. Sample animals for population and pathogen data, as directed below.
6. Once processed, return captures to their respective traps and release at the sites of capture while wearing the PPE required for handling animals.
7. Replace dirty traps with clean traps, either prior to or during the trap setting effort in the evening. Bring all used traps back to the lab for cleaning.
8. Reset and re-bait all traps the following dusk. Clean traps that have been baited on previous trap nights will require a smaller amount of bait, particularly on the trap door. Please note that too much bait can cause the trap to malfunction.

PRIORITIZATION OF PROCESSING STEPS

In the event of very high capture rates, lower priority tasks may be left out of processing. **The goal is to avoid situations where captures are released without any processing.** Please remember to record 'Released' in the fate field for each individual intentionally released without full processing.

For simplicity, guidelines are provided according to captures per grid. If grids predictably vary in capture rates, reduced processing can be implemented on grids that do not exceed the thresholds given below,

to enable increased processing on high-capture grids being processed on the same day. Please keep in mind that these are intended to be used as a guideline only; use professional discretion.

Suggested Modifications to Processing:

- >20 - <30 Captures Per Grid:
    - Blood samples – stop after 20 samples have been collected**
    - Recaptures only – eliminate size measurements
    - Hair and whisker samples – stop after 10 samples have been collected
    - Fecal samples – stop after 10 samples have been collected
    - Ear punches – stop after 10 samples have been collected***
- 30 + Captures Per Grid:
    - Blood samples – stop after 20 samples have been collected**
    - All captures – eliminate size measurements
    - Hair and whisker samples – stop after 10 samples have been collected
    - Fecal samples – stop after 10 samples have been collected
    - Ear punches – stop after 10 samples have been collected***
    - Eliminate tick searches

**When blood sample collections are limited, attempt to distribute the 20 samples among the priority species if possible (provided in Appendix E). Please do not spend additional time counting captures per species prior to processing. The simplest, acceptable implementation of this guidance is to stop collecting blood samples once 10 samples have been collected for a given priority species, if a site has >1 priority species. For sites with priority species that are difficult to distinguish (e.g., PEMA vs. PELE), collect up to 20 samples from individuals of these species, regardless of species ID.

**For maximum time savings, include unsuccessful bleeding attempts in the count to 20.

***If possible, without expending additional effort to review captures, prioritize individuals with uncertain species IDs for ear punch collection.

If an individual is intentionally released without full processing, be sure to record 'Released' in the fate field.

C.4 Processing captured animals

The small mammal field datasheet is provided separately (RD[05]), but a key to the fields on the datasheet and in the mobile application can be found in 8Appendix B.

TRANSFERRING CAPTURE FROM TRAP

1. Record grid ID and point ID and code the "Notes", if appropriate (see Table 2).

    - If the pointID is missing from or illegible on the trap, use 'X' in the recorded pointID to indicate the uncertainty. For example, if the pointID is missing, record the trap coordinate as 'XX'. If only half of the pointID is illegible, use the 'X' only for the illegible half (e.g., 'AX', 'X6').

2. Transfer capture to resealable plastic bag by slipping bag over end of trap that opens and then turning trap over.

    - Use standard thickness gallon resealable plastic bag for species < 100 g
    - Use 4 mil gallon resealable plastic bag for species > 100 g
    - For particularly large or aggressive individuals:
        - Cloth or mesh wash bags can be used instead of a resealable plastic bag, if desired. Keep in mind that these bags must be decontaminated, via laundering or UV, before re-use on another individual.
    - The animal should spend no more than 3-5 minutes in the bag.

3. Immediately observe the animal for signs of stress, and continue to do so throughout the handling period. Each animal should be handled for no more than 15 minutes. However, average time to collect all data should be no more than 5 minutes.

    - If the animal appears dead, check for rigor and for respiration within the bag. If the animal is clearly dead, collect the animal as a voucher specimen (see Section C.9).
    - If there is no rigor and the animal may be overheated or dehydrated, wet the belly and administer sugar water via dropper.
    - If the animal appears hypothermic, place the animal in a secure container containing a disposable hand warmer, batting and bait. Check the animal every 15 minutes, if possible, and release at the point of capture, when the animal exhibits normal behavior.

4. Place bag on handling surface and pin the animal behind the neck. Check capture for existing marking (ear tag or PIT tag).

5. After scruffing or otherwise securing the individual with one hand, remove animal from bag for all processing except anesthetization.

    a. For *Rattus spp.* in D04 and D20, plastic restraint cones can be used to facilitate handling.
    b. Provide a thick, cotton-gloved hand for the animal to bite on as distraction during handling.

c. Cover the animal's head with a piece of material to help calm the animal during the procedure, if necessary.
d. A proper scruff should immobilize the individual's head and forearms. It is recommended that the tail and/or hindlegs are also secured with the remaining fingers on your scruffing hand.
e. For species that prove challenging to effectively scruff (e.g., jumping mice, chipmunks, flying squirrels), a "bander's grip" can be used as an alternative to secure the individual for processing. This grip involves holding the animal's back against the palm of one hand, with the neck held between the bases of the index and middle fingers. If done correctly, the fingers are safely out of the way of the capture's teeth and can be used to hold flailing limbs in place.

If during processing you notice a hole in your glove, stop, put on a new glove, and discard the used glove.

C.5 Sampling for rodent-borne pathogen analyses

Anesthetization and blood sampling should be done in a well-ventilated area and upwind of animal being processed.

CRITERIA FOR BLEEDING ANIMALS

Bleed animals that meet all of the following criteria:

- Member of the Cricetidae, Muridae, or Dipodidae families
  - Not excluded based on permitting regulations (e.g., protected species)
- Weighs at least 10 g
- No pronounced or physically debilitating injury
- Has not yet been bled (whether the attempt was successful or not) during the current sampling bout
  - If uncertain whether or not an animal has been bled during the current sampling bout (for example, due to a recently lost tag), err on the side of caution and do not bleed.

PROPER INFECTION-CONTROL TECHNIQUES

- Disinfect all equipment that is used during processing of a capture before processing the next.
- Disposable items (e.g., gauze, microhematocrit tubes, lancets, paper towels used for clean-up) should be sprayed with quat and properly disposed of (e.g., trash bag, sharps container).

BLOOD COLLECTION TECHNIQUES

- The mandibular blood sampling technique, which involves collection from the submandibular and/or facial vein or artery, has proven successful to date across all species, except for heteromyids. The retro-orbital technique is no longer an allowed technique for NEON.
- The mandibular technique is widely used on laboratory mice, but has limited application to date in the field. It is known to work well on *Peromyscus spp*., but no published evidence of utility on a diversity of wild-caught species.

Anesthetization/Euthanasia

- The use of anesthesia is not required for the mandibular bleeding technique, but anesthesia is recommended for use on larger animals (e.g., >100 g) or by inexperienced personnel, if the technician cannot maintain a scruff.
- The effectiveness of isoflurane varies with ambient conditions (e.g., temperature, relative humidity) and across species. Therefore, a gradual increase in dosing is recommended to avoid accidental euthanasia.
- The required inhalation to effect time should not be longer than 1-5 minutes.
- The animal must not be released until signs of full recovery (i.e., resumption of normal movement and behavior) are observed. Take steps to heat or cool animals that are slow to awaken.

1. If anesthesia is required, place 3-5 drops (~0.2 mL) of isoflurane onto a cotton ball. Place cotton ball:
    - (preferred) in an appropriately sized conical centrifuge tube (15mL, 50mL, or 100mL) - the head of the small mammal should fit comfortably in the tube but leave minimal space surrounding the head to allow for an adequate supply of oxygen to enter the tube (while limiting the amount of isoflurane escaping the tube). Remove the capture from the plastic bag, and, once properly scruffed, insert the capture's head completely into the tube.
        - Please note that this method is preferred, as it can decrease the handling time because the animal is exposed to much higher concentrations of isoflurane. Therefore, this method requires increased vigilance (relative to the tea strainer method below) to prevent overdosing of the animal. Moving the animal's head in and out of the tube can control concentration of the isoflurane.

    OR

    - in a spring-loaded tea strainer, and place the tea strainer in the bag with the small mammal.

2. Avoid direct contact between the animal and the cotton ball. If the animal does not respond within 1-2 minutes, additional isoflurane can be added, 3-5 drops at a time, to the initial dose.
    - The rodent's rate of respiration, spontaneous movements, responses to tactile stimulation, and ability to retain sternal recumbency must be monitored in order to gauge the state of anesthetization.
3. Once the animal is stable and non-responsive to tactile stimulation, the bleeding procedure can be performed (described below).
4. Any animals encountered with significant injuries or found moribund in the field will be euthanized by placing the animal in a plastic bag with a cotton ball soaked in approximately 5mL isoflurane (Parker et al. 2008). This method is approved by the AVMA Guidelines (Leary et al. 2013). The rodent's rate of respiration, spontaneous movements, responses to tactile stimulation, and ability to retain sternal recumbency will be monitored, in order to verify death. Death will be confirmed via cervical dislocation. Personnel performing this procedure must be properly trained and qualified in vertebrate cervical dislocation.

Mandibular Bleeding

- The 4 or 5 mm lancet sizes are appropriate for most species under 40 grams, except *Rattus spp*. The size affects the depth of the puncture, and so the selection of size is dependent on the force used by a particular handler. As a rule of thumb, use the 4 mm for individuals < 20g, the 5 mm for those >20 grams, the 5.5 - 6mm for individuals >60 grams, and the 7 - 8mm for individuals >140 g.

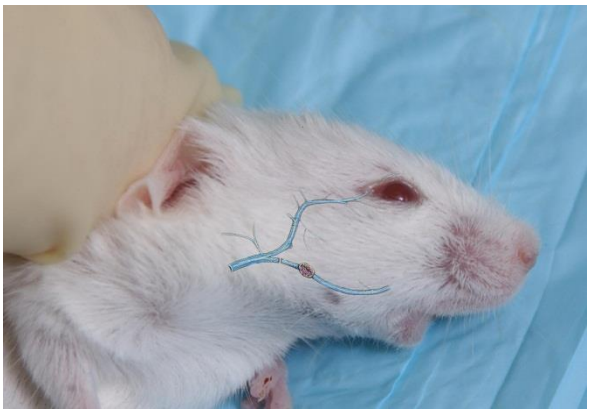


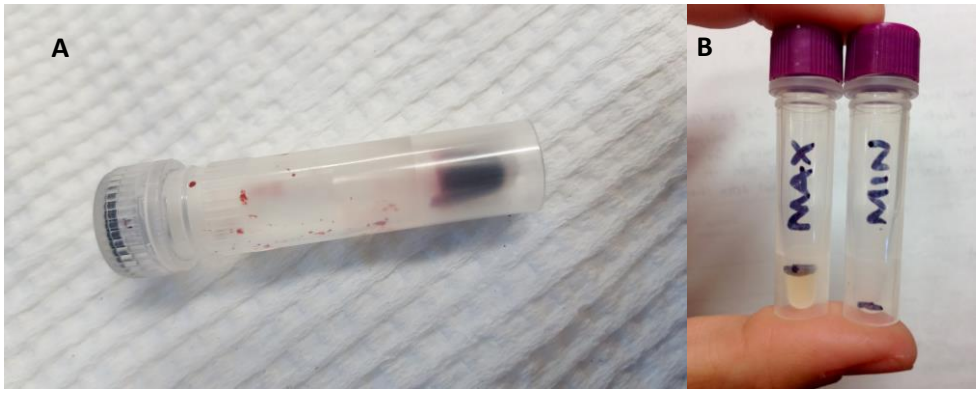
Figure 4. Schematic demonstrating where the facial vein and the submandibular vein meet at the rear end of the mandibular bone on a lab mouse (Mus).

The facial vein (lower branch) is typically the target for blood collection, but the vascular bundle associated with the junction of these vessels can also be used. From http://www.medipoint.com.

1. Securely scruff the rodent between its shoulder blades in one hand.
2. Locate the back of the mandible using the blunt end of the lancet to determine appropriate placement of the lancet.
3. The optimal puncture point is at the back of the jaw of the mouse, very slightly behind the hinge of the jawbones, toward the ear, just behind the point at which the upper and lower jawbones meet (Golde et al. 2005).
4. Puncture the cheek with a quick, firm thrust with the lancet. Be ready with the cryovial. Tilt the head to facilitate blood flow into the cryovial. Withdraw a volume of blood less than 1% of the rodent's body weight (e.g., 0.2 mL of blood from a 20g mouse; Figure 5).

   a. Blood flow can be remarkably rapid and of high volume with this method. Familiarize yourself with the blood sample guidelines relative to the approximate fill levels in the given cryovial.
   b. If an animal shows signs of lethargy or lack of responsiveness, administer sugar water as soon as possible.
   c. If blood flow is too low, use the lancet to puncture the same spot with a bit more force.

Figure 5. (A) Ideal volume of blood sample (50 microliters). (B) Minimum (20 microliters) and maximum sample volumes (50 microliters) needed for serological analysis.



5. In the event of an unsuccessful attempt, the other cheek can also be used. As a rule of thumb, do not try more than three attempts per cheek.
6. Even if the first attempt was unsuccessful, bleeding of an individual should only be attempted once per bout.

7. Even small amounts of blood should be retained as a sample. If the collected amount is less than the minimum required for the pathogen testing of 20 microliters, record the sample as Quantity Not Sufficient (QNS). These samples will be handled differently than those of sufficient quantity. Use a permanent marker to mark the top of the vial containing a QNS sample; this allows for faster organization of samples back in the lab (helps to maintain the cold chain required for these samples).
8. If blood is smearing into the fur, rather than forming drops, apply eye ointment to the area prior to lancing.
9. When the desired amount of blood has been collected, place a fresh piece of sterile gauze over the puncture point and pinch closed for up to 30 seconds to stem further bleeding.
10. Seal the cryovial with a screw cap and apply label. See labeling guidelines in sample collection section below.
11. Dispose of lancet in sharps container, and spray used gauze with quat and place in trash bag.
12. Record the blood collection on the datasheet with an 'M' for mandibular.
13. Proceed with animal processing, as described in next section. After processing for that individual is complete (but no more than 15 minutes after collection), place sample in 4 mil resealable plastic bag or cryovial storage box (cardboard preferred) on dry ice and KEEP FROZEN until sample can be transferred to the -80°C freezer in the lab.

Blood Sample Volume Guidelines

- Hantavirus testing requires at least 0.02 mL
- Extra blood for archiving is also desirable (approximately 0.06 mL)
- Minimum desired sample volume = 0.08 mL
- The National Institutes of Health Office of Animal Care and Use recommends a maximum sample volume of 10% of the circulating blood volume (CBV) of an animal:

Table 13. Approximate blood sample volumes for a range of body weights

Body Weight (g)	* CBV (ml)	1% CBV (ml) *every 24 hrs*†	7.5% CBV (ml) *every 7 days*†	10% CBV (ml) *every 2-4 wks*†
20	1.10 - 1.40	.011 - .014	.082 - .105	.11 - .14
25	1.37 - 1.75	.014 - .018	.10 - .13	.14 - .18
30	1.65 - 2.10	.017 - .021	.12 - .16	.17 - .21
35	1.93 - 2.45	.019 - .025	.14 - .18	.19 - .25
40	2.20 - 2.80	.022 - .028	.16 - .21	.22 - .28
125	6.88 - 8.75	.069 - .088	.52 - .66	.69 - .88
150	8.25 - 10.50	.082 - .105	.62 - .79	.82 - 1.0

200	11.00 - 14.00	.11 - .14	.82 - 1.05	1.1 - 1.4
250	13.75 - 17.50	.14 - .18	1.0 - 1.3	1.4 - 1.8
300	16.50 - 21.00	.17 - .21	1.2 - 1.6	1.7 - 2.1
350	19.25 - 24.50	.19 - .25	1.4 - 1.8	1.9 - 2.5

* Circulating blood volume

† Maximum sample volume for that sampling frequency

C.6 Collecting individual data

Recaptures are processed the same way as new captures. Repeated measurements of the same individual are valuable. However, if time is limited during periods of unusually high capture rates, repeated size-related measurements of recaptures can be skipped (see Appendix B: Quick References). If measurements are not taken on a particular capture instance, do not enter measurements from a previous capture instance into that record.

MARKING ANIMAL

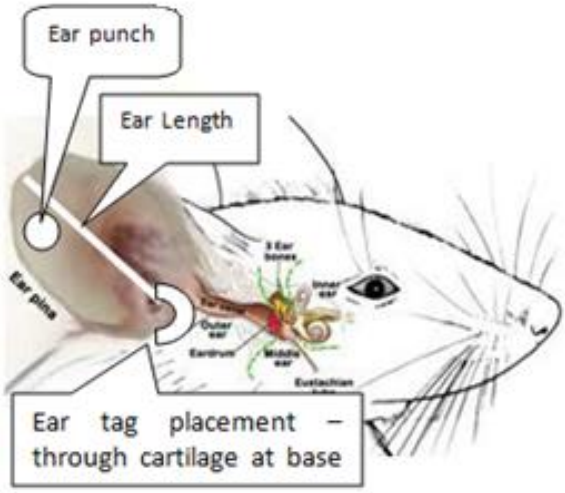


Figure 6. Schematic demonstrating the placement of an ear punch, an ear tag, and how the ear length measurement should be made on a lab mouse (Mus).

1. **Check** capture for existing marking (ear tag or PIT tag).

2. **Mark** the individual (if needed) with ear tag or PIT tag. Mode of tagging will be based on the length of the external pinnae, as some species, such as voles (e.g., *Microtus spp., Myodes spp.*) and pocket mice (e.g., *Chaetodipus spp., Perognathus spp.*), do not have sufficient external pinnae for securing ear tags. Discretion can be used by field personnel to select the appropriate

tagging method. For example, technicians have found that ear-tagging is effective in *Myodes gapperi* and *Microtus pennsylvanicus.* Jumping mice (*Napeozapus spp., Zapus spp.*) can be marked using either method, as technicians have reported varying success with both techniques.

- Shrews will not be permanently marked, but will be temporarily marked using a permanent marker.
- Use ear tag if pinnae are of sufficient size. Attach to right ear (preferred) or left ear, if needed.
    - If an animal appears to have a torn ear due presumably to the loss of an ear tag, attach a new ear tag to the intact ear.
    - If an animal has an ear tag that was not properly attached (e.g., attached in the outer margin of the pinna), remove old tag and attach a new ear tag to the other ear.
    - Ear tags **must** be unique within a domain.
        - Be sure that new shipments of ear tags do not have the same numbers as previous shipments.
        - The quality of the mark-recapture data is compromised when duplicate tagIDs are used within a domain.
- Use PIT tag if pinnae too small for ear tag. All PIT tags and needles must be sterile.
    - This is the often the case with voles and pocket mice.
    - PIT tags should be inserted close to the rear of the animal, inserting the needle pointed towards the head.
    - Suggested technique: Place animal flat on processing surface, with the two middle fingers of one hand securing the back of the head, while the fur is pinched with the thumb and forefinger of the same hand. Use the other hand to insert the needle into the tent of fur. Be careful not to pierce through the skin again (you should feel the tag being released from the applicator as it is inserted).
    - The point of needle insertion can be sutured using veterinary tissue adhesive to reduce PIT tag loss rates.
    - After spraying with quat, dispose of used PIT tag needle in sharps container. To prevent needle sticks, needles should not be recapped prior to discarding into the sharps container.
    - PIT tag reader should be kept in a sealed plastic bag, to facilitate disinfection (i.e., the bag can be sprayed with quat and wiped clean after each use).

3. **Record** the tag number on mobile device or datasheet in tagID fields.

- Format for ear tag is LXXXX for left ear or RXXXX for right ear (preferred).
    - Ear tags that do not have 'NEON' laser-etched on them should be indicated by adding an 'O' for Other in front of the ear tag id (e.g., OL1001).
- PIT tags:
    - Note that some PIT tags have two different serial numbers - one labeled decimal and the other hexadecimal. Please confirm which one the reader reads and please record that one.
    - If using a paper datasheet, write down last six digits of serial number for PIT tags and place one bar code sticker on the back of the datasheet.
    - If using a mobile device:
        - For new tags, scan the PIT tag barcode label.
        - For recaptures, select the corresponding serial number from the drop-down.
- If an individual has a ripped or punched ear indicative of a lost tag or the individual's tag was intentionally replaced (due to poor initial placement):
    - If an ear tag has apparently been ripped out of the ear:
        - Record the previously marked ear (L or R) in the Ripped Ear/Tag Replaced column
        - It is optional to record the ripped ear every time the individual is captured.
    - If an ear tag has been intentionally replaced:
        - Record the previously marked ear (L or R) in the Ripped Ear/Tag Replaced column and note the ID of the removed tag either (a) in this same field on the mobile device or (b) on the back of the datasheet.
    - If an animal has evidence of an ear punch but not clearly a torn ear tag:
        - Record the punched ear (L or R) in the Ripped Ear/Tag Replaced column
- If an individual escapes after a sample is collected but prior to tagging, use the convention described for untagged voucher specimens below (SOP C.9).

4. **Record** the recapture status for all captures.

