

**UNIVERSITY OF CENTRAL OKLAHOMA**

**NATURAL HISTORY MUSEUM**

**(UCONHM)**



**DEPARTMENT OF**  
**Biology**  
**UNIVERSITY OF**  
**CENTRAL OKLAHOMA**

**MAMMAL SPECIMEN PRESERVATION & PREPARATION POLICIES & GUIDELINES**

**Revised Jan 2010**

**William Caire & Lynda Loucks**

## TABLE OF CONTENTS

<b>I. INTRODUCTION.....</b>	<b>5</b>
A. Purpose of Manual .....	5
B. Official Acronym of the UCONHM Mammal Collection .....	5
<b>II. SCOPE AND TYPES OF SPECIMENS IN THE MAMMAL SECTION.....</b>	<b>5</b>
A. Teaching Collection .....	6
B. Research Collection .....	6
<b>III. PERSONNEL OF THE MAMMAL SECTION OF THE UCONHM .....</b>	<b>6</b>
A. Curators .....	6
B. Collection Manager.....	6
C. Nonprofessional Staff.....	6
<b>IV. CODE OF ETHICS OF THE MAMMAL SECTION OF THE UCONHM .....</b>	<b>6</b>
A. Ethical Guidelines .....	6
<b>V. ACCESS TO THE MAMMAL SECTION OF THE UCONHM.....</b>	<b>7</b>
A. Request to Visit the UCONHM Mammal Collection .....	7
B. Denial of Access.....	7
C. Tours.....	7
D. Use of Mammal Teaching Materials.....	7
<b>VI. GUIDELINES FOR USE OF THE COLLECTION AT UCO.....</b>	<b>7</b>
<b>VII. ORGANIZATION OF COLLECTION.....</b>	<b>8</b>
A. Arrangement of Cases .....	8
B. Arrangement of Specimens in Drawers .....	8
C. Arrangement of Fluid Specimens .....	8
<b>VIII. DEPOSITION AND ACCESSIONING OF MAMMAL SPECIMENS AND ASSOCIATED MATERIALS INTO THE UCONHM MAMMAL COLLECTION.....</b>	<b>8</b>
A. Delivery of Materials to the UCONHM Mammal Museum .....	8
B. Criteria for Material to Be Cataloged/accesioned Into the UCONHM Mammal Collection .....	8
C. Ownership of Mammal Specimens and Associated Materials .....	9
D. Cataloging/Accessioning of Mammalian Material into the UCONHM .....	9
1. Official Catalogue .....	9
2. Assigning Specimen Numbers .....	9
3. Entering Specimen Data into the Catalog.....	9
4. Original Field Notes and Data Associated With Mammal Specimens .....	10
<b>IX. DISPOSAL/DEACCESSIONING OF MAMMAL SPECIMENS AND ASSOCIATED MATERIALS .....</b>	<b>10</b>
A. Reasons for Disposal or Deaccessioning Mammal Materials .....	10
B. Acceptable Processes for Disposal/deaccessioning of Specimens and Associated Materials.....	11
1. Trades or Exchanges.....	11
2. Transfers.....	11
3. Institutional Sharing.....	11
4. Discarding Mammal Specimens and Associated Materials.....	11
5. Sales.....	11
C. Record Keeping.....	11
D Catalog Numbers of Deaccessioned Specimens.....	11
<b>X. APPRAISAL OF MAMMAL DONATIONS .....</b>	<b>12</b>
<b>XI. LOANS.....</b>	<b>12</b>
A. Loan Conditions.....	12
B. Borrowing Mammal Specimens and Associated Materials .....	13

C. Incoming Loans to the Mammal Section .....	13
D. Mammal Tissue Loans – Including Invasive or Destructive Sampling.....	13
1. Guidelines Governing Invasive or Destructive Sampling .....	14
2. Written Request for Invasive or Destructive Sampling .....	14
3. Additional Requirements of Tissue Sample Loans.....	15
E. Casting of Mammal Specimens or Associated Materials.....	15
F. Loan of Documents in the Mammal Section of the UCONHM.....	15
1. Guidelines Governing the Loan of Documents .....	15
2. Written Request for Loan of Documents .....	15
G. Packaging of Loan Specimens to be Mailed .....	16
1. Mammal Specimen Skins.....	16
2. Skull and Skeletal Specimens .....	16
3. Fluid Preserved Specimens.....	17
4. Tissue Samples.....	17
H. Documentation of loans.....	17
I. Curation of Loan Material Returning to the UCONHM.....	18
XII. COMPUTER DATABASE OF THE MAMMAL SECTION OF THE UCONHM .....	18
XIII. INTEGRATED PEST MANAGEMENT AND PREVENTATIVE CONSERVATION OF MAMMAL SPECIMENS IN THE UCONHM.....	19
A. Pest management in the mammal section of the UCONHM.....	19
XIV. EMERGENCY MANAGEMENT OF THE MAMMAL SECTION OF THE UCONHM.....	20
XV. HEALTH AND SAFETY CONCERNS IN MAMMAL SECTION OF THE UCONHM .....	20
A. Authority and Responsibilities.....	20
B. Safety Inspections of the Mammal Section of the UCONHM.....	20
C. Hazard Elimination or Control in the Mammal Museum Areas.....	21
D. Safety Training.....	21
E. Hazardous Waste Disposal in the Mammal Section of the UCONHM.....	21
1. Authority and Responsibilities.....	21
2. Storage of Hazardous Materials.....	21
3. Material Safety Data Sheets (MSDS).....	21
4. Chemical Inventory List.....	22
5. Container Labeling.....	22
6. Training.....	22
7. Disposal of Hazardous Chemicals.....	22
F. Disposal of Biohazardous Wastes.....	22
XVI. GUIDELINES FOR THE PREPARATION OF MAMMAL SPECIEMENS FOR THE UCONHM.....	22
A. Permits .....	22
B. Approved Methods of Collecting and Euthanizing mammals.....	22
C. Unprepared Mammal Material.....	22
D. Storing Mammal Specimens in the Field.....	23
E. Data to be Recording in the Field with Each Specimen.....	23
1. Field Data .....	23
a. Collector’s Catalog.....	23
b. Collector’s Journal.....	24
c. Collector’s Species Accounts.....	24
2 Data to be Recorded from and Preserved with Each Specimen .....	24
a. How to Record External Measurements and Weight.....	24
3. Specimen Tags for Dry, Fluid and Skeletal Specimens.....	25
a. Skin Tag .....	25
b. Skull Tag for Any Skull Separated from the Skin .....	25

c. Skelton Tags .....	25
<b>F. Voucher Specimens .....</b>	<b>25</b>
1. Plaster Cast of Tracks.....	26
2. Photographs .....	26
3. Wet or Fluid Specimens .....	26
a. Museum Fluid Preparation Method .....	26
b. Field Containers for Fluid Storage of Mammal Specimens .....	27
c. Cataloging and Storing Fluid Mammal Specimens.....	28
4. Hair Samples .....	28
a. Hair Collecting from an Individual Mammal .....	28
b. Hair Taken at Collection (Snare or Rub) Stations .....	29
5. Tissue Samples.....	29
a. TK Data Sheet .....	29
b. Information Entered on TK Sheet.....	30
c. How to Fill and Label Cryotubes .....	31
d. How to Preserve Tissue Samples in Ethanol for DNA Analysis.....	32
6. Traditional Museum Skin and Skull Specimens.....	33
a. Preparing a Traditional Mammal Study Skin.....	33
7. Mammal Skeletal Material .....	40
a. Skull Extraction From/Before Making a Fluid Specimen .....	40
b. Manual Cleaning of Skulls After Extraction From a Fluid Preserved Specimen.....	41
c. Cleaning Skull and Skeletal Material With Dermestid Beetles.....	41
(1) Drying & Preparation Mammal Skulls & Skeletons for Dermestid Cleaning.....	41
(a) Small Mammals (Bats, Mice, Squirrels).....	42
(b) Medium/Large Mammals (Rabbits, Coyotes, Deer).....	42
(2) After Drying the Specimen.....	42
(a) Skulls.....	42
(b) Small Full Skeleton (e.g. Shrews, Bats, Mice).....	42
• 1 <sup>st</sup> Method.....	42
• 2 <sup>nd</sup> Method .....	42
(c) Large Full Skeleton (badgers, deer).....	43
(3) Into the Dermestid Colony .....	43
(4) After Removal from the Beetle Colony .....	43
(5) Mammal Skull & Skeleton Labeling and Storage.....	43
8. Preparing a Baculum .....	43
a. Equipment for Baculum Preparation and Storage.....	44
b. Steps in Baculum Preparation and Storage.....	44
<b>XVII. EXPENSES ASSOCIATED WITH CURATING THE MAMMAL SECTION OF THE     UCONHM.....</b>	<b>44</b>
<b>XVIII. SUPPLIERS OF MAMMAL CURATORIAL EQUIPMENT IN THE UNITED     STATES.....</b>	<b>45</b>
<b>XIX. LITERATURE CITED .....</b>	<b>46</b>
<b>XX: COPIES OF FORMS.....</b>	<b>47</b>
<b>A. Mammal Loan Form .....</b>	<b>47</b>
<b>B. Mammal TK Form .....</b>	<b>48</b>

**I. INTRODUCTION** Much of what is contained below in the University of Central Oklahoma Natural History Museum (UCONHM) Standard Operating Procedures and Specimen Preparation Guidelines have been paraphrased from several other excellent Collection Management Policy Manuals. One of these is the Manual of the Museum of Southwestern Biology, Division of Mammals located at the University of New Mexico in Albuquerque, New Mexico. Those involved with the preparation of the MSB guidelines were Joseph A. Cook, Curator of Mammals, Michael A. Bogan, USGS Curator Emeritus, Jonathan L. Dunnun, Senior Collection Manager (MSB) and Cindy A. Ramotnik, Senior Collection Manager (USGS). Their manual is at <http://www.msb.unm.edu/mammals/PolicyDOM.pdf>. Another good source used was the animal sections of the Standards for Components of British Columbia's Biodiversity No. 4 which was prepared for the Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee of British Columbia. It can be located at (<https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/voucher.pdf>). A third manual was the voucher Specimen Preparation: Methods for Bats prepared by Dr Paul Bates (Harrison Institute), Mr Vu Dinh Thong (IEBR, Hanoi, Vietnam) and Dr Sara Bumrungsri (Prince of Songkla University, Thailand). This can be accessed at ([Microsoft Word - 14-011 AR 1 Annex 3-2 Voucher specimen preparation - bats.doc \(nationalarchives.gov.uk\)](https://www.nationalarchives.gov.uk/microsoft-word-14-011-ar-1-annex-3-2-voucher-specimen-preparation-bats.doc)). A fourth good source was the University of Kansas Natural History Museum Division of Mammals policy mammal. It is located at <http://www.nhm.ku.edu/mammals/collmgmt.html>. Finally, the American Society of Mammalogist publication on collections (Hafner et al. 1997) and data (McLaren et al. 1996) management were consulted. These can be accessed at [https://www.mammalsociety.org/uploads/committee\\_files/collsurvey.pdf](https://www.mammalsociety.org/uploads/committee_files/collsurvey.pdf) and [https://www.mammalsociety.org/uploads/committee\\_files/docstandards.pdf](https://www.mammalsociety.org/uploads/committee_files/docstandards.pdf)

**A. Purpose of Manual** The UCONHM mammal section policy manual outlines the policies and guidelines for the acquisition of specimens, curating, maintenance, loaning, deaccessioning, preparation, and use by the research, teaching, and public communities of materials in the mammal collection. It sets forth guidelines for the use of the collections and outlines the ethical and legal responsibilities of the museum personnel with respect to the collection. The mammal section of the UCONHM recognizes its role as part of the University of Central Oklahoma (UCO) and will maintain a policy that reflects current University and State of Oklahoma codes as they pertain to mammal collections. The guidelines and policies in this document will adhere as closely as possible to those listed for the Natural Science Collections Alliance, International Council of Museums, American Association of Museums, and the American Society of Mammalogists. This UCONHM policy manual applies to all Curators, Collection Manager, staff, students, researchers, visiting researchers, volunteers, and the public. It is expected that all mammal section personnel will read and follow the policies and guidelines. The policy manual will be updated as needed and will be approved by the Mammal Curators, the Collection Manager, the Chairperson of the Biology Department and the Dean of the College of Mathematics and Science.

**B. Official Acronym of the UCONHM Mammal Collection.** The mammal section of the UCONHM officially recognized acronym by the American Society of Mammalogists (1997) is UCOCV which stands for University of Central Oklahoma, Collection of Vertebrates.