    - Available options are Yes, No, and Unknown
    - For individuals that have had a tag lost or intentionally replaced:
        - If the previous tagID is known: mark the individual as a recapture when replacing the tag.
        - If the previous tagID is unknown: mark the individual as unknown (i.e., record 'U' in the Recapture field), if the animal is clearly a recapture.
        - If the animal escapes prior to assessment of whether it has a tag, record 'U' for 'unknown'.

5. Once the individual is successfully marked, **label** all sample vials with the unique individual ID, as described below.

ASSESSING SEX, REPRODUCTIVE CONDITION, AND AGE

1. Note sex and reproductive condition and enter codes on mobile device or datasheet.

Males

- Scrotal (S): testes may be descended (obvious bulging under the tail)
- Non-scrotal (N): testes not descended (abdominal)
- Unknown (U): testes not able to be assessed due to unusual circumstances (e.g., botfly)

Females

- Nipples
  - Enlarged (E)
  - Not enlarged (N)
  - Unknown (U): nipples not able to be assessed due to unusual circumstances (e.g., botfly)
- Pregnant (P)
  - Pregnancy can be determined by palpating the abdomen for fetuses or by assessing the width of the pubic symphysis
- Vagina
  - Swollen (S) – indicates estrous
  - Plugged (P) – some use the term Perforate
  - Neither (N) – some use the term Non-perforate
  - Unknown (U): – vagina not able to be assessed due to unusual circumstances (e.g., botfly)

Unknown

- If an individual escapes or needs to be released before you can examine the reproductive condition, or the taxon is difficult to assess (e.g., shrews), please be sure to denote 'U' for unknown.

Note animal age: juvenile, sub-adult, or adult on mobile device or datasheet (see also quick reference in Appendix B).

TAKING MEASUREMENTS

Take and record standard measurements to the nearest millimeter, using standard rounding guidelines:

1. Right hind foot: Using the 6-inch flexible ruler, measure the distance from the back of the heel to the end of the longest claw (beyond the fleshy toe).
2. Take additional measurements, at your discretion, if useful for species discrimination. Refer to the dichomotous key for guidance.

- **Ear length:** Insert the end of the ruler in the notch at the base of the ear and measure the maximum length to the distal portion of the pinna (medial aspect), excluding hairs that project beyond the fleshy portion.
- **Tail length:** Pin the animal onto the handling surface, belly down. Bend the tail up at a right angle. Use the 6-inch ruler to measure from the bend on the back at the base of the tail to the tip of the fleshy part of the tail, excluding projecting hairs.
- **Total length**: Place animal, belly down, on the 12-inch rigid plastic ruler and hold it so that the body and tail are straight and taut, but not stretched. Measure the distance from the tip of the nose to the tip of the fleshy part of the tail, excluding any hairs that project beyond the tip.

IDENTIFYING TO SPECIES

1. Once all measurements have been taken, the individual should be identified to species and recorded. Domain-specific lists of species codes are found on the domain-specific paper datasheets and in the drop-down menus on the mobile data entry application.
   - The full list of mammal species codes can be found on the NEON intranet in the Sampling Support Library.
   - Note that this list includes codes for instances where you cannot make an identification below genus (e.g., *Peromyscus sp*.):

Table 14. List of codes for genus-level identifications

taxonID	scientificName
AMSP	*Ammospermophilus sp.*
BLSP	*Blarina sp.*
CHSP	*Chaetodipus sp.*
CYSP	*Cynomys sp.*
DPSP	*Dipodomys sp.*
GESP	*Geomys sp.*
GLSP	*Glaucomys sp.*
LESP	*Lemmus sp.*
LPSP	*Lepus sp.*
MISP	*Microtus sp.*
MUSP	*Mustela sp.*
MYSP	*Myodes sp.*
NESP	*Neotoma sp.*
ONSP	*Onychomys sp.*
PGSP	*Perognathus sp.*
PESP	*Peromyscus sp.*
RASP	*Rattus sp.*
RESP	*Reithrodontomys sp.*
SNSP	*Scapanus sp.*

SCSP	*Sciurus sp.*
SISP	*Sigmodon sp.*
SOSP	*Sorex sp.*
SMSP	*Spermophilus sp.*
SLSP	*Sylvilagus sp.*
SYSP	*Synaptomys sp.*
TMSP	*Tamias sp.*
TSSP	*Tamiasciurus sp.*
THSP	*Thomomys sp.*
ZASP	*Zapus sp.*

2. If there is any uncertainty in the species identification, please note this in the idQ (i.e., identification qualifier) field – using one of the codes below (Table 15). Leave blank if there is not uncertainty.

    a. Species in the genus, *Peromyscus*, are often hard to distinguish in the field. This is especially true of *P. maniculatus* and *leucopus*. In the case of these and other known cryptic species:

        - In the lab, record the cryptic species pair (or group) in the 'Cryptic Species' sheet in the Sampling Support Library.
        - In the field, if you are leaning towards assigning one of the cryptic species to a particular individual, record appropriately and also include a 'CS' in the identification qualifier. Otherwise, you can select the corresponding cryptic species pair code (if available) or one of the generic-level codes (Table 14; e.g., PESP), and no additional entry in identification qualifier is needed.

Table 15. Codes for identification qualifier entries

idQ	Identification Qualifier Description*
CS	cf. species
AS	aff. species
CG	cf. genus
AG	aff. genus
CF	cf. family
AF	aff. family

* cf. roughly equals "not sure"; aff. roughly equals "similar to, but is not"

3. If the identification of the individual to species required consultation of a guidebook or key, please indicate this either (a) as a comment on the paper data sheet, or (b) select from the **Identification References** drop-down menu in the mobie data entry application. If the reference is not available in the drop-down menu, please note the reference in the remarks and issue a problem ticket upon return to the lab.

CHECKING FOR ATTACHED TICKS

Check **only** the mammal's head and neck area for attached ticks, gently blowing in a steady stream and using fine-tipped forceps to part the fur where necessary. Some individuals readily produce fecal samples when blown on, so these data may be collected simultaneously (see below). If wearing a respirator, just use forceps to part the fur. Common tick attachment locations are on the edges of and behind the ears, at the base of the neck, and at the roots of the whiskers. The scruff grip may need to be adjusted to check the neck – for mice, holding the tail while adjusting can reduce escapes. Tick life stages are identifiable by size:

- Larvae are approximately the size of a poppy seed, and only slightly larger when engorged.
- Nymphs are approximately the size of a sesame seed, and somewhat larger when engorged.
- Adults are approximately the size of a grain of rice, but broader and flatter, and can be up to jelly bean-sized when engorged.

Spend no more than 15 seconds checking an animal for attached ticks, which cannot be brushed off. Unattached ticks crawling on the fur should not be recorded, but should be added in the remarks as "unattached tick". Other ectoparasites such as fleas and botflies should also be noted in the remarks.

Any tick life stages attached to the individual L(arvae), N(ymphs), and A(dults), or Z(ero) should be circled on the datasheet or selecting in the mobile application. If an individual was not examined, do not circle anything on the datasheet and select 'Unknown' in the mobile application.

C.7 Collecting samples

If possible, use different forceps for each sample. In between processing individuals, forceps and scissors should be cleaned with quat, whereas the biopsy punch should be cleaned with an alcohol wipe and then flamed with lighter.

SPECIMEN LABEL AND STORAGE REQUIREMENTS

- Site Code (e.g., RMNP)
- Date (Year, month, day)
- Tag ID (RXXXX or last 6 digits of PIT tag)
- Sample Type (B for blood; E for ear; F for feces; H for hair and whiskers)

EXAMPLE:
OSBS.20130714.R1357.B

Note: It is recommended that cryovial labels be used, with some information pre-printed.

- Use fine point permanent marker (Sharpie or equivalent) for writing on cryovial labels, coin envelopes, or directly on the cryovials.

Table 16. Summary of samples to be collected.

Sample	Frequency	Storage container	Label	Field storage	Long-term storage
Blood	Once per bout	Vial rated to -80°C	Label rated to -80°C	Dry ice	-80 °C Ultralow freezer
Fecal	Every capture event	Vial rated to -80°C	Label rated to -80°C	Dry ice	-80 °C Ultralow freezer
Ear punch	Once per life of individual	Vial rated to -80°C	Label rated to -80°C	Dry ice	-80°C Ultralow freezer
Hair	Once per bout; dominant genus	Archival coin envelope	Write on envelope	Ambient	Ambient
Whiskers	Once per bout; dominant genus				
Vouchers	Opportunistically	Resealable plastic bag	Acid-free, archival tag	Dry ice	standard freezer

1. For all target and opportunistic species**:**
   a. Collect any fresh, uncontaminated feces from the animal using either forceps or scooping the sample directly with the cryovial, then label.
      - Do not collect feces from the trap.
      - Store cryovial on dry ice for transport back to the lab.
      - Indicate on mobile device or datasheet (“F” for feces) if sample was collected.
   b. Collect one ear tissue sample per individual, preferably from the untagged ear. One ear tissue sample is to be taken per the lifetime of an individual, regardless of whether it has clearly lost a tag or not.
      - Using a clicker-style 2000 Micron (2 mm) tissue biopsy punch, collect sample from near the edge of the untagged ear; OR
      - Using iris scissors, collect sample by cutting a small triangle of tissue from the edge of the ear
      - Place ear tissue in cryovial and label.
        - If the ear tissue gets stuck in the biopsy punch, remove with forceps. Forceps should by rinsed in quat and wiped clean prior to reuse.
      - Indicate on mobile device or datasheet if sample is collected.

c. Record the weight, to the nearest gram, using the appropriate, tared spring scale. Record on mobile device or datasheet.

d. Make sure all cryovials are labeled correctly, put in cooler with dry ice, and entered on the datasheet. Hair and whiskers are stored at ambient temperature.

e. Put animal back into trap (trap is still in plastic bag) for transport back to point of capture.

Process all individuals on a grid before releasing animals at point of capture, unless extra personnel are available.

2. For individuals belonging to the site-specific dominant genus (see site-specific appendices):
   a. Collect a tuft of hair (approximately 5 hairs) from the scruff of the individual with forceps.
   b. Pluck 2 whiskers with forceps (or similar), or clip with cuticle scissors as close to the base as possible without injury – one from each cheek – from the front half of the nose.
   c. Place hair and whiskers in archival coin envelope together. Do NOT seal coin envelopes; leave flaps folded over but unsealed.
   d. Collect these samples once per individual per sampling bout. If an individual is suspected to be a recapture that has lost a tag, do not collect samples if it is captured on the second or third day of a bout. Although not likely to negatively impact the welfare of the animal, it is best to avoid double collection of whiskers within one sampling bout.

Indicate on datasheet if samples are collected. If a sample does not get entered into the database, then all resulting data and specimens are lost.

Follow clean up procedures described in next section before processing the next animal to avoid cross contamination.

C.8 Cleanup between processing of individuals

Equipment is cleaned and sterilized in the field between processing of individuals to prevent cross contamination. The recorder is typically responsible for these tasks.

1. After spraying with quat, place all contaminated consumables (e.g., paper towels, plastic bags, gauze, and cotton) in the trash bag.
2. Place all used small instruments in the tray filled with quat for at least 5 full seconds (e.g., clip of spring scale only, forceps, biopsy punch, tea infuser spoon, scissors).
   - Dry instruments with paper towel before use.
3. Spray quat on larger reusable equipment (e.g., insulated cooler, squirt bottle containing quat). Use paper towels to carefully and thoroughly wipe the surfaces.
4. Spray down the processing surface with quat. Wipe processing surface with paper towels.
5. Always spray contaminated areas of clothing with quat as soon as possible.
6. Spray quat on gloved hands of animal handler and then own hands.

- Wipe hands together and dry with paper towels as needed.
- Sterilized gloves can be reused with the next animal but should be changed if a hole develops and after each grid is completed.

7. You are now ready to process the next animal.
   - If you were able to fully process an individual (i.e., did not have to reduce sampling according to the prescribed prioritization in the event of high capture rates), please indicate as such in the Fate field on the data sheet or in the mobile application (**F**ully processed).
   - If you did not complete full processing due to high capture rates, record **R**eleased in the Fate field.

C.9 Voucher specimens

Opportunistic collection

All animals that die during the course of regular sampling should be collected as voucher specimens. Dead animals should be processed only after all the live ones have been processed. Blood, whisker, hair, and ear tissue samples do not need to be collected from dead individuals.

Intentional collection

Training grids will also be used as a source of voucher specimens of target species, to both provide a historical record of the taxonomic identifications used in this study and enable additional scientific study. Voucher specimens of all resident species shall be collected from each domain, with a target minimum of 5 vouchers per species collected every 5 years. Ideally, these specimens will include skin, skeleton, and frozen tissues (e.g., liver, heart). These specimens minimally provide a long-term record of the taxonomy of the species being studied, as a reference for verification or evidence to support taxonomic changes that occur as the science advances.

Whenever training grids are sampled, the captured individuals of target species only should be used to meet the sample size criteria above. Individuals selected for vouchering should first be processed for training purposes and then immediately euthanized, as described in SOP C.5 ‘Anesthesia/Euthanasia’ above. The process for determining the vouchering needs to meet the desired sample sizes will be to evaluate the incidental deaths within a domain after the first 3 years of sampling; any species not yet vouchered adequately can then be targeted over the next two years, before the subsequent 5 year cycle begins. Please note that data from the training grids, including voucher specimen data, do not get entered into the small mammal mobile application, as these locations are not long-term sampling locations. Voucher specimen data collected from training grids only should be captured on paper datasheets and then transcribed into a voucher collection application.

Collection Procedure

1. Label a specimen tag with the site ID, tag ID, sex, species, and date of capture.
a. Use archival quality Pigma pen or, if this is not available, a hard lead pencil (#3) to write information on tag.
b. If an individual does not have a tag, assign a tagID with the format: 'O' + 3 digit number of plotID + trapCoordinate + YY + MM + D(or DD) (e.g., O003A5160518).
c. Note that this tagID should be associated with all samples collected from a vouchered specimen, if the samples were collected prior to death.
2. Securely affix the tag to the right hind foot above the ankle using cotton thread. Since long threads tend to become tangled during storage, tie the tag as close to the leg as possible.
3. Place the animal in a resealable plastic bag and immediately place in the cooler.
4. Indicate that a voucher has been collected on datasheet or mobile application.

Note: Specimens in poor condition should first be offered to the identified repository prior to disposal, if required by the state collection permit. If the repository refuses to accept specimens in poor condition, they should be sprayed liberally with disinfectant, double-bagged, and placed in the trash bag.

C.10 End of the sampling day

SAMPLES AND SPECIMENS

1. Keep all samples stored in cryovials on dry ice for transport back to the lab.
    - Frozen samples must remain frozen at all times. Repeated freeze-thaw cycles will compromise the integrity of the sample.
2. Transfer frozen samples to ultralow freezer (-80°C).
3. Store voucher specimens in a standard freezer (≤ 0° C but ≥ -20° C) and record on freezer log, if available.

EQUIPMENT – IN THE FIELD

When all animals are processed and released, clean up as described in previous section, plus do the following.

1. Spray used batting with quat and dispose of in trash bag.
    a. Clean batting can be reused.
2. Pack up all supplies and equipment, once they are clean and dry.
3. Clean PPE as directed by EHS Safety Policy and Program Manual and dispose final round of nitrile gloves and wipes.
4. Close and tie the trash bag(s). Place bag in bed of pickup truck for transport back to the lab

5. If another night of sampling is scheduled, be sure that all traps are closed until dusk.
6. Be sure to replace dirty traps with clean ones.
7. If another night is not scheduled, collapse all traps and place in large plastic bag.
    - Place bag in bed of pickup truck for transport back to the lab or outside of passenger compartment of vehicle to prevent exposure to any remaining pathogens, if present.
    - Be sure to keep clean and dirty traps separate, as dirty traps should not be reused until they have been cleaned and sterilized.
8. Be sure that all soiled disposable sharps (e.g., PIT tag needles, heparinized microhematocrit tubes) have been disposed of in a 1 quart, slip-top, OSHA NIOSH/CDC compliant sharps container in the field, and is in a sealed plastic bag when not in use.

SOP D Equipment Cleaning in the Laboratory

D.1 Timing

Cleaning of dirty traps occurs at the Domain Support Facility, at the earliest convenience of the domain staff. Cleaning should follow the guidelines provided in the NEON Operations Field Safety and Security Plan (AD[02]). Traps must be cleaned before re-deployment in the field. If stored, dirty traps must be stored in plastic bags in a well-ventilated area posted with Biohazard per Biosafety Level 2 requirements.

D.2 Equipment Cleaning and Disposal Procedures

To reduce the risk of disease transmission to technicians and among captured small mammals, thorough cleaning and disinfection of equipment that is known to have been in contact with small mammals is required. Cleaning of traps that are extremely soiled, full of bait, contaminated by ants, slugs, etc., or to be transported for use at another site is recommended. Small mammal traps that have contained trapped animals will be removed from the trapping grid, transported back to the domain lab in a plastic bag, where dirty traps will be thoroughly cleaned, as described below. These traps will be replaced with clean traps before the next night of trapping. The bags containing dirty traps will then be placed in the bed of a pickup truck, which is separated from the passenger compartment. Back at the laboratory, a solution of quaternary ammonia (follow manufacturer guidelines for dilution) or a 10% bleach solution (i.e., 1:10 dilution with water) should be mixed in a carboy, or similar container. Cleaning is best performed in a well-ventilated area, while wearing the full PPE required for handling small mammals at a given site. Chemical-resistant rubber gloves should be worn in place of nitrile gloves. Traps must then be soaked in the quaternary ammonia solution for a minimum of 10 minutes (as specified by the manufacturer guidelines) or the bleach solution for 10 seconds, and scrubbed out with stiff bristled brushes. Traps will be rinsed thoroughly with water, to avoid damage and to remove as much of the disinfectant scent as possible.

Mesh wash bags used for animal handling must be decontaminated via laundering or UV.

SOP E Laboratory Sampling and Analysis

E.1 Sample processing timing

Process all frozen samples immediately upon returning to the lab. Sort frozen cryovials into cryovial storage boxes according to sample type. To keep samples frozen, always endeavor to minimize handling time and, while handling, always stage cryovials containing samples using a lab-top cooling device, dry ice bed, or similar. Once samples are frozen, they must remain frozen; plan accordingly. Be sure to **label the outside of all storage containers (e.g., cryovial storage boxes) with the domain, collection year, and sample type.** Storage Container IDs should follow the format DXX.YYYY.#.(sample type letter from sampleID – e.g., B for blood), where # indicates the number of the box (1 – n).

E.2 Sample processing in the lab

1. **Ear punches**
    a. A subset of the ear tissue samples will be used in SOP F.
    b. The remaining ear tissue samples should be shipped to the archive institution indicated in the CLA shipping document on CLA's NEON intranet site, according to the instructions in SOP H.
2. **Hair/Whiskers, Fecal samples, Voucher specimens**
    a. All samples should be shipped to the archive institution indicated in the CLA shipping document on CLA's NEON intranet site, according to the instructions in SOP H.
3. **Blood samples**
    a. If fewer than 113 total blood samples were collected at a site for the year, send all samples to the testing lab for analysis. Otherwise, consult Appendix D.
    b. See SOP H for further details on sample shipment.

E.3 Sample preservation

- Store **ear punches, fecal samples, and blood samples** in an ultralow (-80°C) freezer.
- Store **voucher specimens** in individual, labeled plastic bags in a standard -20°C freezer. Label by writing the following on the bag in permanent marker: voucherSampleID, if available, or siteID, date, and species code (for specimens captured on the training grids).
- Store **coin envelopes** containing hair and whisker samples in labeled plastic bags at ambient temperature and low humidity. To avoid excess moisture build-up, do not completely seal the plastic bags and use dessicant, if necessary.

SOP F Processing for Genetic Analysis

F.1 Ear Punch Sample Processing Timing

A subset of ear tissue samples will be prepared for DNA barcoding, to provide quality assurance of species identification. Selection of samples for barcoding should not occur prior to the end of field sampling or October, whichever is earlier. DNA barcode samples must be shipped to the contracted barcoding facility by February of the following calendar year in which they were collected.

F.2 Ear Punch Preparation

1. Select the small mammal ear tissue samples to be barcoded.
a. Select up to 95 individuals for 1 DNA barcode plate per domain. The following rationale should be used to select specimens based on the confidence in the species identification:

    a. A minimum of 3 individuals per species recorded in a domain should be sent for barcoding annually (if available).

        - Where possible, select samples from a variety of sampling dates and locations within a domain.

    b. Individuals with species identifications that have uncertainty associated with them are the priority for the remaining wells.

        - Uncertainty should have been recorded in the identificationQualifier field on the small mammal field datasheet (RD[05]).
        - For these species, submit either 10 individuals or 11% of the individuals sampled (whichever is higher, if space is available). If species are present at multiple sites in the domain, include representatives from all possible sites.

2. Print one 96-well datasheet per plate (RD[05]) or enter directly into the Shipping database available on the NEON intranet on the FOPs-TOS landing page.

3. Prepare a workspace with shipping box, 96-well microplate with row caps loosely attached, forceps, lighter, pencil or ethanol-safe pen, and gloves.

F.3 Ear Punch Sample Processing in the Lab

Fill each microplate completely (95 specimens) before shipping.

1. Wipe down the work area with 95% ethanol.
2. Prepare 95 specimens for barcoding.
a. Work with a single microplate at a time and enter all data before proceeding to the next microplate.

b. To keep samples frozen, stage cryovials containing samples using a lab-top cooling device, dry ice bed, or similar.
c. Fill out the 96 well datasheet with the plate number, sample location in the plate, barcode lab and tag ID.
d. DO NOT place any foreign objects (e.g. labels) into sampling wells. If something falls into a well (e.g., eyelash), note it and do not place a sample into that well. Move to the next well.
e. Cover wells that are not in use with row caps. Note that strip caps are numbered and correspond to numbering on plates.
f. Prior to beginning, and between each specimen, flame-sterilize forceps for at least 2 seconds to ensure that no residual tissue is present.
g. Place the ear tissue sample in the well (Figure 7).
    a. Static from the plate and on the forceps can make it difficult to get the tissue into the well.
    b. Be gentle so that the sample does not end up in a different well.
    c. It can be helpful to gently tap the forceps to shake the tissue into the well. If it has gone into a different well, do not remove it.

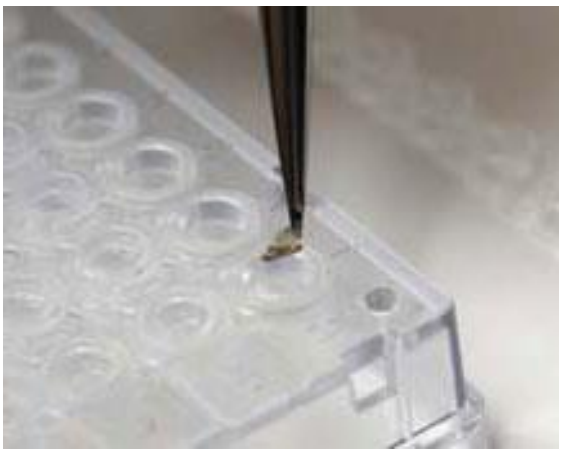


Figure 7. Placing tissue in a well.

h. Repeat until you have filled all wells in the microplate, **EXCEPT** for well H12 which always remains empty as a negative control (fill 95 wells).
i. Cover plate.
j. Complete data entry prior to filling a new plate.

F.4 Ear Punch Data Handling

STOP after each plate and enter the Plate number and Sample location into the Barcode Plate datasheet. Plate number is the unique plate number recorded on the 96-well datasheet. Sample location refers to the position each sample occupies in the plate (A01-H12). Have another technician double-check data entry. See SOP G for further details on data handling.

F.5 Sample Preservation

Store all plates and tubes in a standard (-20°C) freezer until shipped.

F.6 Sample Shipping

Once the data have been quality checked, ship the samples. Ship samples overnight with dry ice to external facilities along with a hard copy of the datasheet for each plate (RD[05]).

See SOP H for further details on sample shipment.

SOP G Data Entry and Verification

The importance of thorough, accurate data entry and transcription cannot be overstated; the value of the efforts in the field is only manifested once the data are properly entered for delivery to NEON's end users.

Mobile applications are the preferred mechanism for data entry. Data should be entered into the protocol-specific application as they are being collected, whenever possible, to minimize data transcription and improve data quality. Mobile devices should be synced at the end of each field day, where possible; alternatively, devices should be synced immediately upon return to the Domain Support Facility.

However, given the potential for mobile devices to fail under field conditions, it is imperative that paper datasheets are always available to record data. Paper datasheets should be carried along with the mobile devices to sampling locations at all times. As a best practice, field data collected on paper datasheets should be digitally transcribed within 7 days of collection or the end of a sampling bout (where applicable). However, given logistical constraints, the maximum timeline for entering data is within 14 days of collection or the end of a sampling bout (where applicable).

Before entering data, all personnel **must** read RD[04] for complete instructions regarding manual data transcription. Prior to entering data via a web user interface (webUI), each technician shall enter a plot (or subplot) of data from one bout into the protocol-specific webUI housed on the Training portal, as described in RD[04].

Protocol-specific instructions

3. can be found on the NEON intranet in the Sampling Support Library.
4. Do NOT enter data from training grids; these data should be collected on paper datasheets.
5. Do NOT enter data for a plot if no traps were set, due to unforeseen circumstances.

SOP H Sample Shipment

Information included in this SOP conveys science-based shipping and handling requirements, not lab-specific or logistical demands. For that information, reference the CLA shipping document on CLA's NEON intranet site.

Other shipping details (e.g., acceptable days of the week for shipping, ship to address, manner of shipping etc.) will be specified by the external facilities and communicated to FOPS by CLA.

Frozen samples should be shipped frozen on dry ice via overnight delivery service to the external facility. **Frozen samples must remain frozen at all times.**

H.1 Handling Hazardous Material

Dry ice is a Class 9 regulated material and must be shipped according to CFR 49 Subchapter C, Hazardous Materials Regulations.

Dry ice releases carbon dioxide gas, which can build up pressure and rupture packaging. Ensure the packaging used allows the release of this pressure to prevent rupturing the package. Dry ice must be packaged using **UN packing group III** compliant materials. The maximum amount of dry ice per package is **200 kg**.

Any human or animal material including, but not limited to, excreta, secreta, blood and its components, issue and tissue fluids, being transported for diagnostic or investigational purposes are considered diagnostic specimens for shipping. These materials are shipped as **Biological Substance, Category B (UN3373)**.

Refer to Chemical Hygiene Plan and Biosafety Manual (AD[03]) for additional requirements on commercial shipment of hazardous or dangerous materials.

Dry ice should be handled according to the guidelines in the EHSS Policy, Program and Management Plan (AD[01]) and the Domain Chemical Hygiene Plan and Biosafety Manual (AD[03]).

H.2 Supplies/Containers

1. **Ear punches, Fecal samples, Blood samples**
    a. Samples should be stored and shipped in cardboard vial storage boxes packed within insulated shipping containers containing dry ice; use dry packaging to fill any headspace.
2. **Voucher specimens**
    a. Ship vouchers in an insulated shipping container containing dry ice.
    b. Layer dry ice, thin cardboard, and plastic bags containing voucher specimens; use dry packaging to fill any headspace.
3. **Hair/Whiskers** - no specific shipping container required.

4. **DNA barcoding plates**
    a. Ship plates in an insulated shipping container containing dry ice.
    b. Layer dry ice, thin cardboard, and plates; use dry packaging to fill any headspace.

H.3 Timelines

All frozen samples must be shipped via overnight service on dry ice to maintain integrity of the samples. Be sure receipt by the facility is possible on the following day, prior to shipping.

Hair and whiskers samples do not have any timing specifications for shipments.

H.4 Conditions

All frozen samples must be shipped on dry ice to keep the samples frozen. Hair and whisker samples can be shipped under any ambient conditions; include a dessicant in the shipping container, if possible.

H.5 Grouping/Splitting Samples

All samples collected during any given site/bout combination should be shipped together and placed in a continuous sequence within the sample storage box in which they are shipped (e.g., wells A1, A2, A3, A4, A5, etc.). Samples from multiple site/bout combinations can be shipped together in the same sample storage box. This method of storage and shipping allows samples to be quickly inventoried sorted at the external facility. Expediting these processes reduces the probability of thawing events that reduce sample quality.

H.6 Shipping Inventory

Whenever a batch of samples or voucher specimens is shipped, the batch must be accompanied by a hard-copy shipping manifest enclosed within the shipping container AND a corresponding electronic version of the manifest (excel or csv file) emailed to the external facility. The shipping manifests lists every sampleID included in the shipped batch.

1. Navigate to the "Shipping Information for External Facilities" document on CLA's NEON intranet site. Check whether there are items such as permits or cover letters required to include in the shipment. *Check this document often as instructions are subject to change*.
2. Print out required documents (if needed) to include in shipment box.
3. Prepare a shipping inventory detailing the contents of the shipment, using the protocol-specific templates found on CLA's NEON intranet site. Include a printed copy of the inventory in the shipment box.
4. Save the inventory with the following naming convention: "DXX_MOD_ShippingInventory_YYYYMMDD_XofX"

a. example: D05_RPT_ShippingInventory_20160905_1of2

5. Complete packing slip, address shipment, and ship ground to the destination(s) specified in the CLA "Shipping Information for External Facilities" document.
6. Email an electronic copy of the shipping manifest and tracking number to the email addresses listed in the CLA "Shipping Information for External Facilities" document.

H.7 Laboratory Contact Information and Shipping/Receipt Days

See the CLA shipping document on CLA's NEON intranet site.

8 REFERENCES

Adams, J., C. Edmondson, D. Willis, and R. Carter. 2013. Effects of prescribed burning on small mammal, reptile, and tick populations on the Talladega National Forest, Alabama. Pages 123–126 *in* J. M. Guldin, editor. Proceedings of the 15th Biennial Southern Silvicultural Research Conference. e-Gen. Tech. Rep. SRS-GTR-175. U.S. Department of Agriculture, Forest Service, Southern Research Station - See more at: http://www.srs.fs.usda.gov/pubs/43491#sthash.l0CCuJHG.dpuf, Asheville, NC.

Annotated Mammal Species List of the Ordway-Swisher Biological Station. (n.d.). . http://ordway-swisher.ufl.edu/species/os-mammalia.htm.

Armstrong, D. M. 2008. Rocky Mountain mammals: a handbook of mammals of Rocky Mountain National Park and vicinity. Third edition. University Press of Colorado.

Baker, M. F., and N. C. Frischknecht. 1973. Small mammals increase on recently cleared and seeded juniper rangeland. Journal of Range Management 26:101–103.

Batzli, G. O., and H. Henttonen. 1990. Demography and resource use by microtine rodents near Toolik Lake, Alaska, U.S.A. Arctic and Alpine Research 22:51–64.

Bock, C. E., and J. H. Bock. 1978. Response of birds, small mammals, and vegetation to burning sacaton grasslands in southeastern Arizona. Journal of Range Management 31:296–300.

Bury, R. B., and P. S. Corn. 1987. Evaluation of Pitfall Trapping in Northwestern Forests: Trap Arrays with Drift Fences. Journal of Wildlife Management 51:112–119.

Cardoza, J. E., G. S. Jones, and T. W. French. 2009. Massachussetts State Mammal List. http://www.mass.gov/dfwele/dfw/wildlife/facts/mammals/mammal_list.htm.

Carey, A., and S. Wilson. 2001. Induced Spatial Heterogeneity in Forest Canopies: Responses of Small Mammals. The Journal of Wildlife Management 65:1014–1027.

Clevenger, G. A. 1977. The effects of campgrounds on small mammals in Canyonlands and Arches National Parks, Utah. Utah State University.

Dahlquist, R. M., T. S. Prather, and J. J. Stapleton. 2007. Time and Temperature Requirements for Weed Seed Thermal Death. Weed Science 55:619–625.

Degrassi, A., and A. M. Ellison. 2013. A Mark-Recapture of the Rodent and Shrew Populations in a Declining Hemlock Stand. http://harvardforest.fas.harvard.edu:8080/exist/xquery/data.xq?id=hf208.

Denali National Park mammal checklist. 2002. .

Discover Life in America - All Taxa Biodiversity Inventory. 2008. The ATBI Database. http://tremont22.campus.utk.edu/ATBI_start.cfm.

Engeman, R., D. Whisson, J. Quinn, F. Cano, P. Quiñones, and T. H. White Jr. 2005. Monitoring invasive mammalian predator populations sharing habitat with the Critically Endangered Puerto Rican parrot Amazona vittata. Oryx 39:95.

Evangelista, P. H., D. T. Barnett, T. J. Stohlgren, P. Stapp, C. Jarnevich, S. Kumar, and S. Rauth. 2008. Field and costs sssessment for the Fundamental Sentinel Unit (FSU) at the Central Plains Experimental Range, Colorado.

Fitch, H. S., and N. A. Slade. (n.d.). Checklist of Field Station Mammals.

Giffen, N. R., R. S. Reasor, and C. A. Campbell. 2011. Small Mammal Abundance and Distribution Survey. Oak Ridge National Laboratory, Oak Ridge, TN.

Golde, W., P. Gollobin, and L. Rodriguez. 2005. A rapid, simple, and humane method for submandibular bleeding of mice using a lancet. Lab Animal 34:39–43.

Gómez, A., a M. Kilpatrick, L. D. Kramer, A. P. Dupuis, J. G. Maffei, S. J. Goetz, P. P. Marra, P. Daszak, and a A. Aguirre. 2008. Land use and west nile virus seroprevalence in wild mammals. Emerging infectious diseases 14:962–5.

Habitat fragmentation and the perceived and actual risk of predation. 1996. . Virginia Journal of Science 47.

Halfpenny, J. (n.d.). Small mammal herbivore trapping in alpine tundra, 1981-1990.

Kaminski, J., M. Davis, and P. Keyser. 2007. Disturbance Effects on Small Mammal Species in a Managed Appalachian Forest. The American Midland Naturalist 157:385–397.

Kao, R. H., C. M. Gibson, R. E. Gallery, C. L. Meier, D. T. Barnett, K. M. Docherty, K. K. Blevins, P. D. Travers, E. Azuaje, Y. P. Springer, K. M. Thibault, V. J. McKenzie, M. Keller, L. F. Alves, E. S. Hinckley, J. Parnell, and D. S. Schimel. 2012. NEON terrestrial field observations: designing continental-scale, standardized sampling. Ecosphere 3:115.

Kays, R. W., and D. E. Wilson. 2011. Mammals of North America. Second Edi. Princeton University Press.

Kelt, D. A., M. S. Hafner, and The Committee for Guidelines on Handling Rodents in the Field of the American Society of Mammalogists. 2010. Updated guidelines for protection of mammalogists and wildlife researchers from hantavirus pulmonary syndrome (HPS). Journal of Mammalogy 91:1524–1527.

Kelt, D. A., D. H. Van Vuren, M. S. Hafner, B. J. Danielson, and M. J. Kelly. 2007. Threat of hantavirus pulmonary syndrome to field biologists working with small mammals. Emerging Infectious Diseases 13:1285–7.

Kilcline, B. 2003. Trap Biases in Surveying the Small Mammals of UNDERC.

Leis, S. A., D. M. J. Leslie, D. M. Engle, and J. S. Fehmi. 2007. Small mammals as indicators of short-term and long-term disturbance in mixed prairie. Environmental Monitoring and Assessment.

Maher, S. 2010. Spatial dynamics of mammals and their pathogens and parasites. University of Kansas, United States -- Kansas.

Mammals of Florida | American Society of Mammalogists. (n.d.). . http://www.mammalsociety.org/mammals-florida.

Martin, S. C., and H. G. Reynolds. 1973. The Santa Rita Experimental Range : Your Facility for Research on Semidesert Ecosystems. Journal of the Arizona Academy of Science 8:56–67.

McMillan, B. R., D. W. Kaufman, G. A. Kaufman, and R. S. Matlack. 1997. Mammals of Konza Prairie: new observations and an updated species list. The Prairie Naturalist 29:263–271.

McShea, W. J., John Pagels, John Orrock, Elizabeth Harper, and Kevin Koy. 2003. Mesic deciduous forest as patches of small-mammal richness within an Appalachian Mountain Forest. Journal of Mammalogy 84:627–643.

Mitchell, J. C., S. C. Rinehart, J. F. Pagels, K. A. Buhlmann, and C. A. Pague. 1997. Factors influencing amphibian and small mammal assemblages in central Appalachian forests. Forest Ecology and Management 96:65–76.

National Park Service. 2006, May. Yellowstone Mammal Certified Species List. https://irma.nps.gov/App/Species/Search.

Osbourne, J. D., J. T. Anderson, and A. B. Spurgeon. 2005. Effects of habitat on small-mammal diversity and abundance in West Virginia. Wildlife Society Bulletin 33:814–822.

Ostfeld, R. S., and R. R. Parmenter. 2008. Small mammals, Fundamental Sentinel Units TIGR team report.

Parker, W. T., L. I. Muller, R. R. Gerhardt, P. O. Dorcas, and C. Edward. 2008. Field Use of Isoflurane for Safe Squirrel and Woodrat Anesthesia. Science 72:1262–1266.

Perry, M. C., P. C. Osenton, and C. S. Stoll. 1998. Biological diversity of created forested wetlands in comparison to reference forested wetlands in the bay watershed. Pages 261–268. Maryland Department of Natural Resources, Annapolis, Maryland.

Price, M. V. 1978. The role of microhabitat in structuring desert rodent communities. Ecology 59:910–921.

Prugh, L., and J. Brashares. 2010. Basking in the moonlight? Effect of illumination on capture success of the endangered giant kangaroo rat. Journal of Mammalogy 91:1205–1212.

Purcell, K. L., D. A. Drynan, and K. M. Mazzocco. 2007. Vertebrate Fauna of the San Joaquin Experimental Range, California: an annotated checklist based on 70 years of observations.

Rexstad, E. A., and E. Debevec. (n.d.). Dynamics of Small Mammal Populations in the Rock Creek Watershed of Denali. http://www.nps.gov/articles/aps-v6-i2-c16.htm.

Reynolds, H. G. 1950. Relation of Merriam kangaroo rats to range vegetation in southern Arizona.

Ecology 31:456–463.

Roberts, S. L., D. A. Kelt, J. W. van Wagtendonk, A. K. Miles, and M. D. Meyer. 2015. Effects of fire on small mammal communities in frequent-fire forests in California. Journal of Mammalogy 96:107–119.

Shiels, A. B., C. A. Flores, A. Khamsing, P. D. Krushelnycky, S. M. Mosher, and D. R. Drake. 2012. Dietary niche differentiation among three species of invasive rodents (Rattus rattus, R. exulans, Mus musculus). Biological Invasions 15:1037–1048.

Sikes, R. S., and The Animal Care And Use Committee of The American Society Of Mammalogists. 2016. 2016 Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. Journal of Mammalogy 97:663–688.

Smith, C. B., and P. J. Urness. 1984. Small mammal abundance on native and improved foothill ranges, Utah. Journal of Range Management 37:353–357.

Snyder, E., and L. Best. 1988. Dynamics of Habitat use by Small Mammals in Prairie Communities. The American Midland Naturalist 119:128–136.

Sureda, M., and M. L. Morrison. 1998. Habitat use by small mammals in southeastern Utah, with reference to Mexican spotted owl management. Western North American Naturalist 58:76–81.

Vaughn, C., S. Glenn, and I. Butler. 1993. Characterization of Prairie Mole Cricket Chorusing Sites in Oklahoma. The American Midland Naturalist 130:364–371.

Wiewel, A. S., W. R. Clark, and M. A. Sovada. 2007. Assessing small mammal abundance with track-tube indices and mark-recapture population estimates. Journal of Mammalogy 88:250–260.

Wilson, D. E., F. R. Cole, J. D. Nichols, R. Rudran, and M. S. Foster, editors. 1996. Measuring and Monitoring Biological Diversity: Standard Methods for Mammals. Biological Diversity Handbook Series. Smithsonian Institution Press, Washington, D.C.

APPENDIX A DATASHEETS

The following datasheets are associated with this protocol:

Table 17. Datasheets associated with this protocol

NEON Doc. #	Title
NEON.DOC.001585	Datasheets for TOS Protocol and Procedure: Small Mammal Sampling

These datasheets can be found in Agile or the NEON Document Warehouse.

APPENDIX B QUICK REFERENCES

Quick Reference: Checking Traps and Processing Captures

Quick Reference: Decision Tree for Processing

Quick Reference: Challenging Conditions

Quick Reference: Small Mammal Sampling Datasheet

Quick Reference: Checking Traps and Processing Captures

STEP 1 - Check ALL traps in grid for captures.

IF trap door CLOSED	IF trap door OPEN
Peek inside to see if there is a capture or feces. Immediately release non-target captures. Write grid coordinate on trap. Place trap in plastic bag, for transport to processing station (even if capture has been released)	Clean trap can be reused. Traps with feces only should be marked, bagged, and taken to processing station. If mid-bout, leave empty trap in place and **close** door. On last day of sampling, remove trap.

STEP 2 – Set up processing station.

STEP 3 – Transfer capture to plastic bag (use stronger 4 mil bags if capture > 100g).

STEP 4 – Assess animal for signs of stress. Treat/release as needed.

STEP 5 – Modify processing, if necessary, based on total number of live captures of target or opportunistic species on the grid.

Captures Per Grid	Suggested Modifications to Processing
>20 - <30	Blood samples – stop after 20 samples have been collected** Recaptures only – eliminate size measurements Hair and whisker samples – stop after 10 samples have been collected Fecal samples – stop after 10 samples have been collected Ear punches – stop after 10 samples have been collected***
30 +	Same as above plus: All captures – eliminate size measurements Eliminate tick searches

CRITERIA FOR BLOOD SAMPLING

COLLECT blood from:

- Cricetids that are > 10 g
- Dipodids that are > 10 g
- Murids that are > 10 g

UNLESS individual has:

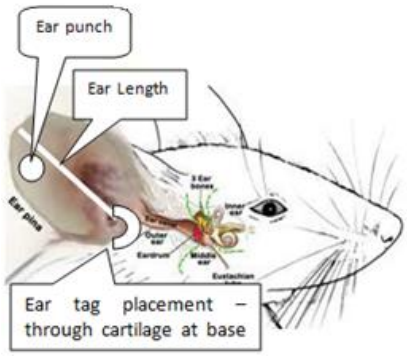
- Pronounced or physically debilitating injury, and/or
- Already been captured and bled during **current** sampling bout.