**II. SCOPE AND TYPES OF SPECIMENS IN THE MAMMAL SECTION** The mammal section of the UCONHM contains mammal specimens and associated materials from original research in Oklahoma by professors and students at UCO, from donations and from transfer of specimens from other museums. The mammal section serves the scientific community and the public through its research, teaching, and access to holdings and associated records. It is also charged with proper maintenance of the specimens for long-term conservation and preservation of scientific data. Approximately 5,000 accessioned mammal specimens are in the UCONHM. The collection contains primarily specimens from Oklahoma with fewer specimens from elsewhere including Mexico. It is primarily a research collection and a

historical documentation of mammals from the time period when they were collected. The specimens and associated materials may be made available for use by the scientific community, for use in exhibits and for teaching. The mammal section of the UCONHM is moving toward maintaining two types of collections (teaching and research) that are managed and conserved. These two collections will ultimately be curated as separate entities but both will be managed according to professional museum standards. They include skins, skeletons, tanned hides, frozen tissues, taxidermy mounts, tracks, owl pellets and fluid-preserved specimens.

**A. Teaching Collection** The teaching collection will contain representative specimens that can be used in classrooms and for public demonstrations. These specimens might not have full documentation associated with them. These specimens will be tagged with the acronym TC (teaching collection) and can be accessioned as part of the main mammal museum section.

**B. Research Collection** The research collections contain mammal specimens, objects and associated materials that are in good condition, unique, and well-documented. This collection will be managed and conserved in a manner that will insure its preservation as historic data and for use by researchers.

### III. PERSONNEL OF THE MAMMAL SECTION OF THE UCONHM

**A. Curators:** The mammal section of the UCONHM is under the direction of professional curators who are faculty members in the Biology Department of UCO. Currently Dr. Michelle Haynie and Dr. Greg Wilson curate the mammal frozen tissue collection and Dr. William Caire oversees the traditional mammal skin, skull, skeleton, track, fluid, and associated materials section of the collection. They are responsible for the collection of specimens, the mammal division policies, specimen preparation guidelines, the conservation practices and assisting the Collection Manager (currently Ms. Lynda Loucks) in securing of funds and developing the annual budget for museum operations.

**B. Collection Manager:** The Collection Manager (currently Ms. Lynda Loucks) works closely with the curators and supervises student workers in the management and maintenance of the mammal collection, loan activities, access to specimens and databases. The Collection Manager attends meetings and workshops, as needed, to remain current on mammal curation practices.

**C. Nonprofessional Staff:** The nonprofessional curatorial staff consists of graduate and undergraduate students, high school interns, and volunteers. They receive training directly from the Collection Manager or from the Curators.

**IV. CODE OF ETHICS OF THE MAMMAL SECTION OF THE UCONHM** It is expected that the mammal Curators, the Collection Manager, staff and volunteers perform all duties associated with the mammal collection in an ethical manner according to the policies and standards established by the UCONHM, the university administration and the mammal scientific community. The mammal section personnel will make every effort to abide by the procedures outlined by the International Council of Museums, Natural Science Collections Alliance, American Association of Museums, and the American Society of Mammalogists. However, any new or traditional curatorial practices and materials listed by any other organization external to UCONHM will be evaluated before they are implemented in the mammal collection.

**A. Ethical Guidelines** All individuals associated with the mammal collection will:

- maintain the integrity of all mammal specimens because they are irreplaceable
- avoid actions that are in conflict with responsibilities or cause personnel to favor other interests over those of the mammal section of the UCONHM
- have as prime responsibilities the conservation of mammal specimens and associated materials in the public trust and to make specimens available for research, teaching and exhibits
- act ethically and legally in the acquisition and the disposing of mammal materials.

- not condone the illegal, unethical, and destructive activities with respect to the mammal collection.
- use the most acceptable preservation, conservation and management methods
- accept mammal specimens and associated data which improve the scientific and educational value of the collection and preserve important scientific data.
- use prudent judgment about the dissemination of information that may jeopardize sensitive or protected species, or unpublished research
- will deny access to users that fail to follow the policies outlined in this manual or if they misrepresent their research and the UCONHM mammal collections.
- clearly identify and mark (or make inaccessible) those specimens that might be unsafe for students, workers, volunteers and researchers because they are hazardous, or have become so through preparation or fumigation,
- adhere to the University of Central Oklahoma's guidelines pertaining to equal opportunity employment practices of staff.

**V. ACCESS TO THE MAMMAL SECTION OF THE UCONHM** Access to use the mammal collection for research, educational or other purposes will be through the approval of the mammal section Curators and/or the Collection Manager. Businesses, organizations and individuals desiring to use the mammal collections for commercial purposes or profit will be granted permission and access at the discretion of the mammal section Curators. For profit entities might be charged a fee or a percentage of the profits which will be deposited into a mammal section discretionary fund account with the university.

**A. Request to visit the UCONHM Mammal Collection** All requests should be made in writing or via e-mail to the Curators or the Collection Manager (currently: [wcaire@uco.edu](mailto:wcaire@uco.edu), [mhaynie@uco.edu](mailto:mhaynie@uco.edu), and [lloucks@uco.edu](mailto:lloucks@uco.edu).) Visitor access is preferred from Monday through Friday, between 8:00 and 17:00.

**B. Denial of Access.** The mammal Curators and the Collection Manager have the right to deny access to individuals or representatives of organizations or businesses that plan to use or who are found using the mammal collection in a manner which does not conform to the mammal collection policies of the UCONHM.

Denial reasons might include these and other reasons:

- excessive costs to the UCONHM in terms of staff involvement
- compromised security of the collections and facilities
- unauthorized destructive sampling of specimens
- a history of misuse of mammal specimens at the UCONHM or at other museums
- falsification of credentials, criminal activity, or disruptive conduct.

**C. Tours.** Tours of the mammal collection for the public or educational groups may be provided by the Curators, Collection Manager or appropriate staff. If possible, please contact them at least 1-2 weeks in advance.

**D. Use of Mammal Teaching Materials.** Use of the mammal teaching collection will be with the approval of the mammal Curators or the Collection Manager.