DO NOT collect blood from:

- Sciurids - chipmunks, squirrels, etc.
- Soricids – shrews
- Talpids – moles
- Geomyids – pocket gophers
- Heteromyids – kangaroo rats, pocket mice
- Any protected species listed on state or federal permit

STEP 6 – Proceed with bleeding, if required.

STEP 7 – Mark Individual (if needed)



MARKING GUIDELINES

- Do not tag shrews or non-target species.

Ear Tag:

- Use if pinnae are of sufficient size.
- Right (R) ear preferred.
- Record ear (L or R) and ID number on datasheet.
- For recaptures, ensure that NEON is on one side of the tag. If not, record 'O' for other and the tag number.

PIT Tag:

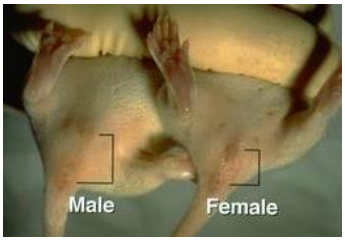
- Use if pinnae are of insufficient size (e.g., voles and pocket mice)
- Record last 6 digits of tag # on datasheet.
- Dispose of needles in Sharps container.
- Place bar-code sticker on back of datasheet.

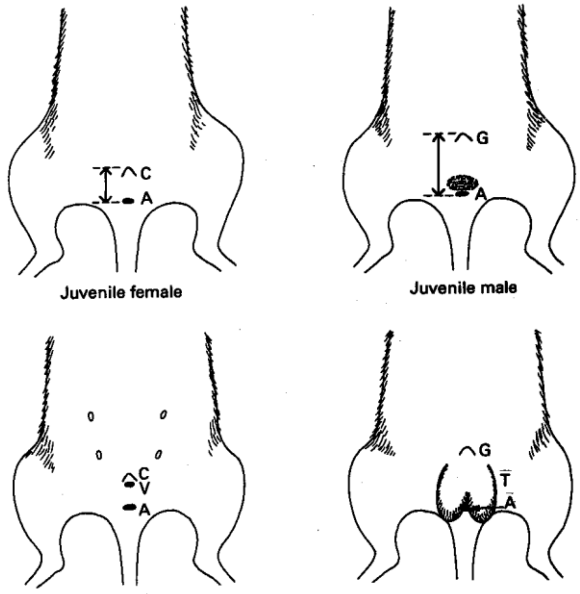
STEP 8 – Assess age, sex and reproductive condition.

Age

Most juvenile cricetids are a uniform steely grey.

Sex





External sex difference in rodents. A = anus; C = clitoris; G = genital papilla; V = vaginal opening; T = testes. The A-C distance in female rodents is less than the A-G distance in males. From Watts and Aslin 1981.

STEP 9 – Measure hind foot length (all species).

STEP 10 – Measure ear length/tail length, and/or total length (if needed for species ID)

STEP 11 – Collect remaining samples

ENSURE that all collected samples are indicated on the datasheet.
If a sample does not get entered into the database, then all resulting data and specimens are lost.

Sample	Description	Frequency	Storage container	Label	Field storage
Hair	tuft (~5 hairs) from back of neck	once per bout; dominant genus	Archival coin envelope	Write on envelope	Ambient
Whiskers	pluck or snip at base, one from each cheek	once per bout; dominant genus			
Fecal	fresh only	every capture event	vial rated to -80°C	Label rated to -80°C	Dry ice
Ear punch	punch from outer margin of right untagged ear	once per life of individual	vial rated to -80°C	Label rated to -80°C	Dry ice
Vouchers	entire specimens	opportunistically	resealable plastic bag	Acid-free, archival tag	Dry ice

STEP 12 – Weigh

STEP 13 – Put back in trap for transport back to point of capture and release.

Label all containers →

Site ID
YR, MO, DAY
Tag #
Sample Type

STEP 14 – Clean all gloves and tools with quat before using on the next individual.

Quick Reference: Decision Tree for Processing

In the event of very high capture rates, lower priority tasks may be left out of processing. **The goal is to avoid situations where captures are released without any processing.** Please remember to record 'Released' in the fate field for each individual intentionally released without full processing.

For simplicity, guidelines are provided according to **captures per grid**. If grids predictably vary in capture rates, reduced processing can be implemented on grids that do not exceed the thresholds given below, to enable increased processing on high-capture grids being processed on the same day. Please keep in mind that the decision tree is intended to be used as a guideline only; use professional discretion.

Captures Per Grid	Suggested Modifications to Processing
>20 - <30	Blood samples – stop after 20 samples have been collected** Recaptures only – eliminate size measurements Hair and whisker samples – stop after 10 samples have been collected Fecal samples – stop after 10 samples have been collected Ear punches – stop after 10 samples have been collected***
30 +	Blood samples – stop after 20 samples have been collected** All captures – eliminate size measurements Hair and whisker samples – stop after 10 samples have been collected Fecal samples – stop after 10 samples have been collected Ear punches – stop after 10 samples have been collected*** Eliminate tick searches

**When blood sample collections are limited, attempt to distribute the 20 samples among the priority species if possible (provided in Appendix E). Please do not spend additional time counting captures per species prior to processing. The simplest, acceptable implementation of this guidance is to stop collecting blood samples once 10 samples have been collected for a given priority species, if a site has >1 priority species. For sites with priority species that are difficult to distinguish (e.g., PEMA vs. PELE), collect up to 20 samples from individuals of these species, regardless of species ID.

**For maximum time savings, include unsuccessful bleeding attempts in the count to 20.

***If possible, without expending additional effort to review captures, prioritize individuals with uncertain species IDs for ear punch collection.

Quick Reference: Challenging Conditions

Small mammal sampling can be performed under a variety of weather conditions. Care must be taken, however, to prevent conditions such that the trapped individual cannot thermoregulate properly, either in hot or cold conditions. Such conditions will result in the death of the trapped individuals.

MORTALITIES

- **Each mortality must be reported to the Field Operations Manager within 24 hours** of processing, in accordance with all state- and site-specific permit requirements.
- **If ≥ 5 individuals** on any given trapping grid during a single night of trapping **die, the trapping** on that grid should be **discontinued** until the next scheduled sampling bout, and a **problem ticket should be issued** detailing the locations, species, sex, and ages of the mortalities.

LOGISTICAL HURDLES

- If there is any chance (i.e., >0%) that traps cannot be checked the following morning at dawn, traps shall not be set (e.g., impassable roads).
- If one night of trapping within the sampling bout is missed, **trapping may be resumed** and continued as normal at any time **within 5 days** of the latest night of trapping.
- If **predators destroy >15** traps on a single grid on any given night, traps should be removed from the site and that sampling bout terminated prematurely. The Field Operations Manager shall be informed as soon as possible, and a problem ticket should be issued.

COLD WEATHER

- **Bedding** should be used when low temperatures are expected to be **< 18°C (65°F), except** at sites where heteromyids dominate.
- **Trapping should not occur** on nights when **both** very cold temperatures (< 5.5°C (42°F)) and (a) precipitation in the form of **rain** are expected (>20% chance at sites with bedding; >5% chance at sites that cannot use bedding) or (b) dew is expected (i.e., if humidity is >75% and the projected minimum temperature is below the dew point).

HOT WEATHER

- When ambient temperatures are expected to reach 27°C (80°F), by 10 a.m., extra effort must be made to **ensure that all traps** containing captured **individuals are processed or placed in the shade as soon as possible**. Initiation of trap checking before sunrise may be necessary in extremely hot environments, especially where shade is lacking.
- If trap checking **does not begin** prior to 8 - 9 am and **all traps are not shaded**, all traps should be opened to release animals and avoid heat-induced mortality. Work should start over that night by resetting the traps.

Quick Reference: Small Mammal Sampling Datasheet

Column Number(s)	Data Field	Description/What to Enter
1-3	plotID	Enter number only (Use leading zeros where applicable.)
4-6	trapCoordinate	Indicate point of capture with grid coordinate e.g., B5. Use an X to indicate uncertainty.
7	Notes	Information on trap condition and quality. Use codes (1 through 6) from top left corner of datasheet. See below.
8-11	taxonID	Use 4 letter species code (examples listed on top of datasheet). Create own code if captured species not listed and record full name on back of each Datasheet on which the code is used.
12	idQ – identification Qualifier	CS – cf. species; cf. = "not sure"; AS – aff. species; aff. = "similar to, but is not" (full list in the protocol above)
13	Sex	Male (M) or female (F) or unknown (U).
14-19	Ear/PIT	Unique tag ID, format: Ear tags: RXXXX or LXXXX; PIT tags: **last** 6 digits of serial number
20-24	Age & repro status	Use uppercase letter codes from datasheet
25-26	HFL	Hind foot length (mm) – to nearest millimeter
27-28	Ear	Right ear length (mm) – to nearest millimeter
29-31	Tail	Tail length (mm) – round to nearest millimeter
32-34	TTL	Total length (head + body) (mm)
35-37	WGT	Weight (g) – round to nearest gram
38	Recapture	Yes/No/Unknown – indicates whether an individual is a recapture
39	Ripped Ear/Tag replaced	Indicate from which ear the tag was presumably lost (R or L), or the tag ID (ear or PIT) replaced. Record 'U' in the Recapture field if the previous tagID is unknown (and the animal is clearly a recapture).
40	Fate	Indicate history/condition of capture. **E**scaped, **D**ead, **N**on-target, **R**eleased. Dead supercedes the Non-target option. Released should only be used in instances when an individual has been intentionally released without full processing. Also available on the mobile application is '**F**ully processed' to indicate when all processing steps were completed on an animal. This code (F) is fine to use on datasheet as well.
41-43	Attached ticks	Circle the tick life stages attached to the individual's head and neck
44	Blood	Indicate whether was blood sample was successfully collected using the **M**andibular technique, **U**nsuccessfully collected, or a **Q**uantity Not Sufficient was collected.
45-49	Samples	Indicate type of sample collected: **F**ecal, **E**ar, **H**air, **W**hisker, or **V**oucher.
50	Comments	Indicate there are comments on back of datasheet ("C").

- If traps are not set on a particular grid as scheduled or if no individuals are captured, these should be recorded in the NOTES field as a line on the datasheet for that given date, grid, and bout combination.
- If traps are damaged or disturbed overnight, note trap locations and code the nature of the disturbance on the datasheet in the NOTES field, with any other known details described on the back of the datasheet.

NOTES codes:

Definitions	Application Rules
1 – traps not set	Used at the level of the entire trapping grid, or, if some traps on a grid were set and others were not, can be used to indicate which ones were not set
2 – trap disturbed/door closed but empty	Used per trap coordinate, when necessary
3 – trap door open or closed with feces left behind	Used per trap coordinate, when necessary
4 – >1 capture per trap	Used per trap coordinate; in the rare event of multiple captures per trap; enter this note code for each individual
5 – single capture in trap	Used per trap coordinate, when necessary
6—no captures	Used ONLY at the per grid level; there is no need to write down every trap

APPENDIX C CHECKLISTS

Trapping Small Mammals

Always have on hand:

- ☑ Copy of IACUC protocol form and IACUC approval letter
- ☑ Copy of state collection permit
- ☑ Copy of site-specific research permit
- ☑ Personal ID
- ☑ GPS with grid locations
- ☑ Compass to aid in following trap lines

Layout of Small Mammal Sampling Grid

	A	B	C	D	E	F	G	H	I	J
1	A1	B1	C1	D1	E1	F1	G1	H1	I1	J1
2	A2	B2	C2	D2	E2	F2	G2	H2	I2	J2
3	A3	B3	C3	D3	E3	F3	G3	H3	I3	J3
4	A4	B4	C4	D4	E4	F4	G4	H4	I4	J4
5	A5	B5	C5	D5	E5	F5	G5	H5	I5	J5
6	A6	B6	C6	D6	E6	F6	G6	H6	I6	J6
7	A7	B7	C7	D7	E7	F7	G7	H7	I7	J7
8	A8	B8	C8	D8	E8	F8	G8	H8	I8	J8
9	A9	B9	C9	D9	E9	F9	G9	H9	I9	J9
10	A10	B10	C10	D10	E10	F10	G10	H10	I10	J10

Setting Traps:

- ☑ Each person should carry enough traps at one time for at least two traplines (i.e., 20 traps plus a few extra), for efficiency.
- ☑ Always walk the traplines along the N-S axis, except when moving to the next trapline. This will constrain vegetation disturbance to narrow trails within the grids over time.
- ☑ Whenever possible, place traps near shrubs, downed logs, burrows, or other microsites that offer shelter.
- ☑ Place trap, making sure trap is on level ground and the door remains open. If necessary, adjust trap sensitivity by gently pulling or pushing catch.
- ☑ Bait trap, by distributing a teaspoon up to a tablespoon (use more in colder conditions) of seed mix throughout the trap, including near the entrance to the trap.
- ☑ When overnight lows will be <18°C (65°F), place approximately 5 cm (2 in) of batting into trap (except at sites dominated by heteromyids).

Setting Equipment

- Traps (100 per grid + extras)
- Tree planting bags (1 per person or per 40-50 traps)
- Bait: Sterilized millet & sunflower seed (mealworms, where needed).
- Lumbar bags of bait (1 per person)
- Batting and bag for carrying batting
- Replacement pin flags and sharpies

Checking Equipment

- Replacement traps
- Trap-sized plastic bags
- Work gloves
- Tree planting bags (1 per person or per 40-50 traps)
- Plastic bags to line tree planting bags
- Wet or dry erase markers & sharpies

Getting Ready for Small Mammal Sampling

- ☑ Ensure all **traps** and sampling equipment is functioning and sanitized.
- ☑ Ensure safety gear (**PPE**) is available in sufficient quantities, clean, and functioning.
- ☑ Prepare pre-printed **labels** and materials for handwriting on the sample containers in the field.
- ☑ Ensure pit tag reader and camera batteries are charged. Bring spare batteries for headlamps.
- ☑ Print the NEON template provided on the NEON intranet (on the FOPs – TOS landing page) onto specimen tags in the event of voucher specimens.
- ☑ Prepare a small vial of **10% sugar** in water to revitalize stressed, hypothermic or heat-stressed captures. Change solution often to prevent mold growth.
- ☑ Sterilize and mix a sufficient amount of millet (65% of **seed** mix) and sunflower seeds (35%), or, in D04 and D20, prepare bait balls.
- ☑ Ensure that all necessary **datasheets, identification keys,** and equipment are packed.
- ☑ Prepare and maintain a **list of individuals already bled** within the current sampling bout to ensure that no individuals are bled twice within a bout. Also note any individuals with missing data that can be collected if recaptured in this bout.
- ☑ Prepare **quat**: if necessary, mix a batch of quat stock solution in the lab (5% solution, or 1:20 dilution in tap water). Fill up the spray bottle(s) and field stock bottles.
- ☑ Prepare **isoflurane**: in a fume hood or well ventilated outdoor location fill up the glass bottle with rubber dropper bulb and glass bottle with screw top with isoflurane.
- ☑ Pack **supplies**: bring enough supplies for processing at least twice as many individuals as you expect.
- ☑ Obtain **dry ice**: this should be done as close to departure for the field as possible and stored in an ultra-low freezer (-80°C) prior to use.

Personal Protective Equipment (PPE)

- Eye protection (safety glasses to discourage rubbing of the eyes and protect from extreme splashes)
- Disposable respirators with N95 (HEPA-equivalent) particulate filter
- Required: all sites in CO, NM, AZ, CA
- Recommended: all sites in KS, TX, UT, MT, NV, ID, OR, and WA
- Latex and/or nitrile gloves
- Long-sleeved shirt
- Long pants
- Close-toed shoes with socks
- a disposable or reusable (cotton) laboratory coat or apron
- Special cloth gloves with rubber-tipped fingers are recommended to be worn while handling to reduce the incidence of bites (latex/nitrile gloves should be worn over these)

APPENDIX D GUIDELINES FOR BLOOD SAMPLE SELECTION FOR PATHOGEN ANALYSIS

The following guidelines should be considered halfway through and at the end of the trapping season to make any necessary decisions prior to shipping samples. Sample shipment is planned to occur twice per year to balance the desire to ship samples for analysis as soon as possible and the desire to select samples for testing strategically, if more samples are collected than the budget allows.

Only blood samples with volumes of at least 20 microliters should be sent for analysis. The remaining samples should be archived.

If the number of eligible samples exceeds a maximum of 112 samples per site per year:

- Consult Appendix E for site-specific species that are priorities for pathogen testing. Samples from these species should be given priority to the exclusion of other species, if necessary.
- For the shipping event planned for halfway through the trapping season, ship no more than 56 samples.
- Samples to be analyzed should include representatives from all sampling bouts.
- If the number of samples still exceeds the maximum, prioritize samples collected from adult individuals to the exclusion of juveniles and subadults.
- Distribute samples across priority species and bouts as much as possible.

APPENDIX E SITE-SPECIFIC INFORMATION

E.1 D01 – CORE – HARV (Harvard Forest)

Trapping Issues

- Slugs after rainfall events may fill traps
- Large (i.e., bear) and medium sized carnivore (e.g., fishers, raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F.

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous/Evergreen/Mixed Forest

Priority species for pathogen testing: Microtus pennsylvanicus, Myodes gapperi, Peromyscus leucopus, Peromyscus maniculatus

Species List and Abundance Estimates

This species list is based on Cardoza, Jones, & French, 2009. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported in Degrassi & Ellison, 2013, and updated with NEON data from 2014 through 2016**.**

Table 18. Site-specific species list (HARV)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Gapper's Red-backed Vole	50 - 500
Microtus pennsylvanicus	Meadow Vole	0 - 50
Napaeozapus insignis	Woodland Jumping mouse	20 - 100
Peromyscus leucopus	White footed mouse	50 - 500
Peromyscus maniculatus	N. American deer mouse	100 - 500
Microtus pinetorum	Woodland Vole	0 - 20
Synaptomys cooperi	Southern Bog Lemming	0 - 20
Zapus hudsonius	Meadow Jumping Mouse	0 - 20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	50 - 150
Sorex cinereus	Masked Shrew	0 - 50
Sorex fumeus	Smoky Shrew	0 - 30
Tamias striatus	Eastern Chipmunk	50 - 150

Sorex dispar	Long-tailed Shrew	0 - 20
Sorex hoyi	American Pygmy Shrew	0 - 20
Sorex palustris	American Water Shrew	0 - 20
Tamiasciurus hudsonicus	Red Squirrel	0 - 20
NON-TARGET ANIMALS (Scientific and Common Name)		
Parascalops breweri	Hairy-tailed Mole	0 - 20
Scalopus aquaticus	Eastern Mole	0 - 20
Glaucomys volans	Southern Flying Squirrel	0 - 20
Glaucomys sabrinus	Northern Flying Squirrel	0 - 20

E.2 D01 – RELOCATABLE - BART (Barlett Experimental Forest)

Trapping Issues

- Large (i.e., bear) and medium sized carnivore (e.g., fishers, raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F.

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Mixed/Deciduous/Evergreen Forest

Priority species for pathogen testing: Microtus pennsylvanicus, Myodes gapperi, Peromyscus leucopus, Peromyscus maniculatus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Ryan B. Stephens (pers. comm.) based on 2013 trapping efforts, and updated with NEON data from 2014 through 2016.

Table 19. Site-specific species list (BART)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus chrotorrhinus	Rock Vole	0-20
Microtus pennsylvanicus	Meadow Vole	0-20
Microtus pinetorum	Woodland Vole	0-20
Myodes gapperi	Southern Red-backed Vole	10-200
Peromyscus leucopus	White-footed Deermouse	50-200
Peromyscus maniculatus	North American Deermouse	50-500
Synaptomys borealis	Northern Bog Lemming	0-5
Synaptomys cooperi	Southern Bog Lemming	0-5
Napaeozapus insignis	Woodland Jumping Mouse	100-500
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	20-200
Sorex cinereus	Cinereus Shrew	0-50
Sorex dispar	Long-tailed Shrew	0-5

Sorex fumeus	Smoky Shrew	0-50
Sorex hoyi	American Pygmy Shrew	0-5
Sorex palustris	American Water Shrew	0-5
Tamias striatus	Eastern Chipmunk	0-50
Tamiasciurus hudsonicus	Red Squirrel	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Condylura cristata	Star-nosed Mole	0-5
Glaucomys sabrinus	Northern Flying Squirrel	0-5
Glaucomys volans	Southern Flying Squirrel	0-50
Martes americana	American Marten	0-5
Martes pennanti	Fisher	0-5
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Neovison vison	American Mink	0-5
Parascalops breweri	Hairy-tailed Mole	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Sylvilagus transitionalis	New England Cottontail	0-5

E.3 D02 – CORE – SCBI (Smithsonian Conservation Biology Institute)

Trapping Issues

- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest

Priority species for pathogen testing: Microtus pennsylvanicus, Myodes gapperi, Neotoma magister, Peromyscus leucopus, Peromyscus maniculatus, Rattus spp., Reithrodontomys humulis

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by McShea et al. 2003 and Osbourne et al. 2005, and updated with NEON data from 2014 through 2016.