**VI. GUIDELINES FOR USE OF THE COLLECTION AT UCO** Consult with the Collection Manager or Curators about the following procedures before proceeding into the collection and accessing any materials:

- sign the guest register
- first time users of the mammal collection and associated materials should receive instructions on the organization and handling of specimens
- open cases carefully and slide all drawers slowly so not as to disturb arrangement of specimens
- handle the specimens as little as possible, make sure hands are clean and use gloves when possible

- do not pick up specimens by the skin or tags or by the tail, feet, ears, or hair -handle each one carefully so as to not break off any extremities.
- after the use of a specimen, make sure that it is returned to the exact place in the drawer and case from which it came and close the case doors
- do not leave specimens out overnight
- keep all specimens out of sunlight
- when examining skeletal materials of more than one specimen, open only one specimen box or container at a time to avoid confusing bones
- do not add any remarks to the tags or alter them in any fashion
- if errors are noted, please notify the Collection Manager or Curators
- insure your safety by washing hands after handling specimens
- familiarize yourself with all safety policies before commencing your study.

**VII. ORGANIZATION OF COLLECTION** The mammal skins and skeletal materials are located in room 165 of the Science Lab of the University of Central Oklahoma. Fluid specimens are currently stored in room 156. The Frozen tissue collection is in room 252.

**A. Arrangement of Cases** The general arrangement and sequence of the specimen cases in the mammal collection follows the order, family and genus arrangement as listed in Wilson and Reeder (2005). In some situations because of the size of the specimens, a case might be located out of sequence.

**B. Arrangement of Specimens in Drawers** In general skins are arranged in archival wrapped cardboard paperboard trays parallel to the longitudinal axis of the drawer from left to right front to rear. All specimens within a species are arranged in numerical sequence by catalog accession number. Skulls are in numerical sequence and located either in trays or in boxes close to the matching skins. Skull only or skeletal only materials are arranged in numerical sequence.

**C. Arrangement of Fluid Specimens** The general arrangement and sequence of the specimen cases containing the fluid mammal collection follows the order, family and genus arrangement as listed in Wilson and Reeder (2005). Jars of specimens are arranged in phylogenetic order but in some situations because of the size of the specimen container, a jar might be located out of sequence.

**VIII. DEPOSITION AND ACCESSIONING OF MAMMAL SPECIMENS AND ASSOCIATED MATERIALS INTO THE UCONHM MAMMAL COLLECTION** The mammal section of the UCONHM acquires mammal specimens and associated materials from research projects conducted by faculty and students at UCO, other researchers, donations, transfer of specimens from other collections, exchanges, and other field activities. All decisions on what will be accessioned into the mammal collection are made by Collection Manager and the Curators.

**A. Delivery of Materials to the UCONHM Mammal Museum** The mammal Curator and Collection Manager should be notified in advance when to expect a collection of mammals and associated materials. They should be informed about the quantity of material, format (fresh specimen, frozen, skins, skeletal, whole animal, fluid specimen, tissue samples, etc.) so that staff will be available to process the incoming specimens. A copy of permits, reports and field notes associated with the mammal specimens should be provided when the mammal specimens are delivered to the museum.

**B. Criteria for Material To Be Cataloged/Accessioned Into The UCONHM Mammal Collection** All mammal material to be officially accepted, deposited and cataloged into the UCONHM mammal collections must meet these standards:

- the mammal specimens and associated materials are within the scope of the mammal section of the UCONHM and are consistent with all policies and guidelines



- the mammal specimens and associated materials are collected or acquired ethically and legally according to any laws and regulations of the international, federal, and state agencies (Oklahoma Department of Wildlife Conservation) which protect mammals. Copies of documentation such as collecting permits, import, and export documents, animal use committees, etc., should be retained (as needed) in the mammal section of the UCONHM accession files.
- prepared, labeled and contained properly
- the mammal section of the UCONHM can properly provide for the storage, protection, and conservation of the mammal specimens and associated materials according to professional standards.
- the required reports for mammal gift acquisitions to the University of Central Oklahoma follow the university requirements. Some gifts to the UCONHM might require University or Board of Regents approval.
- the mammal specimens and associated materials are free and clear in title of ownership, with no preconditions or terms that limit the mammal section of the UCONHM in its preservation or retention of the specimens or associated data.
- all mammal specimens and associated material acquired can be given a UCONHM mammal section accession number, properly archived and then made accessible
- library type materials that are considered rare or valuable and associated with mammals

**C. Ownership of Mammal Specimens and Associated Materials** All mammal materials deposited into the mammal section of the UCONHM and curated at the expense of the University become the property of the University Central Oklahoma and State of Oklahoma.

**D. Cataloging/Accessioning of Mammalian Material into the UCONHM**

**1. Official Catalog** Each specimen and associated materials in the mammal collection of the UCONHM will be catalogued into the official mammal section catalog (a hard copy ledger) of the UCONHM. This catalog will be kept in a fireproof safe in room 165 of the Science Lab Building. Access to, use of and adding data to the catalog will only be by permission of the Collection Manager or the Curators. The entries into the catalog are hand written. Specimen data from the official catalog is also entered into a computer database (SPECIFY) which is located on the UCO mainframe computer in the Information and Technology Center and is accessible (see section of this manual related to the Computer Database).

**2. Assigning Specimen Numbers** Each mammal specimen will have its own unique accession number and entry information in the catalog.

The unique accession numbers:

- ensure that the mammal specimen and its associated information can be accessed on the collection's database
- ensure that different parts of the original mammal specimen (e.g., skull, body, baculum, notes.) can be efficiently and reliably linked and preserved together
- ensure that UCONHM mammal specimens and their associated materials can be described or referenced in publications
- ensure that the mammal specimens can be located and used by researchers, staff, etc.

**3. Entering Specimen Data into the Catalog**

- Data on the specimen skin and skull tags or other associated materials should be checked carefully for spelling errors and lack of information prior to being entered into the accession catalog.
- Write the specimen data into the hard copy accession catalog of the mammal section of the UCONHM by hand in a clear and legible fashion in either archival permanent ink or pencil.

- Each specimen is assigned the next available sequential number in the catalog. This will result in the specimen or associated materials having a unique, permanent, catalog number. All items (skin, skull, skeleton, baculum, tissue, etc.) will be assigned the same number and those components present will be recorded in the proper column of the catalog.
- Each entry line in the main catalog should contain the following information:
  - collector's full name
  - collector's field number
  - collection date
  - species name
  - sex and any reproductive information included on the field tag
  - locality in full
  - geographical coordinates if available
  - external measurements and weight
  - any additional comments included by the collector on the field tag
  - whether the specimen is a skin and skull, skull only, fluid specimen or if there is a partial skeleton,
  - any tissues preserved and the tissue identification number (TK#)
- When cataloging a large accession, all specimens of a taxon from a common locality should be entered into the main catalog as close together as possible.
- Data from the main mammal catalog will be input into the computer database SPECIFY as soon as possible.
- Errors produced during the cataloging or data entry process can easily lead to erroneous information being published in the literature. Attention to detail is paramount.