Table 20. Site-specific species list (SCBI)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Southern Red-backed Vole	0-50
Microtus pennsylvanicus	Meadow Vole	0-100
Microtus pinetorum	Woodland Vole	0-50
Mus musculus musculus	House mouse	0-150
Neotoma magister	Allegheny Woodrat	0-20
Peromyscus leucopus	Northern white-footed mouse	100-500
Peromyscus maniculatus	North American deer mouse	0-50
Rattus norvegicus	Norway rat	0-5
Rattus rattus	Black rat	0-5
Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Synaptomys cooperi	Southern Bog Lemming	0-50
Napaeozapus insignis	Woodland Jumping Mouse	50-200
Zapus hudsonius	Meadow Jumping Mouse	0-50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		

Blarina brevicauda	Northern Short-tailed Shrew	50-200
Cryptotis parva	North American Least Shrew	0-5
Sorex cinereus	Cinereus Shrew	0-20
Sorex fumeus	Smoky shrew	0-20
Sorex hoyi	American Pygmy Shrew	0-50
Sorex longirostris	Southeastern shrew	0-5
Tamias striatus	Eastern Chipmunk	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Condylura cristata	Star-nosed Mole	0-5
Glaucomys volans	Southern Flying Squirrel	0-5
Mustela frenata	Long-tailed weasel	0-5
Mustela nivalis	Least weasel	0-5
Mustela vison	Common mink	0-5
Parascalops breweri	Hairy-tailed Mole	0-5
Scalopus aquaticus	Southern mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5

E.4 D02 – RELOCATABLE – SERC (Smithsonian Environmental Research Center)

Trapping Issues

- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest

Priority species for pathogen testing: Microtus pennsylvanicus, Myodes gapperi, Neotoma magister, Peromyscus leucopus, Peromyscus maniculatus, Rattus spp., Reithrodontomys humulis

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Perry et al. 1998 and Gómez et al. 2008, and updated with NEON data from 2015 through 2016.

Table 21. Site-specific species list (SERC)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Southern Red-backed Vole	0-20
Microtus pennsylvanicus	Meadow Vole	100-500
Microtus pinetorum	Woodland Vole	0-50
Mus musculus	House mouse	0-50
Neotoma magister	Allegheny Woodrat	0-20
Peromyscus leucopus	Northern white-footed mouse	50-500
Peromyscus maniculatus	North American deer mouse	0-50
Rattus norvegicus	Norway rat	0-5
Rattus rattus	Black rat	0-5
Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Synaptomys cooperi	Southern Bog Lemming	0-5
Napaeozapus insignis	Woodland Jumping Mouse	0-20
Zapus hudsonius	Meadow Jumping Mouse	0-50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		

Blarina brevicauda	Northern Short-tailed Shrew	20-100
Cryptotis parva	North American Least Shrew	0-5
Sorex cinereus	Cinereus Shrew	0-20
Sorex fumeus	Smoky shrew	0-20
Sorex hoyi	American Pygmy Shrew	0-5
Sorex longirostris	Southeastern shrew	0-5
Tamias striatus	Eastern Chipmunk	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Condylura cristata	Star-nosed Mole	0-5
Glaucomys volans	Southern Flying Squirrel	0-5
Mustela frenata	Long-tailed weasel	0-5
Mustela nivalis	Least weasel	0-5
Mustela vison	Common mink	0-5
Parascalops breweri	Hairy-tailed Mole	0-5
Scalopus aquaticus	Southern mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5

E.5 D02 – RELOCATABLE – BLAN (Blandy Experimental Farm)

Trapping Issues

- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Pasture/hay

Priority species for pathogen testing: Microtus pennsylvanicus, Myodes gapperi, Neotoma magister, Peromyscus leucopus, Peromyscus maniculatus, Rattus spp., Reithrodontomys humulis

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Matter et al. 1996 and Mitchell et al. 1997, and updated with NEON data from 2015 through 2016.

Table 22. Site-specific species list (BLAN)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Southern Red-backed Vole	0-20
Microtus pennsylvanicus	Meadow Vole	0-50
Microtus pinetorum	Woodland Vole	0-50
Mus musculus	House mouse	0-20
Neotoma magister	Allegheny Woodrat	0-20
Peromyscus leucopus	Northern white-footed mouse	50-500
Peromyscus maniculatus	North American deer mouse	0-50
Rattus norvegicus	Norway rat	0-5
Rattus rattus	Black rat	0-5
Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Synaptomys cooperi	Southern Bog Lemming	0-50
Napaeozapus insignis	Woodland Jumping Mouse	0-20
Zapus hudsonius	Meadow Jumping Mouse	0-50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	0-50

Cryptotis parva	North American Least Shrew	0-5
Sorex cinereus	Cinereus Shrew	0-5
Sorex fumeus	Smoky shrew	0-5
Sorex hoyi	American Pygmy Shrew	0-5
Sorex longirostris	Southeastern shrew	0-5
Tamias striatus	Eastern Chipmunk	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Condylura cristata	Star-nosed Mole	0-5
Glaucomys volans	Southern Flying Squirrel	0-5
Mustela frenata	Long-tailed weasel	0-5
Mustela nivalis	Least weasel	0-5
Mustela vison	Common mink	0-5
Parascalops breweri	Hairy-tailed Mole	0-5
Scalopus aquaticus	Southern mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5

E.6 D03 – CORE – OSBS (Ordway-Swisher Biological Station)

Trapping Issues

- Fire ants
  - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
  - Traps can also be set closer to sunset and checked earlier, to minimize traps being open when ants are most active.
- Medium sized carnivore (e.g., coyotes, raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or traps are in any danger of becoming waterlogged overnight.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Podomys

Dominant vegetation type(s) for bleed grid designation: N/A (due to the low capture rates at this site, bleed grids were selected based on capture rates rather than vegetation type)

Priority species for pathogen testing: Neotoma floridana, Ochrotomoys nuttalli, Oryzomys palustris, Peromyscus gossypinus, Peromyscus polionotus, Podomys floridanus, Reithrodontomys humulis, Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on the Annotated Mammal Species List of the Ordway-Swisher Biological Station. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Dr. Bob McCleery at the University of Florida, and updated with NEON data from 2014 through 2016.

Table 23. Site-specific species list (OSBS)

TARGET species (Scientific and Common Name)		Number to be Used Annually
Mus musculus	House mouse	0 - 20
Neotoma floridana floridana	Florida wood rat	0 - 50
Ochrotomys nuttalli	Golden Mouse	0 - 50
Oryzomys palustris natator	Marsh rice rat	0 - 20
Peromyscus gossypinus gossypinus	Cotton mouse	10 - 100
Peromyscus polionotus subgriseus	Oldfield mouse	100 - 50
Podomys floridanus	Florida Deermouse	10 - 100
Reithrodontomys humulis	Eastern Harvest Mouse	0 - 50
Sigmodon hispidus hispidus	Hispid Cotton Rat	0 - 50

OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina carolinensis	Southern Short-tailed Shrew	0 - 20
Cryptotis parva floridana	Least shrew	0 - 20
Sorex longirostris	Southeastern Shrew	0 - 20
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys pinetis floridanus	Florida pocket gopher	0 - 5
Scalopus aquaticus australis	Southern mole	0 - 5
Glaucomys volans	Southern Flying Squirrel	0 – 100
Sciurus carolinensis	Eastern grey squirrel	0 - 5

E.7 D03 – RELOCATABLE – DSNY (Disney Wilderness Preserve)

Trapping Issues

- Fire ants
  - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
- Medium sized carnivore (e.g., coyotes, raccoons) disturbance
- Cattle disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or traps are in any danger of becoming waterlogged overnight.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Sigmodon

Dominant vegetation type(s) for bleed grid designation: Woody Wetlands

Priority species for pathogen testing: Neotoma floridana, Ochrotomoys nuttalli, Oryzomys palustris, Peromyscus gossypinus, Peromyscus polionotus, Podomys floridanus, Rattus spp., Reithrodontomys humulis, Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on the Mammals of Florida | American Society of Mammalogists. The abundance estimates were based on an average capture rate of 10%, and, in the absence of existing data, estimates of captures are based on data for Ordway Swisher, and updated with NEON data from 2014 through 2016.

Table 24. Site-specific species list (DISN)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Neotoma floridana	Eastern Woodrat	0 - 20
Peromyscus gossypinus	Cotton Deermouse	0 - 50
Peromyscus polionotus	Oldfield Deermouse	0 - 20
Podomys floridanus	Florida Deermouse	0 - 50
Sigmodon hispidus	Hispid Cotton Rat	5 - 150
Ochrotomys nuttalli	Golden Mouse	0 - 5
Oryzomys palustris	Marsh Oryzomys	0 - 20
Mus musculus	House mouse	0 - 20
Rattus norvegicus	Norway rat	0 - 20
Rattus rattus	Black rat	0 - 20
Reithrodontomys humulis	Eastern Harvest Mouse	0 - 50

OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina carolinensis	Southern Short-tailed Shrew	0 - 20
Cryptotis parva floridana	Least shrew	0 - 20
Sorex longirostris	Southeastern Shrew	0 - 20
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys pinetis	Southeastern Pocket Gopher	0 - 5
Scalopus aquaticus	Eastern Mole	0 - 5
Glaucomys volans	Southern Flying Squirrel	0 - 20

E.8 D03 – RELOCATABLE – JERC (Jones Ecological Research Center)

Trapping Issues

- Fire ants
  - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
- Medium sized carnivore (e.g., coyotes, raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Evergreen/Deciduous/Mixed Forest

Priority species for pathogen testing: Neotoma floridana, Ochrotomoys nuttalli, Oryzomys palustris, Peromyscus gossypinus, Peromyscus polionotus, Podomys floridanus, Reithrodontomys humulis, Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays & Wilson, 2011 and Smith et al., 2006. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported in Ford et al. 1994, and updated with NEON data from 2014 through 2016.

Table 25. Site-specific species list (JERC)

TARGET SPECIES (Scientific and Common Name)		**Number to be Used Annually**
Microtus pinetorum	Woodland Vole	0-50
Mus musculus	House mouse	0-50
Neotoma floridana	Eastern Woodrat	0-20
Ochrotomys nuttalli	Golden Mouse	0-20
Oryzomys palustris	Marsh Oryzomys	0-20
Peromyscus gossypinus	Cotton Deermouse	100-500
Peromyscus polionotus	Oldfield Deermouse	20-100
Rattus norvegicus	Norway rat	0-20
Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	20-200
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina carolinensis	Southern Short-tailed Shrew	0-5
Cryptotis parva	North American Least Shrew	0-5

Sorex longirostris	Southeastern Shrew	0-5
Tamias striatus	Eastern Chipmunk	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys pinetis	Southeastern Pocket Gopher	0-5
Glaucomys volans	Southern Flying Squirrel	0-5
Mustela frenata	Long-tailed Weasel	0-5
Mustela vison	Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger shermani	Sherman's fox squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Sylvilagus palustris	Marsh Rabbit	0-5

E.9 D04 – CORE – GUAN (Guanica Forest)

Trapping Issues

- The small mammal community in Puerto Rico is now dominated by invasive rats (*Rattus spp.*). Please note that these species can be quite aggressive; use of anesthesia is recommended.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Rattus

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Rattus norvegicus, Rattus rattus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011.

Table 26. Site-specific species list (GUAN)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Mus musculus	House mouse	0-50
Rattus norvegicus	Norway rat	0-50
Rattus rattus	Black rat	100-200
Rattus exulans	Roof rat	0-50

E.10 D04 – RELOCATABLE – LAJA (Lajas Experimental Station)

Trapping Issues

- The small mammal community in Puerto Rico is now dominated by invasive rats (*Rattus spp.*). Please note that these species can be quite aggressive; use of anesthesia is recommended.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Rattus

Dominant vegetation type(s) for bleed grid designation: Pasture/hay

Priority species for pathogen testing: Rattus norvegicus, Rattus rattus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011.

Table 27. Site-specific species list (LAJA)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Mus musculus	House mouse	0-50
Rattus norvegicus	Norway rat	0-50
Rattus rattus	Black rat	100-200
Rattus exulans	Roof rat	0-50

E.11 D05 – CORE – UNDE (University of Notre Dame Environmental Research Center)

Trapping Issues

- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, when temperatures are below freezing (<0°C (32°F)), or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- Due to the high mortality rates of shrews during April and October sampling bouts in 2014 and 2015, it is recommended that these bouts be dropped from the sampling schedule for this site.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Woody Wetlands

Priority species for pathogen testing: Microtus pennsylvanicus, Myodes gapperi, Peromyscus leucopus, Peromyscus maniculatus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Kilcline 2003 and data collected by NEON, and updated with NEON data from 2014 through 2016.

Table 28. Site-specific species list (UNDE)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Southern Red-backed Vole	20-200
Microtus pennsylvanicus	Meadow Vole	0-50
Mus musculus	House mouse	0-20
Peromyscus leucopus	White-footed Deermouse	50-300
Peromyscus maniculatus	North American Deermouse	50-500
Synaptomys cooperi	Southern Bog Lemming	0-50
Napaeozapus insignis	Woodland Jumping Mouse	20-200
Zapus hudsonius	Meadow Jumping Mouse	0-100
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	10-250
Sorex arcticus	Arctic Shrew	0-50
Sorex cinereus	Cinereus Shrew	20-200

Sorex hoyi	American Pygmy Shrew	0-5
Sorex palustris	American Water Shrew	0-5
Tamias minimus	Least Chipmunk	0-10
Tamias striatus	Eastern Chipmunk	0-50
Tamiasciurus hudsonicus	Red Squirrel	0-10
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Condylura cristata	Star-nosed Mole	0-5
Glaucomys sabrinus	Northern Flying Squirrel	10-100
Glaucomys volans	Southern Flying Squirrel	10-100
Lepus americanus	Snowshoe Hare	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Martes pennanti	Fisher	0-5
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Mustela nivalis	Least Weasel	0-5

E.12 D05 – RELOCATABLE – STEI (Steigerwaldt)

Trapping Issues

- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, , when temperatures are below freezing ((<0°C (32°F)), or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- Due to the high mortality rates of shrews during April and October sampling bouts at UNDE in 2014 and 2015, it is recommended that these bouts be dropped from the sampling schedule for this site.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest

Priority species for pathogen testing: Microtus pennsylvanicus, Myodes gapperi, Peromyscus leucopus, Peromyscus maniculatus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Kilcline 2003, and updated with NEON data from 2015 through 2016.

Table 29. Site-specific species list (STEI)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Southern Red-backed Vole	20-200
Microtus pennsylvanicus	Meadow Vole	0-50
Mus musculus	House mouse	0-20
Peromyscus leucopus	White-footed Deermouse	50-300
Peromyscus maniculatus	North American Deermouse	100-500
Synaptomys cooperi	Southern Bog Lemming	0-50
Napaeozapus insignis	Woodland Jumping Mouse	0-20
Zapus hudsonius	Meadow Jumping Mouse	10-100
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	20-100

Sorex arcticus	Arctic Shrew	0-10
Sorex cinereus	Cinereus Shrew	10-100
Sorex hoyi	American Pygmy Shrew	0-5
Sorex palustris	American Water Shrew	0-5
Tamias minimus	Least Chipmunk	0-50
Tamias striatus	Eastern Chipmunk	0-20
Tamiasciurus hudsonicus	Red Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Condylura cristata	Star-nosed Mole	0-5
Glaucomys sabrinus	Northern Flying Squirrel	5-50
Glaucomys volans	Southern Flying Squirrel	5-50
Lepus americanus	Snowshoe Hare	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Martes pennanti	Fisher	0-5
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Mustela nivalis	Least Weasel	0-5

E.13 D05 – RELOCATABLE – TREE (Treehaven)

Trapping Issues

- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, when temperatures are below freezing (<0°C (32°F)), or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- Due to the high mortality rates of shrews during April and October sampling bouts at UNDE in 2014 and 2015, it is recommended that these bouts be dropped from the sampling schedule for this site.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Woody Wetlands/Evergreen Forest

Priority species for pathogen testing: Microtus pennsylvanicus, Myodes gapperi, Peromyscus leucopus, Peromyscus maniculatus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Kilcline 2003, and updated with NEON data from 2015 through 2016.

Table 30. Site-specific species list (TREE)

TARGET SPECIES (Scientific and Common Name)		**Number to be Used Annually**
Myodes gapperi	Southern Red-backed Vole	20-100
Microtus pennsylvanicus	Meadow Vole	0-50
Mus musculus	House mouse	0-20
Peromyscus leucopus	White-footed Deermouse	20-200
Peromyscus maniculatus	North American Deermouse	20-200
Synaptomys cooperi	Southern Bog Lemming	0-50
Napaeozapus insignis	Woodland Jumping Mouse	0-20
Zapus hudsonius	Meadow Jumping Mouse	0-50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	0-50

Sorex arcticus	Arctic Shrew	0-50
Sorex cinereus	Cinereus Shrew	0-50
Sorex hoyi	American Pygmy Shrew	0-5
Sorex palustris	American Water Shrew	0-5
Tamias minimus	Least Chipmunk	0-50
Tamias striatus	Eastern Chipmunk	0-50
Tamiasciurus hudsonicus	Red Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Condylura cristata	Star-nosed Mole	0-5
Glaucomys sabrinus	Northern Flying Squirrel	0-5
Glaucomys volans	Southern Flying Squirrel	0-5
Lepus americanus	Snowshoe Hare	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Martes pennanti	Fisher	0-5
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Mustela nivalis	Least Weasel	0-5

E.14 D06 – CORE – KONZ (Konza Prairie Biological Station)

Trapping Issues

- Medium sized carnivore (e.g., raccoons, coyotes) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Grassland/Herbaceous

Priority species for pathogen testing: Microtus spp., Neotoma floridana, Peromyscus leucopus, Peromyscus maniculatus, Reithrodontomys spp., Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by McMillan et al. 1997, and updated with NEON data from 2015 through 2016.

Table 31. Site-specific species list (KONZ)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus hispidus	Hispid Pocket Mouse	20-200
Microtus ochrogaster	Prairie Vole	100-500
Microtus pinetorum	Woodland Vole	0-20
Mus musculus	House mouse	0-20
Neotoma floridana	Eastern Woodrat	20-100
Onychomys leucogaster	Northern Grasshopper Mouse	0-20
Peromyscus leucopus	White-footed Deermouse	50-300
Peromyscus maniculatus	North American Deermouse	50-300
Reithrodontomys megalotis	Western Harvest Mouse	0-50
Reithrodontomys montanus	Plains Harvest Mouse	100-500
Sigmodon hispidus	Hispid Cotton Rat	20-200
Synaptomys cooperi	Southern Bog Lemming	0-5
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		

Blarina brevicauda	Northern Short-tailed Shrew	0-20
Blarina hylophaga	Elliot's Short-tailed Shrew	0-50
Cryptotis parva	North American Least Shrew	0-50
Tamias striatus	Eastern Chipmunk	0-20
Spermophilus franklinii	Franklin's Ground Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys bursarius	Plains Pocket Gopher	0-5
Mustela frenata	Long-tailed Weasel	0-5
Neovison vison	Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.15 D06 – RELOCATABLE – UKFS (University of Kansas Field Station)

Trapping Issues

- Medium sized carnivore (e.g., raccoons, coyotes) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest

Priority species for pathogen testing: Microtus spp., Neotoma floridana, Peromyscus leucopus, Peromyscus maniculatus, Reithrodontomys spp., Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Fitch and Slade 2014, and updated with NEON data from 2015 through 2016.

Table 32. Site-specific species list (UKFS)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus hispidus	Hispid Pocket Mouse	0-20
Microtus ochrogaster	Prairie Vole	0-100
Microtus pinetorum	Woodland Vole	0-20
Mus musculus	House mouse	0-20
Neotoma floridana	Eastern Woodrat	20-200
Onychomys leucogaster	Northern Grasshopper Mouse	0-20
Peromyscus leucopus	White-footed Deermouse	100-300
Peromyscus maniculatus	North American Deermouse	0-50
Reithrodontomys megalotis	Western Harvest Mouse	0-50
Reithrodontomys montanus	Plains Harvest Mouse	0-50
Sigmodon hispidus	Hispid Cotton Rat	100-300
Synaptomys cooperi	Southern Bog Lemming	0-5
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		

Blarina brevicauda	Northern Short-tailed Shrew	0-20
Blarina hylophaga	Elliot's Short-tailed Shrew	0-50
Cryptotis parva	North American Least Shrew	0-50
Tamias striatus	Eastern Chipmunk	0-20
Spermophilus franklinii	Franklin's Ground Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys bursarius	Plains Pocket Gopher	0-5
Mustela frenata	Long-tailed Weasel	0-5
Neovison vison	Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.16 D06 – RELOCATABLE – KONA (Konza Prairie Biological Station - Agriculture)

Trapping Issues

- Medium sized carnivore (e.g., raccoons, coyotes) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Agriculture

Priority species for pathogen testing: Microtus spp., Neotoma floridana, Peromyscus leucopus, Peromyscus maniculatus, Reithrodontomys spp., Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by McMillan et al. 1997, and updated with NEON data from nearby Konza Biological Stations from 2015 through 2016.

Table 33. Site-specific species list (KONA)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus hispidus	Hispid Pocket Mouse	20-200
Microtus ochrogaster	Prairie Vole	100-500
Microtus pinetorum	Woodland Vole	0-20
Mus musculus	House mouse	0-20
Neotoma floridana	Eastern Woodrat	20-100
Onychomys leucogaster	Northern Grasshopper Mouse	0-20
Peromyscus leucopus	White-footed Deermouse	50-300
Peromyscus maniculatus	North American Deermouse	50-300
Reithrodontomys megalotis	Western Harvest Mouse	0-50
Reithrodontomys montanus	Plains Harvest Mouse	100-500
Sigmodon hispidus	Hispid Cotton Rat	20-200
Synaptomys cooperi	Southern Bog Lemming	0-5
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		

Blarina brevicauda	Northern Short-tailed Shrew	0-20
Blarina hylophaga	Elliot's Short-tailed Shrew	0-50
Cryptotis parva	North American Least Shrew	0-50
Tamias striatus	Eastern Chipmunk	0-20
Spermophilus franklinii	Franklin's Ground Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys bursarius	Plains Pocket Gopher	0-5
Mustela frenata	Long-tailed Weasel	0-5
Neovison vison	Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.17 D07 – CORE – ORNL (Oak Ridge National Laboratory)

Trapping Issues

- Fire ants
  - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest

Priority species for pathogen testing: Microtus spp., Neotoma spp., Peromyscus leucopus, Peromyscus maniculatus, Reithrodontomys spp., Rattus norvegicus, Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Giffen et al. 2011, and updated with NEON data from 2014 through 2016.

Table 34. Site-specific species list (ORNL)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus chrotorrhinus	Rock Vole	0-20
Microtus ochrogaster	Prairie Vole	0-20
Microtus pennsylvanicus	Meadow Vole	0-20
Microtus pinetorum	Woodland Vole	0-20
Mus musculus	House mouse	0-20
Neotoma floridana	Eastern Woodrat	0-20
Neotoma magister	Allegheny Woodrat	0-20
Ochrotomys nuttalli	Golden Mouse	0-20
Oryzomys palustris	Marsh Oryzomys	0-20
Peromyscus leucopus	White-footed Deermouse	50-300
Peromyscus maniculatus	North American Deermouse	20-200
Rattus norvegicus	Norway rat	0-20

Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	10-100
Synaptomys cooperi	Southern Bog Lemming	0-5
Napaeozapus insignis	Woodland Jumping Mouse	0-20
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	10-100
Cryptotis parva	North American Least Shrew	0-5
Glaucomys volans	Southern Flying Squirrel	0-50
Sorex cinereus	Cinereus Shrew	0-5
Sorex dispar	Long-tailed Shrew	0-5
Sorex fumeus	Smoky Shrew	0-5
Sorex hoyi	American Pygmy Shrew	0-5
Sorex longirostris	Southeastern Shrew	0-5
Tamias striatus	Eastern Chipmunk	10-100
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela frenata	Long-tailed Weasel	0-5
Neovison vison	Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Didelphis virginiana	Virginia Opossum	0-5

E.18 D07 – RELOCATABLE – GRSM (Great Smoky Mountains National Park)

Trapping Issues

- Fire ants
    - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
- Large (i.e., bear) and medium sized carnivore (e.g., raccoons, coyotes) disturbance
    - Due to the high density of bears in the Park, if **ONE** or more traps are disturbed, traps must be removed from the disturbed grid and any other grid within one mile. The sampling bout must be terminated prematurely for these grids; trapping can resume after a month.
    - If bears disturb the same grid twice, then trapping cannot recur for one year.
    - The Park and the Field Operations Manager shall be informed as soon as possible, and a problem ticket should be issued.
    - To reduce the probability of bear disturbance, every effort should be made to collect all seed for disposal off site.
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- Do not intentionally collect vouchers at this site. It is not permitted by the Park.
- **Contingency plot guidelines**: Preferably trap the original 6 designated mammal plots each year. If one of those locations is closed to trapping due to repeated bear disturbance, in accordance with the Park rules, trap one of the 3 contingent mammal plots as a replacement, according to the assigned priority. That contingent plot will be either a bleed or diversity plot, depending on which plot is dropped. Contingent plots will be used as needed and can change grid type (bleed or diversity) from season to season.

Animal Care

- When performing maxio-facial bleeding of small mammals, it is important that the lancet be applied in alignment with the muscle fibers of the animal's jaw line to avoid undue trauma by severing muscles associated with mastication.
- A maximum 2-attempt rule to the facial bleeding of animals in the field should be observed.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Neotoma spp., Peromyscus spp., Reithrodontomys humulis, Rattus norvegicus, Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Discover Life in America - All Taxa Biodiversity Inventory 2008, and updated with NEON data from 2015 through 2016.

Table 35. Site-specific species list (GRSM)

TARGET SPECIES (Scientific and Common Name)		**Number to be Used Annually**
Microtus chrotorrhinus	Rock Vole	0-20
Microtus ochrogaster	Prairie Vole	0-20
Microtus pennsylvanicus	Meadow Vole	0-20
Microtus pinetorum	Woodland Vole	0-20
Myodes gapperi	Southern red-backed vole	0-20
Mus musculus	House mouse	0-20
Neotoma floridana	Eastern Woodrat	0-20
Neotoma magister	Allegheny Woodrat	0-20
Ochrotomys nuttalli	Golden Mouse	0-20
Oryzomys palustris	Marsh Oryzomys	0-20
Peromyscus gossypinus	Cotton Mouse	0-20
Peromyscus leucopus	White-footed Deermouse	50-300
Peromyscus maniculatus	North American Deermouse	20-200
Rattus norvegicus	Norway Rat	0-20
Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	0-20
Synaptomys cooperi	Southern Bog Lemming	0-5
Napaeozapus insignis	Woodland Jumping Mouse	0-20
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	5-50
Cryptotis parva	North American Least Shrew	0-5
Glaucomys sabrinus	Northern Flying Squirrel	0-5
Glaucomys volans	Southern Flying Squirrel	0-50
Sorex cinereus	Cinereus Shrew	0-5
Sorex dispar	Long-tailed Shrew	0-5
Sorex fumeus	Smoky Shrew	0-20

Sorex hoyi	American Pygmy Shrew	0-5
Sorex longirostris	Southeastern Shrew	0-5
Sorex palustris	American Water Shrew	0-5
Tamias striatus	Eastern Chipmunk	5-50
Tamiasciurus hudsonicus	Red Squirrel	0 - 20
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela frenata	Long-tailed Weasel	0-5
Neovison vison	Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.19 D07 – RELOCATABLE – MLBS (Mountain Lake Biological Station)

Trapping Issues

- Fire ants
  - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Neotoma spp., Peromyscus spp., Reithrodontomys humulis, Rattus norvegicus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Kaminski et al. 2007.

Table 36. Site-specific species list (MLBS)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus pennsylvanicus	Meadow Vole	0-50
Microtus pinetorum	Woodland Vole	0-50
Mus musculus	House Mouse	0-50
Myodes gapperi	Southern Red-backed Vole	0-50
Napaeozapus insignis	Woodland Jumping Mouse	50-200
Neotoma floridana	Eastern Woodrat	0-20
Neotoma magister	Allegheny Woodrat	0-20
Ochrotomys nuttalli	Golden Mouse	0-50
Peromyscus leucopus	White-footed Deermouse	50-200
Peromyscus maniculatus	North American Deermouse	50-200
Reithrodontomys humulis	Eastern Harvest Mouse	50-200
Synaptomys cooperi	Southern Bog Lemming	0-50
Zapus hudsonius	Meadow Jumping Mouse	50-200

OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	50-200
Cryptotis parva	North American Least Shrew	0-50
Glaucomys volans	Southern Flying Squirrel	0-20
Sorex cinereus	Cinereus Shrew	100-500
Sorex dispar	Long-tailed Shrew	0-50
Sorex fumeus	Smoky Shrew	50-200
Sorex hoyi	American Pygmy Shrew	0-50
Sorex longirostris	Southeastern Shrew	0-50
Sorex palustris	American Water Shrew	0-50
Tamias striatus	Eastern Chipmunk	0-50
Tamiasciurus hudsonicus	Red Squirrel	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Condylura cristata	Star-nosed Mole	0-5
Mephitis mephitis	Striped Skunk	0
Mustela frenata	Long-tailed Weasel	0-50
Mustela nivalis	Least Weasel	0-50
Neovison vison	American Mink	0-5
Ondatra zibethicus	Common Muskrat	0
Parascalops breweri	Hairy-tailed Mole	0-50
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Spilogale putorius	Eastern Spotted Skunk	0
Sylvilagus floridanus	Eastern Cottontail	0-5
Sylvilagus obscurus	Appalachian Cottontail	0-5

E.20 D08 – CORE – TALL (Talladega National Forest)

Trapping Issues

- Fire ants
  - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Neotoma floridana, Oryzomys palustris, Peromyscus spp., Reithrodontomys humulis, Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Adams et al. 2013 and data collected by NEON in 2014 through 2016.

Table 37. Site-specific species list (TALL)

TARGET SPECIES (Scientific and Common Name)		**Number to be Used Annually**
Microtus pinetorum	Woodland Vole	0-20
Neotoma floridana	Eastern Woodrat	0-20
Ochrotomys nuttalli	Golden Mouse	0-20
Oryzomys palustris	Marsh Oryzomys	0-20
Peromyscus gossypinus	Cotton Deermouse	20-200
Peromyscus leucopus	White-footed Deermouse	20-200
Peromyscus polionotus	Oldfield Deermouse	0-20
Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	0-20
Blarina carolinensis	Southern Short-tailed Shrew	10-100
Cryptotis parva	North American Least Shrew	0-5

Sorex longirostris	Southeastern Shrew	0-5
Tamias striatus	Eastern Chipmunk	0-20
Mus musculus	House mouse	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Glaucomys volans	Southern Flying Squirrel	0-5
Mustela frenata	Long-tailed Weasel	0-5
Geomys pinetis	Southeastern Pocket Gopher	0-5
Neovison vison	American Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus aquaticus	Swamp Rabbit	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.21 D08 – RELOCATABLE – DELA (Dead Lake)

Trapping Issues

- Fire ants
  - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Woody Wetlands

Priority species for pathogen testing: Neotoma floridana, Oryzomys palustris, Peromyscus spp., Reithrodontomys humulis, Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Adams et al. 2013 and data collected by NEON in 2015 and 2016.

Table 38. Site-specific species list (DELA)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus pinetorum	Woodland Vole	0-20
Neotoma floridana	Eastern Woodrat	0-20
Ochrotomys nuttalli	Golden Mouse	50-200
Oryzomys palustris	Marsh Oryzomys	0-20
Peromyscus gossypinus	Cotton Deermouse	10-200
Peromyscus leucopus	White-footed Deermouse	0-20
Peromyscus polionotus	Oldfield Deermouse	0-20
Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina carolinensis	Southern Short-tailed Shrew	0-5
Cryptotis parva	North American Least Shrew	0-5
Sorex longirostris	Southeastern Shrew	0-5

Tamias striatus	Eastern Chipmunk	50-200
Mus musculus	house mouse	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Glaucomys volans	Southern Flying Squirrel	0-5
Mustela frenata	Long-tailed Weasel	0-5
Geomys pinetis	Southeastern Pocket Gopher	0-5
Neovison vison	American Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus aquaticus	Swamp Rabbit	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.22 D08 – RELOCATABLE – LENO (Lenoir Landing)

Trapping Issues

- Fire ants
    - If fire ant activity is present in the immediate vicinity of a trapping station, be sure to dust the ground under and around the trap with Talstar granules.
- Large (i.e., bear) and medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Woody Wetlands

Priority species for pathogen testing: Neotoma floridana, Oryzomys palustris, Peromyscus spp., Reithrodontomys humulis, Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Adams et al. 2013 and data collected by NEON in 2016.

Table 39. Site-specific species list (LENO)

TARGET SPECIES (Scientific and Common Name)		**Number to be Used Annually**
Microtus pinetorum	Woodland Vole	0-20
Neotoma floridana	Eastern Woodrat	0-20
Ochrotomys nuttalli	Golden Mouse	0-20
Oryzomys palustris	Marsh Oryzomys	0-20
Peromyscus gossypinus	Cotton Deermouse	20-200
Peromyscus leucopus	White-footed Deermouse	0-100
Peromyscus polionotus	Oldfield Deermouse	0-20
Reithrodontomys humulis	Eastern Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina carolinensis	Southern Short-tailed Shrew	0-5
Cryptotis parva	North American Least Shrew	0-5

Sorex longirostris	Southeastern Shrew	0-5
Tamias striatus	Eastern Chipmunk	0-20
Mus musculus	house mouse	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Glaucomys volans	Southern Flying Squirrel	0-5
Mustela frenata	Long-tailed Weasel	0-5
Geomys pinetis	Southeastern Pocket Gopher	0-5
Neovison vison	American Mink	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus aquaticus	Swamp Rabbit	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.23 D09 – CORE – WOOD (Woodworth Field Station)

Trapping Issues

- Medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Microtus

Dominant vegetation type(s) for bleed grid designation: Grassland/Herbaceous

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Peromyscus spp., Reithrodontomys megalotis

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Wiewel et al. 2007 and data collected by NEON in 2014 through 2016.

Table 40. Site-specific species list (WOOD)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus ochrogaster	Prairie Vole	0-20
Microtus pennsylvanicus	Meadow Vole	100-1000
Myodes gapperi	Southern Red-backed Vole	0-20
Onychomys leucogaster	Northern Grasshopper Mouse	0-20
Perognathus fasciatus	Olive-backed Pocket Mouse	0-20
Perognathus flavescens	Plains Pocket Mouse	0-20
Peromyscus leucopus	White-footed Deermouse	0-20
Peromyscus maniculatus	North American Deermouse	50-200
Reithrodontomys megalotis	Western Harvest Mouse	0-50
Zapus hudsonius	Meadow Jumping Mouse	5-50
Zapus princeps	Western Jumping Mouse	50-200
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Blarina brevicauda	Northern Short-tailed Shrew	0-200
Sorex arcticus	Arctic Shrew	0-5

Sorex cinereus	Cinereus Shrew	5-50
Spermophilus franklinii	Franklin's Ground Squirrel	0-20
Spermophilus richardsonii	Richardson's Ground Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	10-100
Sorex haydeni	Prairie Shrew	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
Tamias striatus	Eastern Chipmunk	0-5
Rattus norvegicus	Norway rat	0-5
Mus musculus	House mouse	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela frenata	Long-tailed Weasel	0-5
Mustela nivalis	Least Weasel	0-5
Mustela vison	Mink	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Thomomys talpoides	Northern Pocket Gopher	0-5
Sylvilagus nuttallii	Mountain Cottontail	0-5
Mustela erminea	Ermine	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5

E.24 D09 – RELOCATABLE – DCFS (Dakota Coteau Field School)

Trapping Issues

- Medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Microtus

Dominant vegetation type(s) for bleed grid designation: Grassland/Herbaceous

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Peromyscus spp., Rattus norvegicus, Reithrodontomys megalotis

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Snyder and Best 1988.

Table 41. Site-specific species list (DCFS)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus ochrogaster	Prairie Vole	0-20
Microtus pennsylvanicus	Meadow Vole	400-1000
Mus musculus	House Mouse	0-50
Myodes gapperi	Southern Red-backed Vole	0-20
Onychomys leucogaster	Northern Grasshopper Mouse	0-20
Perognathus fasciatus	Olive-backed Pocket Mouse	0-50
Perognathus flavescens	Plains Pocket Mouse	0-20
Peromyscus leucopus	White-footed Deermouse	0-50
Peromyscus maniculatus	North American Deermouse	50-200
Rattus norvegicus	Norway Rat	0-5
Reithrodontomys megalotis	Western Harvest Mouse	0-50
Zapus hudsonius	Meadow Jumping Mouse	50-200
Zapus princeps	Western Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		

Blarina brevicauda	Northern Short-tailed Shrew	0-50
Sorex arcticus	Arctic Shrew	0-5
Sorex cinereus	Cinereus Shrew	50-200
Sorex haydeni	Prairie Shrew	0-5
Spermophilus franklinii	Franklin's Ground Squirrel	0-5
Spermophilus richardsonii	Richardson's Ground Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-5
Tamias striatus	Eastern Chipmunk	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Mustela nivalis	Least Weasel	0-5
Mustela vison	Mink	0-5
Ondatra zibethicus	Common Muskrat	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Sylvilagus nuttallii	Mountain Cottontail	0-5
Thomomys talpoides	Northern Pocket Gopher	0-5

E.25 D09 – RELOCATABLE – NOGP (Northern Great Plains Research Laboratory)

Trapping Issues

- Medium sized carnivore (e.g., raccoons) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Microtus

Dominant vegetation type(s) for bleed grid designation: Grassland/Herbaceous

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Peromyscus spp., Rattus norvegicus, Reithrodontomys megalotis

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Snyder and Best 1988, and updated with NEON data from 2016.

Table 42. Site-specific species list (NOGP)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus ochrogaster	Prairie Vole	0-20
Microtus pennsylvanicus	Meadow Vole	20-200
Mus musculus	House Mouse	0-50
Myodes gapperi	Southern Red-backed Vole	0-20
Onychomys leucogaster	Northern Grasshopper Mouse	0-20
Perognathus fasciatus	Olive-backed Pocket Mouse	0-50
Perognathus flavescens	Plains Pocket Mouse	0-20
Peromyscus leucopus	White-footed Deermouse	0-50
Peromyscus maniculatus	North American Deermouse	50-300
Rattus norvegicus	Norway Rat	0-5
Reithrodontomys megalotis	Western Harvest Mouse	5-50
Zapus hudsonius	Meadow Jumping Mouse	0-20
Zapus princeps	Western Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		

Blarina brevicauda	Northern Short-tailed Shrew	0-50
Sorex arcticus	Arctic Shrew	0-5
Sorex cinereus	Cinereus Shrew	0-20
Sorex haydeni	Prairie Shrew	0-5
Spermophilus franklinii	Franklin's Ground Squirrel	0-5
Spermophilus richardsonii	Richardson's Ground Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	5-50
Tamias striatus	Eastern Chipmunk	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Mustela nivalis	Least Weasel	0-5
Mustela vison	Mink	0-5
Ondatra zibethicus	Common Muskrat	0-5
Sciurus carolinensis	Eastern Gray Squirrel	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5
Sylvilagus nuttallii	Mountain Cottontail	0-5
Thomomys talpoides	Northern Pocket Gopher	0-5

E.26 D10 – CORE – CPER (Central Plains Experimental Range)

Trapping Issues

- Kangaroo rats require larger traps (12" long rather than 9"), to minimize trap-related injuries to their long tails.
- Coyote disturbance
- Cattle disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: NOT recommended under any circumstances.

Dominant genus for hair & whisker sampling purposes: Dipodomys

Dominant vegetation type(s) for bleed grid designation: Grassland/Herbaceous

Priority species for pathogen testing: Microtus spp., Neotoma cinerea, Peromyscus sp., Reithrodontomys spp.

Species List and Abundance Estimates

This species list is based on the Shortgrass Steppe LTER website (http://www.sgslter.colostate.edu/species_download.aspx?type=Mammals, accessed 2012). Abundance estimates were based on an average capture rate of 10%, and the species-specific abundances reported in Evangelista et al., 2008 and data collected by NEON in 2014 through 2016.

Table 43. Site-specific species list (CPER)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus hispidus	Hispid Pocket Mouse	0 - 100
Chaetodipus intermedius	Rock Pocket Mouse	0 - 20
Dipodomys ordii	Ord's Kangaroo Rat	0 - 100
Microtus longicaudus	Long-tailed Vole	0 - 50
Microtus ochrogaster	Prairie Vole	0-100
Microtus pennsylvanicus	Meadow Vole	0 - 50
Neotoma cinerea	Bushy-tailed Woodrat	0 - 50
Onychomys leucogaster	Northern Grasshopper Mouse	5 - 50
Perognathus fasciatus	Olive-backed Pocket Mouse	0 - 20
Perognathus flavescens	Plains Pocket Mouse	0 - 50
Perognathus flavus	Silky Pocket Mouse	5 - 100
Peromyscus maniculatus	N. American Deer Mouse	5 - 100

Reithrodontomys megalotis	Western Harvest Mouse	50 - 300
Reithrodontomys montanus	Plains Harvest Mouse	50 - 300
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Cryptotis parva	North American Least Shrew	0 - 20
Spermophilus spilosoma	Spotted Ground Squirrel	0 - 20
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0 - 20
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys bursarius	Plains Pocket Gopher	0 - 20
Mustela frenata	Long-tailed Weasel	0 -5
Sylvilagus floridanus	Eastern cottontail	0-5

E.27 D10 – RELOCATABLE – STER (Sterling)

Trapping Issues

- Coyote disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F; depends on the relative abundance (RA) of heteromyid species – stop use if RA of heteromyids exceeds 50%

Dominant genus for hair & whisker sampling purposes: Onychomys

Dominant vegetation type(s) for bleed grid designation: Cultivated Crops

Priority species for pathogen testing: Microtus spp., Neotoma cinerea, Peromyscus sp., Reithrodontomys spp.