**4. Original Field Notes and Data Associated with Mammal Specimens** All original field catalogs of collectors (if available) should be deposited permanently in the fireproof safe in room 165 in the Science Lab Building. Documents are a part of what is considered to be "other associated materials." They can include any information recorded using any of a variety of media such as paper, photographic, electronic, X-ray, MRI, CTs, sound recordings, video, etc., related to the research, identification, condition, and/or history of a mammal specimen. This also includes information that reflects processes and transactions related to the mammal specimen, e.g., accessioning, cataloging, loans, sampling, analysis, and treatment. Maintenance of documentation in the mammal section of the UCONHM follows recommendations by professional societies such as the Society of American Archivists (Deiss 1984; Ritzenthaler 1983) and American Institute for Conservation of Historic and Artistic Works (Kushel 1980).

## **IX. DISPOSAL/DEACCESSIONING OF MAMMAL SPECIMENS AND ASSOCIATED**

**MATERIALS** Mammal specimens and associated materials are disposed of or deaccessioned only for sound scientific and curatorial reasons. The disposal must follow written guidelines, and each deaccessioned item must be thoroughly documented in writing. All disposals will be done in an ethical manner, and any compensation received will be used only for the mammal section of the UCONHM. The mammal Curators assume final responsibility for disposal/deaccessions of any specimens or associated materials.

**A. Reasons For Disposal Or Deaccessioning Mammal Materials** Mammal specimens and associated items may after careful consideration and discussion of the mammal Curators and the Collection Manager be disposed of or deaccessioned because of the following reasons:

- the specimens or items no longer fit the mammal section of the UCONHM's scope or have deteriorated beyond use or restoration.

- the material is excessively duplicated in the collection and/or cannot be properly curated
- the specimen or items represent a serious health or safety hazard
- it is part of a justified and appropriate trade, exchange or transfer to another museum which will provide proper conservation standards to maintain the specimens or items

## **B. Acceptable Processes For Disposal/deaccessioning of Specimens and Associated Materials:**

**1. Trades or Exchanges** These are written agreements between the mammal section of the UCONHM and other entities such as a museum to trade or exchange mammal specimens and/or associated materials and to mutually relinquish their respective curatorship over those items. No exchanges are made with individuals but between the institutions involved. The trade or exchange will be approved by the mammal Curators and Collection Manager of the UCONHM and the university.

**2. Transfers** These are arranged written agreements between the mammal section of the UCONHM and another museum or institution that the mammal section of the UCONHM will transfer ownership of selected mammal specimens and/or associated materials that no longer serve a purpose to the mammal section of the UCONHM (or require more accessibility to the wider scientific community or the specimens or materials can not be curated in the proper manner). Mammal specimens and/or associated materials will only be transferred to institutions which have and can insure that the basic standards of curation will be provided. The transfers will be approved by the mammal Curators and Collection Manager of the UCONHM and they must be approved by the University.

**3. Institutional Sharing** This arrangement is made by the mammal section of the UCONHM in order to share an important series of mammal specimens or associated information with another institution in order to increase accessibility of those materials (e.g. dividing a series of unique mammals among several institutions). The sharing agreement will be approved by the mammal Curators and Collection Manager of the UCONHM and the University.

**4. Discarding mammal specimens and associated materials** Natural disasters, museum pests, and consumptive or destructive sampling might lead to the destruction of cataloged mammal specimens or associated materials. The mammal Curators after consultation with the Collection Manager may decide which mammal specimens no longer have scientific, teaching or public value. However, any original documentation associated with the discarded specimens or materials will always be retained by the mammal section of the UCONHM. Type series (holotypes, topotype, etc.) and rare or unusual materials will never be discarded, regardless of condition. Any documents which are no longer relevant to the mammal section of the UCONHM will be transferred to the University of Central Oklahoma Library archives after approval by the mammal Curators and the Collection Manager.

**5. Sales** Any sale of gift items or other material with no scientific, teaching or public value for enhancement of the existing collections are subject to the policies of the University and the resulting funds will go toward maintaining the mammal collections.

**C. Record Keeping** A record of the circumstances and/or the conditions under which mammal specimens and associated materials are deaccessioned and disposed will be retained as part of the permanent record of the mammal section of the UCONHM. All the original documentation of deaccessioned specimens or materials will be retained by the mammal section of the UCONHM.

**D. Catalog Numbers of Deaccessioned Specimens** The original main catalog numbers assigned to deaccessioned or disposed of specimens will not be reassigned to other or new items. However, the main catalog entries are amended to indicate the disposal/deaccessioned status of the

specimens and associated materials, the personnel involved in making the decision and the date of deaccessioning.

## **X. APPRAISAL OF MAMMAL DONATIONS**

The monetary value of any mammal specimen or associated materials donated to the UCONHM will not be assessed by mammal Curators or the Collection Manager. It is outside the scope of their expertise.

## **XI. LOANS**

The loan of mammal specimens and associated materials in the UCONHM is at the discretion of the mammal Curators after consulting with the Collection Manager. Any mammal specimens or associated materials or data that are loaned should be noted in both the hard copy catalog and the computer data base.