Species List and Abundance Estimates

This species list is based on the North Sterling State Park website (http://www.parks.state.co.us/parks/northsterling/Pages/NorthSterling.aspx, accessed 2012). Abundance estimates were based on an average capture rate of 10%, and relative abundances in data collected by NEON from 2014 through 2016.

Table 44. Site-specific species list (STER)

TARGET species (Scientific and Common Name)		Number to be Used Annually
Chaetodipus hispidus	Hispid Pocket Mouse	20 - 200
Dipodomys ordii	Ord's Kangaroo Rat	0 - 50
Microtus ochrogaster	Prairie Vole	0 - 50
Microtus pennsylvanicus	Meadow Vole	0 - 50
Neotoma cinerea	Bushy-tailed Woodrat	0 - 5
Onychomys leucogaster	Northern Grasshopper Mouse	50 - 500
Perognathus flavescens	Plains Pocket Mouse	0 - 50
Perognathus flavus	Silky Pocket Mouse	0 - 50
Peromyscus maniculatus	Deer Mouse	50 - 500
Reithrodontomys megalotis	Western Harvest Mouse	0 - 50
Reithrodontomys montanus	Plains Harvest Mouse	0 - 50
Mus musculus	House Mouse	0 - 5
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Cryptotis parva	Least Shrew	0 - 20

Sorex cinereus	Masked Shrew	0 - 20
Spermophilus spilosoma	Spotted Ground Squirrel	0 - 20
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	5 - 50
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys bursarius	Plains Pocket Gopher	0 – 20
Mustela frenata	Long-tailed Weasel	0 - 5

E.28 D10 – RELOCATABLE – RMNP (Rocky Mountain National Park)

Trapping Issues

- Cold temperatures, wind, and snow
  - Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- Bear and elk disturbance

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: TBD

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Neotoma spp., Peromyscus spp.

Species List and Abundance Estimates

This species list is based on Armstrong, 2008, as well as the NEON 2012 capture data. The abundance estimates were based on an average capture rate of 10%, with declining returns of unique individuals over the consecutive nights of a sampling bout, as well as the species-specific relative abundances reported in Maher, 2010**.**

Table 45. Site-specific species list (RMNP)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Red-backed vole	50 - 200
Lemmiscus curtatus	Sagebrush Vole	20 - 100
Microtus longicaudus	Long-tailed Vole	20 - 200
Microtus montanus	Montane Vole	20 - 200
Neotoma cinerea	Bushy-tailed Woodrat	0 - 50
Neotoma mexicana	Mexican Woodrat	0 - 5
Peromyscus maniculatus	N. American Deermouse	500 - 2000
Peromyscus nasutus	Northern Rock Deermouse	0 - 50
Zapus princeps	Western Jumping Mouse	5 – 100
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Sorex cinereus	Cinereus Shrew	0 - 25
Sorex hoyi	American Pygmy Shrew	0 - 25
Sorex merriami	Merriam's Shrew	0 - 25
Sorex monticolus	Dusky Shrew	0 - 50
Sorex nanus	Dwarf Shrew	0 - 25
Sorex palustris	American Water Shrew	0 – 10
Spermophilus elegans	Wyoming Ground Squirrel	0 - 50

Spermophilus lateralis	Golden-mantled Ground Squirrel	5 - 50
Spermophilus variegatus	Rock Squirrel	0 - 10
Tamias minimus	Least Chipmunk	100 - 500
Tamias quadrivittatus	Colorado Chipmunk	0 - 20
Tamias umbrinus	Uinta Chipmunk	20 - 100
Tamiasciurus hudsonicus	Red Squirrel	0 - 50
NON-TARGET ANIMALS (Scientific and Common Name)		
Thomomys talpoides	Northern Pocket Gopher	0 - 50

E.29 D11 – CORE – CLBJ (Caddo/LBJ National Grassland)

Trapping Issues

- Medium sized carnivore (e.g., raccoons, coyotes) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Pending capture rates of heteromyids; Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest/ Grassland/ Herbaceous

Priority species for pathogen testing: Neotoma micropus, Peromyscus sp., Reithrodontomys spp., Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Vaughn et al. 1993, updated based on NEON data in 2016.

Table 46. Site-specific species list (CLBJ)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Baiomys taylori	Northern Pygmy Mouse	0-20
Chaetodipus hispidus	Hispid Pocket Mouse	0-50
Dipodomys ordii	Ord's Kangaroo Rat	0-50
Microtus pinetorum	Woodland Vole	0-20
Neotoma micropus	Southern Plains Woodrat	20-100
Onychomys leucogaster	Northern Grasshopper Mouse	0-5
Perognathus flavescens	Plains Pocket Mouse	0-50
Perognathus flavus	Silky Pocket Mouse	0-20
Peromyscus attwateri	Texas Deermouse	0-50
Peromyscus leucopus	White-footed Deermouse	50-300
Peromyscus maniculatus	North American Deermouse	50-300
Reithrodontomys fulvescens	Fulvous Harvest Mouse	0-20
Reithrodontomys montanus	Plains Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	50-300

OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Cryptotis parva	North American Least Shrew	0-50
Notiosorex crawfordi	Crawford's Gray Shrew	0-20
Spermophilus spilosoma	Spotted Ground Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys bursarius	Plains Pocket Gopher	0-5
Mustela frenata	Long-tailed Weasel	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus audubonii	Desert Cottontail	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.30 D11 – RELOCATABLE – OAES (Klemme Range Research Station)

Trapping Issues

- Medium sized carnivore (e.g., raccoons, coyotes) disturbance
- Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: If capture rates of heteromyids exceed 35% of all capture, do not use; Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Sigmodon

Dominant vegetation type(s) for bleed grid designation: Grassland/Herbaceous

Priority species for pathogen testing: Neotoma micropus, Peromyscus sp., Reithrodontomys spp., Sigmodon hispidus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Leis et al. 2008 and data collected by NEON in 2015 and 2016.

Table 47. Site-specific species list (OAES)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus hispidus	Hispid Pocket Mouse	20-200
Dipodomys ordii	Ord's Kangaroo Rat	0-20
Microtus ochrogaster	Prairie Vole	0-50
Neotoma micropus	Southern Plains Woodrat	0-20
Onychomys leucogaster	Northern Grasshopper Mouse	20-200
Perognathus flavescens	Plains Pocket Mouse	0-20
Perognathus flavus	Silky Pocket Mouse	0-20
Peromyscus attwateri	Texas Deermouse	0-20
Peromyscus leucopus	White-footed Deermouse	20-200
Peromyscus maniculatus	North American Deermouse	20-200
Reithrodontomys fulvescens	Fulvous Harvest Mouse	0-20
Reithrodontomys montanus	Plains Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	50-500

OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Cryptotis parva	North American Least Shrew	0-5
Spermophilus spilosoma	Spotted Ground Squirrel	0-5
Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel	0-5
Tamias striatus	Eastern Chipmunk	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Geomys bursarius	Plains Pocket Gopher	0-5
Mustela frenata	Long-tailed Weasel	0-5
Scalopus aquaticus	Eastern Mole	0-5
Sciurus niger	Eastern Fox Squirrel	0-5
Sylvilagus audubonii	Desert Cottontail	0-5
Sylvilagus floridanus	Eastern Cottontail	0-5

E.31 D12 – CORE – YELL (Yellowstone National Park)

Trapping Issues

- Cold temperatures, wind, and snow
  - Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- Bear, wolf, and elk disturbance

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: TBD (initial sampling to use Peromyscus)

Dominant vegetation type(s) for bleed grid designation: Shrub Scrub

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Neotoma cinerea, Peromyscus sp.

Species List and Abundance Estimates

This species list is based on Armstrong et al., 2001. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by National Park Service 2006.

Table 48. Site-specific species list (YELL)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Southern Red-backed Vole	400-1,000
Microtus longicaudus	Long-tailed Vole	50-200
Microtus montanus	Montane Vole	400-1,000
Microtus pennsylvanicus	Meadow Vole	400-1,000
Microtus richardsoni	Richardson Water Vole	0-20
Mus musculus	House Mouse	0-20
Neotoma cinerea	Bushy-tailed Woodrat	50-200
Peromyscus maniculatus	North American Deermouse	400-1,000
Phenacomys intermedius	Western Heather Vole	0-20
Zapus princeps	Western Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Glaucomys sabrinus	Northern Flying Squirrel	0-20
Tamias amoenus	Yellow Pine Chipmunk	0-20
Tamias minimus	Least Chipmunk	0-20
Tamias umbrinus	Uinta Chipmunk	0-20

Sorex cinereus	Cinereus Shrew	0-20
Sorex monticolus	Dusky Shrew	0-20
Sorex nanus	Rocky Mountain Dwarf Shrew	0-20
Sorex palustris	American Water Shrew	0-20
Sorex preblei	Preble's Shrew	0-20
Spermophilus armatus	Uinta Ground Squirrel	0-5
Spermophilus lateralis	Golden-mantled Ground Squirrel	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
Glaucomys sabrinus	Northern Flying Squirrel	0-20
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Mustela vison	American Mink	0-5
Sylvilagus audubonii	Desert Cottontail	0-5
Sylvilagus nuttallii	Mountain Cottontail	0-5
Thomomys talpoides	Northern Pocket Gopher	0-5

E.32 D13 – CORE – NIWO (Niwot Ridge Mountain Research Station)

Trapping Issues

- Cold temperatures, wind, and snow
  - Do not trap when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- Bear and elk disturbance
- Due to the shortness of the warm weather season at this high-elevation core site, it is expected that trapping will only occur for four, rather than six, bouts per year.

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest/ Grassland/ Herbaceous

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Neotoma cinerea, Peromyscus sp.

Species List and Abundance Estimates

This species list is based on Armstrong et al., 2001. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Halfpenny 2010, and updated based on NEON data from 2015 and 2016**.**

Table 49. Site-specific species list (NIWO)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Myodes gapperi	Red-backed vole	20 - 200
Phenacomys intermedius	Heather Vole	0 - 20
Microtus longicaudus	Long-tailed Vole	0 - 20
Microtus montanus	Montane Vole	0 - 20
Neotoma cinerea	Bushy-tailed Woodrat	0 - 50
Peromyscus maniculatus	N. American Deermouse	50 - 500
Zapus princeps	Western Jumping Mouse	0 – 20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Sorex cinereus	Cinereus Shrew	0 - 5
Sorex monticolus	Montane Shrew	0 – 5
Sorex nanus	Dwarf Shrew	0 - 5
Spermophilus lateralis	Golden-mantled Ground Squirrel	0 - 20
Tamias minimus	Least Chipmunk	5-50

NON-TARGET ANIMALS (Scientific and Common Name)		
Thomomys talpoides	Northern Pocket Gopher	0 - 10
Mustela ermine	Short-tailed weasel	0-5
Mustela frenata	Long-tailed weasel	0-5
Ochotona princeps	American Pika	0-5

E.33 D13 – RELOCATABLE – MOAB (Moab)

Trapping Issues

- Kangaroo rats require larger traps (12" long rather than 9"), to minimize trap-related injuries to their long tails.
- Coyote disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: NOT recommended under any circumstances.

Dominant genus for hair & whisker sampling purposes: Dipodomys

Target vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Microtus spp., Neotoma spp., Peromyscus spp., Reithrodontomys sp.

Species List and Abundance Estimates:

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Clevenger 1977 and Sureda and Morrison 1998.

Table 50. Site-specific species list (MOAB)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Dipodomys ordii	Ord's Kangaroo Rat	20-200
Microtus longicaudus	Long-tailed Vole	0-20
Microtus montanus	Montane Vole	0-50
Neotoma albigula	White-throated Woodrat	0-20
Neotoma cinerea	Bushy-tailed Woodrat	0-20
Neotoma lepida	Desert Woodrat	0-20
Neotoma mexicana	Mexican Woodrat	0-20
Onychomys leucogaster	Northern Grasshopper Mouse	10-100
Perognathus fasciatus	Olive-backed Pocket Mouse	0-20
Perognathus flavescens	Plains Pocket Mouse	0-20
Perognathus parvus	Great Basin Pocket Mouse	0-20
Peromyscus boylii	Brush Deermouse	0-20
Peromyscus crinitus	Canyon Deermouse	0-20

Peromyscus maniculatus	North American Deermouse	5-300
Peromyscus truei	Pinon Deermouse	3-300
Reithrodontomys megalotis	Western Harvest Mouse	0-20
Zapus princeps	Western Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Notiosorex crawfordi	Crawford's Gray Shrew	0-5
Sorex merriami	Merriam's Shrew	0-5
Sorex monticolus	Dusky Shrew	0-5
Sorex nanus	Dwarf Shrew	0-5
Ammospermophilus leucurus	White-tailed Antelope Squirrel	0-5
Spermophilus lateralis	Golden-mantled Ground Squirrel	0-5
Spermophilus spilosoma	Spotted Ground Squirrel	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
Tamias minimus	Least Chipmunk	0-5
Tamias quadrivittatus	Colorado Chipmunk	0-5
Tamias rufus	Hopi Chipmunk	0-20
NON-TARGET ANIMALS (Scientific and Common Name)		
Spermophilus variegatus	Rock Squirrel	0-5
Sylvilagus audubonii	Desert Cottontail	0-5
Sylvilagus nuttallii	Mountain Cottontail	0-5
Thomomys bottae	Botta's Pocket Gopher	0-5
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5

E.34 D14 – CORE – SRER (Santa Rita Experimental Range)

Trapping Issues

- Kangaroo rats require larger traps (12" long rather than 9"), to minimize trap-related injuries to their long tails.
- Coyote disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: NOT recommended under any circumstances.

Dominant genus for hair & whisker sampling purposes: Chaetodipus

Dominant vegetation type(s) for bleed grid designation: Shrub Scrub

Priority species for pathogen testing: Neotoma spp., Peromyscus spp., Reithrodontomys spp., Sigmodon spp.

Species List and Abundance Estimates

This species list is based on Martin and Reynolds 1973 and Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Reynolds 1950, Price 1978, and Bock and Bock 1978, and from data collected by NEON in 2016.

Table 51. Site-specific species list (SRER)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Baiomys taylori	Northern Pygmy Mouse	0-20
Chaetodipus baileyi	Bailey's Pocket Mouse	50-200
Chaetodipus hispidus	Hispid Pocket Mouse	0-20
Chaetodipus intermedius	Rock Pocket Mouse	0-50
Chaetodipus penicillatus	Desert Pocket Mouse	100-500
Dipodomys merriami	Merriam's kangarro rat	100-500
Dipodomys ordii	Ord's Kangaroo Rat	20-100
Dipodomys spectabilis	Banner-tailed Kangaroo Rat	0-50
Neotoma albigula	White-throated Woodrat	20-200
Neotoma mexicana	Mexican Woodrat	0-20
Onychomys leucogaster	Northern Grasshopper Mouse	0-50
Onychomys torridus	Southern Grasshopper Mouse	20-200

Perognathus amplus	Arizona Pocket Mouse	0-20
Perognathus flavus	Silky Pocket Mouse	0-20
Peromyscus boylii	Brush Deermouse	0-20
Peromyscus eremicus	Cactus Deermouse	5-100
Peromyscus leucopus	White-footed Deermouse	0-20
Peromyscus maniculatus	North American Deermouse	0-20
Peromyscus truei	Pinon Deermouse	0-50
Reithrodontomys megalotis	Western Harvest Mouse	0-20
Peromyscus merriami	Merriam's Deermouse	0-20
Reithrodontomys fulvescens	Fulvous Harvest Mouse	5-50
Reithrodontomys megalotis	Western Harvest Mouse	0-20
Reithrodontomys montanus	Plains Harvest Mouse	0-20
Sigmodon arizonae	Arizona Cotton Rat	0-20
Sigmodon fulviventer	Tawny-bellied Cotton Rat	0-20
Sigmodon ochrognathus	Yellow-nosed Cotton Rat	20-100
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Notiosorex crawfordi	Crawford's Gray Shrew	0-5
Sorex arizonae	Arizona Shrew	0-5
Sorex monticolus	Dusky Shrew	0-5
Ammospermophilus harrisii	Harris's Antelope Squirrel	0-20
Spermophilus tereticaudus	Round-tailed Ground Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Sylvilagus audubonii	Desert Cottontail	0-5
Thomomys bottae	Botta's Pocket Gopher	0-5
Thomomys umbrinus	Southern Pocket Gopher	0-5

E.35 D14 – RELOCATABLE – JORN (Jornada Experimental Range)

Trapping Issues

- Kangaroo rats require larger traps (12" long rather than 9"), to minimize trap-related injuries to their long tails.
- Coyote disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: NOT recommended under any circumstances.

***Dominant genus for hair & whisker sampling purposes*:** Dipodomys

Dominant vegetation type(s) for bleed grid designation: Shrub scrub

Priority species for pathogen testing: Neotoma spp., Peromyscus spp.

Species List and Abundance Estimates

Data sets were provided by the Jornada Basin Long-Term Ecological Research (LTER) project. Funding for these data was provided by the U.S. National Science Foundation (Grant DEB-1235828). The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Bestelmeyer and Lightfoot (http://jornada-www.nmsu.edu/studies/lter/projects/smlmamex.prj, accessed 5 March 2015) and data collected by NEON in 2015 and 2016.

Table 52. Site-specific species list (JORN)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus intermedius	Rock pocket mouse	0-20
Chaetodipus penicillatus	Desert pocket mouse	100-600
Dipodomys merriami	Merriam's kangaroo rat	100-500
Dipodomys ordii	Ord's kangaroo rat	50-200
Dipodomys spectabilis	Banner-tailed kangaroo rat	0-100
Mus musculus	House mouse	0-5
Neotoma albigula	White-throated woodrat	0-50
Neotoma micropus	Southern plains woodrat	0-20
Onychomys arenicola	Mearns' grasshopper mouse	5-200
Onychomys leucogaster	Northern grasshopper mouse	5-200
Perognathus fasciatus	Olive-backed Pocket Mouse	0-20
Perognathus flavus	Silky pocket mouse	5-200

Peromyscus boylii	Brush mouse	0-20
Peromyscus eremicus	Cactus mouse	0-20
Peromyscus leucopus	White-footed mouse	0-50
Peromyscus maniculatus	Deer mouse	0-20
Reithrodontomys megalotis	Western Harvest Mouse	0-20
Sigmodon hispidus	Hispid Cotton Rat	0 - 50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Notiosorex crawfordi	Desert shrew	0-5
Spermophilus spilosoma	Spotted ground squirrel	0-50
Spermophilus variegatus	Rock squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Lepus californicus	Black-tailed jackrabbit	0-5
Sylvilagus audubonii	Desert cottontail	0-5
Thomomys bottae	Botta's pocket gopher	0-5

E.36 D15 – CORE – ONAQ (Onaqui-Ault)

Trapping Issues

- Kangaroo rats require larger traps (12" long rather than 9"), to minimize trap-related injuries to their long tails.
- Coyote disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- Capture rates at all grids tend to be high (> 25 captures per grid). Technicians should use the prioritization scheme outlined in C.4, but do not need to issue a problem ticket when all data cannot be collected (since it is expected that this will occur during most bouts).

Use of bedding: Not recommended, as the relative abundance of heteromyids at the site is ~50%

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Shrub scrub

Priority species for pathogen testing: Microtus spp., Neotoma spp., Peromyscus spp., Reithrodontomys spp.

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Baker and Frischknecht 1973 and Smith and Urness 1984 and data collected by NEON in 2014 through 2016.

Table 53. Site-specific species list (ONAQ)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus formosus	Long-tailed Pocket Mouse	0-20
Dipodomys microps	Chisel-toothed Kangaroo Rat	5-200
Dipodomys ordii	Ord's Kangaroo Rat	20-300
Dipodomys spectabilis	Banner-tailed kangaroo rat	0-20
Lemmiscus curtatus	Sagebrush Vole	0-20
Microdipodops megacephalus	Dark Kangaroo Mouse	0-20
Microtus longicaudus	Long-tailed Vole	0-20
Microtus montanus	Montane Vole	0-20
Microtus pennsylvanicus	Meadow Vole	0-20
Neotoma cinerea	Bushy-tailed Woodrat	0-20
Neotoma lepida	Desert Woodrat	0-20

Onychomys leucogaster	Northern Grasshopper Mouse	0-50
Perognathus parvus	Great Basin Pocket Mouse	100-500
Peromyscus boylii	Brush Deermouse	0-20
Peromyscus crinitus	Canyon Deermouse	0-20
Peromyscus maniculatus	North American Deermouse	100-500
Peromyscus truei	Pinon Deermouse	0-50
Reithrodontomys megalotis	Western Harvest Mouse	5-100
Zapus princeps	Western Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Sorex cinereus	Cinereus Shrew	0-5
Sorex palustris	American Water Shrew	0-5
Sorex vagrans	Vagrant Shrew	0-5
Sorex merriami	Merriam's Shrew	0-5
Ammospermophilus leucurus	White-tailed Antelope Squirrel	0-5
Tamiasciurus hudsonicus	Red Squirrel	0-5
Tamias alpinus	Alpine Chipmunk	0-5
Tamias dorsalis	Cliff Chipmunk	0-20
Tamias minimus	Least Chipmunk	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Spermophilus variegatus	Rock Squirrel	0-5
Sylvilagus audubonii	Desert Cottontail	0-5
Sylvilagus nuttallii	Mountain Cottontail	0-5
Brachylagus idahoensis	Pygmy Rabbit	0-5

E.37 D16 – CORE – WREF (Wind River Experimental Forest)

Trapping Issues

- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: TBD (initial sampling to use Myodes)

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Neotoma cinerea, Peromyscus sp., Reithrodontomys sp.