**A. Loan Conditions** The mammal section of the UCONHM will loan materials under the following conditions.

- Types, rare, or one of a kind mammal specimens are not loaned.
- Loans of original field catalogs, journals and species accounts, correspondence, photographs, slides, etc. are not granted. However, if funds are provided for the copy of these materials, then a copy of the material will be provided.
- A loan request may be denied or limited because of the fragile nature of a specimen, the rarity, or uniqueness of the specimen(s) as well as the size or number of specimens being requested.
- CITES-listed material will not be loaned to institutions that do not hold a CITES Exemption Permit. For details of species listed on the CITES Appendices, visit the CITES website at <http://www.cites.org/>. If any of the mammal materials requested in the loan are listed on CITES Appendices I, II, or III, the loan requestor must provide their institution's CITES Exemption Permit Number.
- Loan shipments are made in accordance with the Lacey Act of 1903 and the United States Department of Interior regulations concerning "import, export, and interstate transportation of wildlife".
- Loans of mammal specimens or associated materials for use in exhibits must comply with the mammal section of the UCONHM loan policy as it relates to the storage, security, and proper environmental conditions. Before any of the mammal materials to be used in the exhibit are displayed, the specimens or material must be correctly identified to species (if possible) and the UCONHM mammal section must be acknowledged on the exhibit. All specimen tags and other identification information are to remain on the loaned specimens at all times.
- Any UCONHM mammal section materials or data that have not been published and are the result of research activities (i.e. data sheets, tissue samples, food habit remains, field catalogs, journals and species accounts) may be copied and/or the original loaned after a reasonable length of time, with written permission by the original researcher or if they were a graduate student by their graduate advisor. Researchers must cite the mammal section of the UCONHM and any relevant catalog accession numbers (if available) in published reports even if that material was not accessioned at the time it was loaned to a researcher.
- Teaching collection specimens and associated materials might under special conditions be loaned if they are returned prior to the material being needed in a class.
- Occasionally mammal specimens may loaned for longer than normal periods of time (6 months) for use in identifying taxa in certain research projects.
- Any UCONHM mammal specimens cited in published works must be identified by their catalog numbers and standard institutional code. Two copies of any resulting published work should be sent to the museum after the research has been published.

- Foreign loans are made only to international entities that have dependable mail service. Western Hemisphere loans are mailed out only to institutions in the US and Canada. In the Eastern Hemisphere loans will only be mailed to England, western European countries, Japan, and Australia. International loans might require that the U.S. Fish & Wildlife Service Form 3-177 or other forms be completed and validated prior to mailing the material.
- All loans will be made to an institution, rather than to individuals; and in all cases a permanent member of the institution must accept responsibility for the loan.
- For most loan requests, specimens and/or associated materials will be loaned only for a period of six months. An extension of the loan may be requested prior to the return date of loaned material.
- Whether or not future loan requests are honored will be contingent on previous care provided to the UCONHM mammal specimens.

### **B. Borrowing Mammal Specimens And Associated Materials From The UCONHM**

The mammal section of the UCOMNH makes loans of catalogued material from its collections to faculty, curators, permanent research staff, and occasionally to students under the direction of a faculty advisor at scientifically recognized institutions and under the conditions listed in the previous section.

- The mammal Curators in consultation with Collection Manager approves all outgoing loans after receiving a fully completed request.
- Loan requests and extension of a loan should be made in writing to the mammal Curators at the UCONHM.
- The Loan request should include the following information:
  - should be on the borrower's home institutional letterhead.
  - the scientific merit and purpose of the research
  - evidence of the investigator's competence conducting the study
  - the exact amount and identity of the material required
  - why mammal museum specimen material is preferred over other sources
  - evidence that the borrowed specimens will be properly cared for during the loan period
  - that the loan institution has the proper facilities to care for the mammal specimens and associated materials.
- In a loan made to a student (undergraduate or graduate), the student's faculty advisor will be responsible for the loan and making the loan request.
- The cost of shipping (depending on the amount of material and the destination) which includes packaging materials might be charged to the individual requesting the loan.

**C. Incoming Loans To The Mammal Section Of The UCONHM** After consultation with the mammal Curators and the Collection Manager and a UCO researcher or student making a loan request from another institution, the mammal section of the UCONHM will accept incoming loans pursuant to arrangements made with the other scientists or scientific institution making the loan. All incoming loans will be maintained as a composite lot (not separated) and curated in a professional manner.

**D. Mammal Tissue Loans – Including Invasive Or Destructive Sampling** Invasive or destructive sampling would involve such things as asking for tissues from the frozen tissue collection, sampling preserved specimens for genetic studies, dissection of fluid specimens for anatomical studies, sectioning of teeth, bones, or skin, splatter coating of specimens for SEM studies, toe clips, hair samples, or otherwise altering a UCONHM mammal specimen. Some of these samples will be associated with voucher specimens in the mammal section of the UCONHM. Unlike traditional museum specimens, such invasive samples could eventually deplete the unit being sampled. Therefore, requests for skin, hair, toes, bone or frozen tissues for DNA, isotope, or other analyses are evaluated more stringently than other requests and some

requests for destructive samples might be denied. The mammal Curators and the Collection Manager will consider destructive sampling loan requests.

**1. Guidelines Governing Invasive Or Destructive Sampling** Certain guidelines and conditions govern whether an invasive or destructive sampling request will be honored to ensure the sampling does not exhaust the limited resources. The goal of having these guidelines is to preserve the value and usefulness of the mammal collections for present and future use.

These include:

- the taxon is well represented in the UCONHM mammal collection
- there is sufficient scientific merit to justify destruction of the material
- the material is not available in another institution
- in general, rare material or specimens that represent extinct or endangered species will not have invasive or destructive sampling done on them
- Requests for samples of the UCONHM mammal tissues or specimens is an acknowledgment that the researcher supports legitimate scientific collecting, and that they understand and value the time and expense that goes into preparing and maintaining mammal museum collections. In exchange for providing the samples, the UCONHM mammal section requires that the researcher provide a letter in support of scientific field collecting and of the value of the UCONHM mammal collection.
- Invasive or destructive sampling is usually undertaken by researchers experienced in the sampling technique being used. However, it may be done by students, but the request for tissues must be made by the student's advisor, who will confirm that the student has the expertise to conduct work. The advisor should provide an assurance that the results of the study will be published.

**2. Written request for invasive or destructive sampling of mammal specimens**

- Requests for invasive or destructive sampling of any UCONHM mammal collections should be made in writing to the mammal Curators.
- All loan requests should be on the borrower's home institutional letterhead.
- For each tissue or destructive sample request the investigator must include the following information:
  - the scientific merit and purpose of the research
  - why mammal museum specimen material is preferred over other sources
  - compelling reasons why the project cannot be completed without the use of museum specimens.
  - that the proposed research will generate usable information
  - evidence that the research question being addressed is historical and therefore requires the use of museum specimens or tissues, or that the mammalian taxa being examined cannot be sampled in the field.
  - the destructive or invasive samples are to supplement research materials obtained from other sources and they are not to replace primary data collection efforts such as field sampling of extant taxa.
  - evidence of the investigator's competence with the sampling and analysis method (e.g., PCR amplification and DNA sequencing from museum skins and tissues)
  - why the chosen sampling method is the least destructive method
  - the exact amount and identity of the material required
  - why the use of UCONHM mammal specimens (as opposed to that from other institutions) is needed. Include evidence that contact has been made with other institutions about specimen samples.

- that any residual products resulting from the consumptive sampling (e.g., parasites, DNA strands, gut contents, karyotype test slides, left over or unused tissues, etc.) are to be returned to the mammal section of the UCONHM.

### **3. Additional Requirements Of Tissue Sample Loans**

- Any UCONHM mammal specimen tissues cited in published works must be identified by their catalog numbers and museum acronym.
- Two copies of any resulting published work should be sent to the museum after the research has been published.
- If the original mammal specimen is altered by the sampling protocol, the researcher must return to the UCONHM mammal section the specimen in its altered form, documented and ready for accession. For example, alcohol-preserved specimens which have been made into histological sections should be returned with documentation of the size (i.e., CRL, HL, body mass) of the original, and with details on techniques used for decalcification, mounting, staining, and section thickness of the slides. For DNA studies, the researcher should make all sequences amplified from UCONHM mammal material publicly available (via EMBL, GenBank, or equivalent web-accessible sources).
- The cost of shipping (depending on the amount of material, whether it is considered a biohazard and requires special handling, and the destination, and packing materials) might be charged to the individual requesting the loan.

**E. Casting of Mammal Specimens Or Associated Materials** Casting of mammal specimens should be arranged through the mammal Curators and Collection Manager of the UCONHM. Polysiloxane or a good equivalent is the molding compound allowed for casting of bone and tooth material. One cast should be returned to the UCONHM mammal section. All specimens from which casts are taken shall be cleaned and properly controlled for pest before being placed back into the collection.

**F. Loan Of Documents In The Mammal Section Of The UCONHM** Documents in the mammal section of the UCONHM are available for noncommercial uses such as research and exhibits. All requests to use or borrow documents in the mammal section of the UCONHM must be approved by the mammal Curators and the Collection Manager.

#### **1. Guidelines Governing The Loan Of Documents**

- Loans of original documents associated with mammal specimens in the UCONHM (field notes, correspondence, catalogs, etc.) are not allowed. Copies can be loaned.
- Reproduction of documents in mammal section of the UCONHM is not allowed without the consent of the mammal Curators and the Collection Manager. Methods of document reproduction must not damage any originals.
- Public display or publication of documents or copies must acknowledge the mammal section of the UCONHM as the source.
- Two copies of any published papers which cite the loaned mammal section documents must be provided to the mammal section of the UCONHM.
- Documents and other associated materials related to specimens in the mammal section of the UCONHM and that are no longer actively used might possibly be archived in the UCO library. The UCO Library should be contacted about borrowing those documents. However, those documents are subject to the same guidelines as documents still in current use.

#### **2. Written Request For Loan Of Documents**

- Loan requests of any UCONHM mammal collections documents should be made in writing to the mammal Curators.
- The Loan request should include the following information:

- should be on the borrower's home institutional letterhead.
- the scientific merit and purpose of the research
- evidence of the investigator's competence conducting the study
- the exact amount and identity of the document material required
- evidence that the borrowed documents will be properly cared for during the loan period
- that the loan institution has the proper facilities to care for the documents.
- In a loan made to a student (undergraduate or graduate), the student's faculty advisor will be responsible for the loan and making the loan request.
- The cost of shipping (depending on the amount of material and the destination) which includes packaging materials might be charged to the individual requesting the loan.

**G. Packaging of Loan Specimens to be Mailed** All specimens being shipped from the mammal section of the UCONHM must be correctly packaged to insure their safe arrival and that they are not damaged during possible rough mailing or shipping conditions. This may involve attention to such details as dropping of containers, dust, humidity, temperature, and packing containers used.

- Substantial wooden boxes, crates or reinforced cardboard boxes that will not easily crush should be used for the shipping of mammal specimens and associated materials
- A return shipping label and a copy of the documentation associated with the loan should be included inside the shipping container
- Proof of delivery documentation should be obtained from the postal service or other shipping carrier
- A loan return form should be included and the borrower should return it as soon as the loan is in their possession. It should clearly document the condition of the arriving materials. It should contain instructions on how and when the borrower should return the loan and instructions detailing how to package the material for its return and how to store the specimens while they are in possession of the borrower.

#### **1. Mammal Specimen Skins**

- a loan form should be completed and placed in the loan notebook which should be stored in the fireproof safe in room 165 in the Science Lab Building
- a loan slip should be installed in the collection drawer where the specimen and materials were removed and it should indicate where the material was loaned
- each specimen should be individually wrapped in thin tissue paper
- make sure that the tail and any associated tags are not folded and that the specimen will not be compressed
- if possible, place the wrapped specimens in a zip-lock bag to prevent any liquids from damaging them during shipment
- ensure that no part of the specimen is in contact with the inside of the shipping container
- if multiple layers of specimens are being placed in the box, keep each layer level and separate the layers by layers of cotton tucked down on the ends and sides of the container to prevent jarring of the specimens in transit and to keep them from coming into contact with the walls of the container.

#### **2. Skull And Skeletal Specimens**

- a loan form should be completed and placed in the loan notebook which should be stored in the fireproof safe in room 165 in the Science Lab Building



- a loan slip should be installed in the collection drawer where the specimen and materials were removed and it should indicate where the material was loaned
- cotton should be carefully placed around the skull or small skeletons in the original skull collection containers
- each container will be wrapped in tissue paper
- all the skulls should be placed in a box within the shipping container, cushioned with cotton
- all medium and large-sized skeletal specimen bones should be wrapped in tissue paper, placed in a plastic bag, and then placed back into that specimen's original skeletal box (or for some in which the packing material forces the use of a second or third box - each should be clearly labeled).
- larger specimens may require more packing material to prevent heavy bones from damaging other portions of the skeleton during rough handling

### 3. Fluid-preserved Specimens

- a loan form should be completed and placed in the loan notebook which should be stored in the fireproof safe in room 165 in the Science Lab Building
- a loan slip should be installed in the collection near where the specimen and materials were removed and it should indicate where the material was loaned
- each fluid preserved specimen will be removed from its storage jar and wrapped in cheesecloth moistened in preservative to prevent drying during shipping.
- the wrapped specimens are placed in a plastic bag, sealed and then placed in a second sealed bag.
- use packing material liberally between the bags and inside of the wooden box.
- federal postage and shipping regulations apply to the shipping of many chemicals such as formalin, ethanol and isopropanol and special shipping arrangements must be made with companies capable of safely handling hazardous specimens or associated materials. Consult the local postal service or the carrier you will use for information regarding how these materials should be packed and labeled. Specimens have to be shipped in adequately padded containers to prevent damage to the specimens and leakage of preservative during normal handling.