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Carey and Wilson 2001.

Table 54. Site-specific species list (WREF)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus longicaudus	Long-tailed Vole	0-20
Microtus oregoni	Creeping Vole	0-50
Microtus richardsoni	North American Water Vole	0-20
Microtus townsendii	Townsend's Vole	0-20
Myodes gapperi	Southern Red-backed Vole	50-200
Neotoma cinerea	Bushy-tailed Woodrat	0-20
Peromyscus keeni	Forest Deer Mouse	0-20
Peromyscus maniculatus bairdii	North American Deermouse	0-50
Phenacomys intermedius	Heather Vole	0-20
Reithrodontomys megalotis	Western Harvest Mouse	0-20
Zapus trinotatus	Pacific Jumping Mouse	0-50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Glaucomys sabrinus	Northern Flying Squirrel	0-5
Neurotrichus gibbsii	Shrew-mole	0-50
Scapanus orarius	Coast Mole	0-50
Sorex bairdi	Baird's Shrew	0-20

Sorex bendirii	Marsh Shrew	0-50
Sorex cinereus	Cinereus Shrew	0-20
Sorex monticolus	Dusky Shrew	50-200
Sorex palustris punctulatus	American Water Shrew	0-20
Sorex trowbridgii	Trowbridge's Shrew	100-500
Sorex vagrans	Vagrant Shrew	50-200
Spermophilus saturatus	Cascade Golden-mantled Ground Squirrel	0-5
Tamias amoenus	Yellow-pine Chipmunk	0-5
Tamias townsendii	Townsend's Chipmunk	0-5
Tamiasciurus douglasii	Douglas's Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Neovison vison	American Mink	0-5
Thomomys talpoides	Northern Pocket Gopher	0-5

E.38 D16 – RELOCATABLE – ABBY (Abby Road)

Trapping Issues

- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Peromyscus

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Microtus spp., Myodes gapperi, Neotoma cinerea, Peromyscus sp., Reithrodontomys sp.

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Bury and Corn 1987 and data collected by NEON in 2016.

Table 55. Site-specific species list (ABBY)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Microtus longicaudus	Long-tailed Vole	0-20
Microtus oregoni	Creeping Vole	0-50
Microtus richardsoni	North American Water Vole	0-20
Microtus townsendii	Townsend's Vole	0-20
Myodes gapperi	Southern Red-backed Vole	0-50
Neotoma cinerea	Bushy-tailed Woodrat	0-20
Peromyscus keeni	Northwestern Deermouse	0-50
Peromyscus maniculatus	North American Deermouse	50-500
Phenacomys intermedius	Western Heather Vole	0-50
Zapus trinotatus	Pacific Jumping Mouse	0-50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Glaucomys sabrinus	Northern Flying Squirrel	0-5
Neurotrichus gibbsii	Shrew-mole	0-50
Sorex bairdi	Baird's Shrew	0-20
Sorex bendirii	Marsh Shrew	0-50

Sorex cinereus	Cinereus Shrew	0-20
Sorex monticolus	Dusky Shrew	0-20
Sorex palustris	American Water Shrew	0-20
Sorex trowbridgii	Trowbridge's Shrew	0-20
Sorex vagrans	Vagrant Shrew	0-20
Tamias amoenus	Yellow-pine Chipmunk	0-5
Tamias townsendii	Townsend's Chipmunk	0-5
Tamiasciurus douglasii	Douglas's Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Ermine	0-5
Mustela frenata	Long-tailed Weasel	0-5
Neovison vison	American Mink	0-5
Scapanus orarius	Coast Mole	0-50
Scapanus townsendii	Townsend's Mole	0-20

E.39 D17 – CORE – SJER (San Joaquin Experimental Range)

Trapping Issues

- Kangaroo rats require larger traps (12" long rather than 9"), to minimize trap-related injuries to their long tails.
- Coyote disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

***Use of bedding*:** Not recommended

***Dominant genus for hair & whisker sampling purposes*:** TBD (initial sampling to use Peromyscus)

Dominant vegetation type(s) for bleed grid designation: Grassland/ Herbaceous

Priority species for pathogen testing: Microtus spp., Neotoma spp., Peromyscus spp., Reithrodontomys sp.

Species List and Abundance Estimates:

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Purcell et al. 2007.

Table 56. Site-specific species list (SJER)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus californicus	California pocket mouse	50-200
Dipodomys heermanni	Heermann's Kangaroo Rat	0-50
Microtus californicus	California Vole	0-20
Microtus longicaudus	Long-tailed Vole	50-200
Microtus montanus	Montane Vole	50-200
Mus musculus	house mouse	0-20
Neotoma cinerea	Bushy-tailed Woodrat	0-20
Neotoma fuscipes	Dusky-footed Woodrat	0-50
Neotoma macrotis	big-eared woodrat	0-20
Onychomys torridus	Southern Grasshopper Mouse	0-50
Perognathus inornatus	San Joaquin pocket mouse	0-50
Peromyscus boylii	brush deermouse	100-500
Peromyscus californicus	California Deermouse	0-20
Peromyscus maniculatus	North American Deermouse	100-500

Peromyscus truei	Pinon Deermouse	100-500
Reithrodontomys megalotis	Western Harvest Mouse	50-200
Zapus princeps	Western Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Sorex lyelli	Mt. Lyell Shrew	0-5
Sorex ornatus	Ornate Shrew	0-5
Sorex palustris	American Water Shrew	0-5
Scapanus latimanus	Broad-footed Mole	0-5
Glaucomys sabrinus	Northern Flying Squirrel	0-5
Spermophilus beecheyi	California Ground Squirrel	0-5
Spermophilus lateralis	Golden-mantled Ground Squirrel	0-5
Tamias merriami	Merriam's chipmunk	0-5
Tamiasciurus douglasii	Douglas's Squirrel	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Sciurus griseus	Western Gray Squirrel	0-5
Sylvilagus audubonii	Desert Cottontail	0-5
Sylvilagus bachmani	Brush Rabbit	0-5
Thomomys bottae	Botta's Pocket Gopher	0-5
Mustela frenata	Long-tailed Weasel	0-5

E.40 D17 – RELOCATABLE – SOAP (Soaproot Saddle)

Trapping Issues

- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: TBD (initial sampling to use Peromyscus)

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Microtus spp., Neotoma spp., Peromyscus spp., Reithrodontomys sp.

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Roberts et al. 2015.

Table 57. Site-specific species list (SOAP)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus californicus	California pocket mouse	0-50
Microtus californicus	California Vole	0-20
Microtus longicaudus	Long-tailed Vole	0-20
Microtus montanus	Montane Vole	0-20
Onychomys torridus	Southern Grasshopper Mouse	0-50
Neotoma macrotis	Large-eared woodrat	0-50
Peromyscus boylii	Brush Deermouse	10-100
Peromyscus californicus	California Deermouse	0-50
Peromyscus maniculatus	North American Deermouse	400-1,000
Peromyscus truei	Pinon Deermouse	0-50
Reithrodontomys megalotis	Western Harvest Mouse	0-50
Zapus princeps	Western Jumping Mouse	0-50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Callospermophilus lateralis	Golden-mantled ground squirrel	0 - 50
Glaucomys sabrinus	Northern flying squirrel	0 - 50
Tamias quadrimaculatus	Long-eared chipmunk	50 - 200

Tamias speciosus	Lodgepole chipmunk	0 - 50
Otospermophilus beecheyi	California ground squirrel	0 - 50
Sorex lyelli	Mt. Lyell Shrew	0-20
Sorex ornatus	Ornate Shrew	0-20
Sorex palustris	American Water Shrew	0-20
Sorex trowbridgii	Trowbridge's Shrew	0-20
Sorex vagrans	Vagrant Shrew	0-20
Tamiasciurus douglasii	Douglas squirrel	0 - 50
NON-TARGET ANIMALS (Scientific and Common Name)		
Scapanus latimanus	Broad-footed Mole	0 - 50
Sciurus griseus	Western gray squirrel	0 - 50
Thomomys monticola	Montane pocket gopher	0 - 50

E.41 D17 – RELOCATABLE – TEAK (Teakettle Experimental Forest)

Trapping Issues

- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: TBD (initial sampling to use Peromyscus)

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Microtus spp., Neotoma spp., Peromyscus spp., Reithrodontomys sp.

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Roberts et al. 2015.

Table 58. Site-specific species list (TEAK)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Chaetodipus californicus	California pocket mouse	0-50
Microtus californicus	California Vole	0-20
Microtus longicaudus	Long-tailed Vole	0-20
Microtus montanus	Montane Vole	0-20
Onychomys torridus	Southern Grasshopper Mouse	0-50
Neotoma macrotis	Large-eared woodrat	0-50
Peromyscus boylii	Brush Deermouse	10-100
Peromyscus californicus	California Deermouse	0-50
Peromyscus maniculatus	North American Deermouse	400-1,000
Peromyscus truei	Pinon Deermouse	0-50
Reithrodontomys megalotis	Western Harvest Mouse	0-50
Zapus princeps	Western Jumping Mouse	0-50
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Callospermophilus lateralis	Golden-mantled ground squirrel	0 - 50
Glaucomys sabrinus	Northern flying squirrel	0 - 50
Tamias quadrimaculatus	Long-eared chipmunk	50 - 200

Tamias speciosus	Lodgepole chipmunk	0 - 50
Otospermophilus beecheyi	California ground squirrel	0 - 50
Sorex lyelli	Mt. Lyell Shrew	0-20
Sorex ornatus	Ornate Shrew	0-20
Sorex palustris	American Water Shrew	0-20
Sorex trowbridgii	Trowbridge's Shrew	0-20
Sorex vagrans	Vagrant Shrew	0-20
Tamiasciurus douglasii	Douglas squirrel	0 - 50
NON-TARGET ANIMALS (Scientific and Common Name)		
Scapanus latimanus	Broad-footed Mole	0 - 50
Sciurus griseus	Western gray squirrel	0 - 50
Thomomys monticola	Montane pocket gopher	0 - 50

E.42 D18 – CORE – TOOL (Toolik Lake)

Trapping Issues

- Summers are cool and humid with 24 hours of daylight from mid-May through early August. Trapping can be done continuously, but, due to logistical constraints, NEON will set traps by 2000h and check and close traps at 0600h during these times of year. During the spring and fall, trapping hours can be shifted earlier in the evening or later in the morning to reflect shifts in the timing of civil twilight.
- Caribou disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: TBD (initial sampling to use Microtus)

Dominant vegetation type(s) for bleed grid designation: Grassland/ Herbaceous

Priority species for pathogen testing: Microtus spp., Myodes rutilus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Batzli and Henttonen 1990.

Table 59. Site-specific species list (TOOL)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Dicrostonyx groenlandicus	Nearctic Collared Lemming	0-5
Lemmus trimucronatus	Nearctic Brown Lemming	0-5
Microtus miurus	Singing Vole	50-200
Microtus oeconomus	Tundra Vole	50-200
Microtus pennsylvanicus	Meadow Vole	0-20
Microtus xanthognathus	Taiga Vole	0-50
Myodes rutilus	Northern Red-backed Vole	0-50
Synaptomys borealis	Northern Bog Lemming	0-5
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Sorex cinereus	Cinereus Shrew	0-50
Sorex hoyi	Pygmy Shrew	0-5
Sorex monticolus	Dusky Shrew	0-50

Sorex tundrensis	Tundra Shrew	0-5
Sorex ugyunak	Barren Ground Shrew	0-5
Sorex yukonicus	Tiny Shrew	0-5
Spermophilus parryii	Arctic Ground Squirrel	0-20
Tamiasciurus hudsonicus	Red Squirrel	0-20
Sorex ugyunak	Barren Ground Shrew	0-5
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Short-tailed weasel	0-5
Mustela nivalis	Least Weasel	0-5

E.43 D18 – RELOCATABLE – BARR (Barrow Environmental Observatory)

Trapping Issues

- Summers are cool and humid with 24 hours of daylight from mid-May through early August. Trapping can be done continuously, but, due to logistical constraints, NEON will set traps by 2000h and check and close traps at 0600h during these times of year. During the spring and fall, trapping hours can be shifted earlier in the evening or later in the morning to reflect shifts in the timing of civil twilight.
- Large mammal disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: TBD (initial sampling to use Microtus)

Dominant vegetation type(s) for bleed grid designation: Grassland/ Herbaceous

Priority species for pathogen testing: Microtus oeconomus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported by Batzli and Henttonen 1990.

Table 60. Site-specific species list (BARR)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Dicrostonyx groenlandicus	Nearctic Collared Lemming	0-5
Lemmus trimucronatus	Nearctic Brown Lemming	0-5
Microtus oeconomus	Tundra Vole	10-100
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Sorex tundrensis	Tundra Shrew	0-5
Sorex ugyunak	Barren Ground Shrew	0-5
Spermophilus parryii	Arctic Ground Squirrel	0-20
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Short-tailed weasel	0-5
Mustela nivalis	Least Weasel	0-5
Neovison vison	American Mink	0-5

E.44 D19 – CORE – BONA (Caribou Creek - Poker Flats Watershed)

Trapping Issues

- Summers are cool and humid with 24 hours of daylight from mid-May through early August. Trapping can be done continuously, but, due to logistical constraints, NEON will set traps by 2000h and check and close traps at 0600h during these times of year. During the spring and fall, trapping hours can be shifted earlier in the evening or later in the morning to reflect shifts in the timing of civil twilight.
- Large mammal disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- **Shrews are particularly abundant**; mealworms should be added to the bait. Shrew mortality may become prohibitively high at certain sites.

Use of bedding: Recommended under all conditions

Dominant genus for hair & whisker sampling purposes: TBD (initial Sampling should use Myodes)

Dominant vegetation type(s) for bleed grid designation: Deciduous Forest

Priority species for pathogen testing: Microtus spp.

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011 and Cook et al. 2002. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported for Denali National Park by Rexstad and Debevec n.d, and updated with NEON data from Healy in 2015 and 2016.

Table 61. Site-specific species list (BONA)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Lemmus trimucronatus	Nearctic Brown Lemming	0-5
Microtus miurus	Singing Vole	0-50
Microtus oeconomus	Root Vole	0-50
Microtus pennsylvanicus	Meadow Vole	0-20
Microtus xanthognathus	Taiga Vole	0-20
Myodes rutilus	Northern Red-backed Vole	20-200
Synaptomys borealis	Northern Bog Lemming	0-5
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		

Sorex cinereus	Cinereus Shrew	0-50
Sorex hoyi	American Pygmy Shrew	0-20
Sorex monticolus	Dusky Shrew	0-50
Sorex palustris	American Water Shrew	0-50
Sorex tundrensis	Tundra Shrew	0-50
Sorex yukonicus	Tiny shrew	0-50
Glaucomys sabrinus	Northern Flying Squirrel	0-20
Spermophilus parryii	Arctic Ground Squirrel	0-50
Tamiasciurus hudsonicus	Red Squirrel	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Short-tailed weasel	0-5
Mustela nivalis	Least Weasel	0-5

E.45 D19 – RELOCATABLE – HEAL (Healy)

Trapping Issues

- Summers are cool and humid with 24 hours of daylight from mid-May through early August. Trapping can be done continuously, but, due to logistical constraints, NEON will set traps by 2000h and check and close traps at 0600h during these times of year. During the spring and fall, trapping hours can be shifted earlier in the evening or later in the morning to reflect shifts in the timing of civil twilight.
- Large mammal disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).
- **Shrews are particularly abundant**; mealworms should be added to the bait. Shrew mortality may become prohibitively high at certain sites.

Use of bedding: Recommended under all conditions

Dominant genus for hair & whisker sampling purposes: Myodes

Dominant vegetation type(s) for bleed grid designation: Shrub scrub

Priority species for pathogen testing: Microtus spp., Myodes rutilus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011 and Cook et al. 2002. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported for Denali National Park by Rexstad and Debevec n.d, and updated with NEON data from 2015 and 2016.

Table 62. Site-specific species list (HEAL)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Lemmus trimucronatus	Nearctic Brown Lemming	0-5
Microtus miurus	Singing Vole	0-50
Microtus oeconomus	Root Vole	0-50
Microtus pennsylvanicus	Meadow Vole	0-20
Microtus xanthognathus	Taiga Vole	0-20
Myodes rutilus	Northern Red-backed Vole	20-200
Synaptomys borealis	Northern Bog Lemming	0-5
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Sorex cinereus	Cinereus Shrew	0-50
Sorex hoyi	American Pygmy Shrew	0-20

Sorex monticolus	Dusky Shrew	0-50
Sorex palustris	American Water Shrew	0-50
Sorex tundrensis	Tundra Shrew	0-50
Sorex yukonicus	Tiny shrew	0-50
Glaucomys sabrinus	Northern Flying Squirrel	0-20
Spermophilus parryii	Arctic Ground Squirrel	0-50
Tamiasciurus hudsonicus	Red Squirrel	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Short-tailed weasel	0-5
Mustela nivalis	Least Weasel	0-5

E.46 D19 – RELOCATABLE – DEJU (Delta Junction)

Trapping Issues

- Summers are cool and humid with 24 hours of daylight from mid-May through early August. Trapping can be done continuously, but, due to logistical constraints, NEON will set traps by 2000h and check and close traps at 0600h during these times of year. During the spring and fall, trapping hours can be shifted earlier in the evening or later in the morning to reflect shifts in the timing of civil twilight.
- Large mammal disturbance
- **Do not trap** when very cold temperatures (< 5.5°C (42°F)) are coupled with precipitation, or when there is sufficient snow on the ground (i.e., > 15 cm (6 inches)).

Use of bedding: Recommended under all conditions

Dominant genus for hair & whisker sampling purposes: Myodes

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Microtus spp., Myodes rutilus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011 and Cook et al. 2002. The abundance estimates were based on an average capture rate of 10%, as well as the species-specific relative abundances reported for Denali National Park by Rexstad and Debevec (n.d.).

Table 63. Site-specific species list (DEJU)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Lemmus trimucronatus	Nearctic Brown Lemming	0-5
Microtus miurus	Singing Vole	0-100
Microtus oeconomus	Root Vole	0-50
Microtus pennsylvanicus	Meadow Vole	0-20
Microtus xanthognathus	Taiga Vole	0-20
Myodes rutilus	Northern Red-backed Vole	0-200
Synaptomys borealis	Northern Bog Lemming	0-5
Zapus hudsonius	Meadow Jumping Mouse	0-20
OPPORTUNISTIC ANIMALS (Scientific and Common Name)		
Sorex cinereus	Cinereus Shrew	50-200
Sorex hoyi	American Pygmy Shrew	0-20
Sorex monticolus	Dusky Shrew	0-50
Sorex palustris	American Water Shrew	0-50

Sorex tundrensis	Tundra Shrew	0-50
Sorex yukonicus	Tiny shrew	0-50
Glaucomys sabrinus	Northern Flying Squirrel	0-20
Spermophilus parryii	Arctic Ground Squirrel	0-50
Tamiasciurus hudsonicus	Red Squirrel	0-50
NON-TARGET ANIMALS (Scientific and Common Name)		
Mustela erminea	Short-tailed weasel	0-5
Mustela nivalis	Least Weasel	0-5

E.47 D20 – CORE – PUUM (Pu'u Maka'ala Natural Area Reserve)

Trapping Issues

- The small mammal community in Hawaii is dominated by invasive rats (*Rattus spp.*). Please note that these species can be quite aggressive; use of anesthesia is recommended.

Use of bedding: Recommended only when low temperatures are expected to be <18°C/65°F

Dominant genus for hair & whisker sampling purposes: Rattus

Dominant vegetation type(s) for bleed grid designation: Evergreen Forest

Priority species for pathogen testing: Rattus norvegicus, Rattus rattus

Species List and Abundance Estimates

This species list is based on Kays and Wilson 2011.

Table 64. Site-specific species list (PUUM)

TARGET SPECIES (Scientific and Common Name)		Number to be Used Annually
Mus musculus	House mouse	0-50
Rattus norvegicus	Norway rat	0-50
Rattus rattus	Black rat	100-200
Rattus exulans	Roof rat	0-50