### 4. Tissue Samples...

**H. Documentation of Loans** Each mammal loan has a unique number associated with it and its documentation. The loan numbers will be consecutive and listed in a UCONHM Mammal Section Loan notebook. The Loan notebook will also contain a description of the loan. One copy of the loan invoice is kept in the Loan notebook and contains a complete description of the loan

- loan request letter
- who was the loan to and who approved the loan
- start date and due date for return of loan
- who packed the loan material.
- what is contained in the loan and in each container the loan was shipped.
- the loan description will include specimen main catalog number, sex, and prep type for each specimen loaned.
- each specimen should be carefully examined for any damage or missing parts and those should be listed on the loan description form.
- the company used to ship the loan and tracking numbers
- a copy of the loan will be packed with the specimens and is to be signed by the borrower upon receipt of the loan, returned, and placed in the Open Loan file section of the mammal section Loan notebook. The borrower should examine each specimen upon

receipt of the loan and note, in detail, any changes in condition. The loan material will be examined upon its return.

**I. Curation of Loan Material Returning to the UCONHM** Upon receipt of loan material, mammal section staff should examine its condition.

- any differences compared to when it was originally shipped to the borrower and what was reported by the borrower on its arrival to them. Any changes or damages should be noted on the loan forms in the loan notebook.
- all specimens and associated materials should be inspected for pests and they should be placed into the super cold freezer for at least a week prior to being reinstalled in the main collection

## **XII. COMPUTER DATABASE OF THE MAMMAL SECTION OF THE UCONHM**

Dr. Chris Butler (cbutler11@uco.edu) is responsible for the implementation and maintenance of Specify (a software database network interface application) which is the mammal section computer collection management tool. The following description of Specify is paraphrased from the Specify Software Project (2006; [www.specifysoftware.org](http://www.specifysoftware.org)) of the Biodiversity Research Center, University of Kansas. Specify can manage specimen data, descriptions of collecting locations, and information about collections loans, exchanges, etc. There is no charge for using Specify (and its web and DiGIR interfaces; 2001) which avoids maintenance expenses. This data management system has a comprehensive data model and a customizable interface designed for accurate data entry. Its user interface is customizable. Specify supports 'Express Search' full-text indexing and searching. Site administrators (UCO IT) can configure the search engine to index data & fields of interest which are then maintained automatically. Web users have rapid, full-text search access. Specify supports structured database queries against all fields in the database. Specify taxon dictionary is compatible with the Integrated Taxonomic Information System (ITIS) format. ITIS taxonomic trees can be imported and customized. Specify includes a report designer for creating custom print outputs for specimen labels, etc. Training & oversight of data entry personnel by the Collections Manager and Curators help insure accurate specimen data entry. By maintaining the database server through UCO IT, expansion is not an issue. Dr. Chris Butler Provides oversight and maintenance of the database and Specify. We intend to use Specify's web-publishing tools to allow visitors to the UCONHM website to search the mammal collection online. Windows based "Excel" and "Access" spreadsheet programs from Microsoft®, are compatible with the "Specify" software. Specify has georeferencing capabilities but it has not been implemented for mammals at this time. The UCONHM webpage will be the entry point for data queries.

### **Guidelines for use of Specify:**

- Users accessing the mammal records in Specify and who fail to comply with the guidelines may be denied access.
- If a for-profit organization opts to use the mammal data records in Specify, special clearance must be obtained from the Curators. A fee may be charged to users of the collection information for profit.
- The mammal section of the UCONHM strives to maintain accurate data in its computer database. However, users who access the database must be aware that specimen-based databases are continually updated as species nomenclatural changes occur. Both specimen examination and verification of identification remain the responsibility of the researcher accessing the data.
- The mammal section of the UCONHM may restrict access to certain data fields, including specific localities of threatened or endangered mammals.
- Data related to current research or ongoing research of faculty, students or staff may have restricted access until the information is published.
- All users of any mammal information acquired through the UCONHM Specify database must acknowledge the mammal section of the UCONHM as the source of specimen data, and must provide copies of publications, reports, or projects.

### **XIII. INTEGRATED PEST MANAGEMENT AND PREVENTATIVE CONSERVATION OF MAMMAL SPECIMENS IN THE UCONHM**

The care and conservation of the mammal specimens and associated materials are the responsibility of all Curators, Collection Manager, curatorial staff, and visitors. All of the mammal staff should be aware of and adhere to the conservation practices that meet professional standards for the care and maintenance of the mammal specimens and associated materials.

1) Items such as food, drink, living plants, animals, and other organisms and unprocessed biological material should not be allowed in the mammal collection storage areas.

- An Integrated Pest Management plan should be in place and applied on a regular schedule.
- Storage containers, trays, paper, tags, vials, jars, etc. should be of archival quality.
- The air temperature and humidity in the collection rooms should be kept at appropriate levels.
- Only individuals approved by the mammal curators and the Collection Manager should have access to the collection and the collection should be in a secure room.
- Extra preservation precautions should be used for the protection, care, and conservation of mammal type, holotype, etc. specimens, first records of and other irreplaceable specimens.

#### **A. Pest Management in the Mammal Section of the UCONHM**

- The Mammal section of the UCONHM staff should strive on a continuous basis and in a collective manner to prevent insect pests and other destructive organisms from damaging the mammal collection items or associated materials.
- Food, unpreserved plant and animal materials, and other high-risk materials should be restricted to designated rooms of the mammal section of the UCONHM. Under no circumstances are such materials permitted in or near where collections are maintained.
- An integrated pest management program (IPM) should be maintained at all times throughout the mammal section of the UCONHM. Included in this plan are good housekeeping, clean work habits, surveillance, and documentation.
- If an infestation is noted, responsible safe and effective pest management actions should be implemented as quickly as possible. These should be (if possible) non-chemical or inert chemical control methods before toxic (hazardous to humans) compounds are applied. All infestations and treatments should be documented and maintained as a permanent record.
- Any toxic chemicals used should be in compliance with federal and state regulations. Precautions will be taken to protect human health and safety, to avoid environmental pollution, and preserve the integrity of the mammal specimens and associated materials in the UCONHM.
- The Collection Manager is responsible for implementing effective and safe mechanisms to address the pest management in the mammal section of the UCONHM and the mammal Curators are responsible for overseeing the process. As part of this process, written procedures should be available to support the pest management policy.
- Periodic freezing of specimens is the safest method of preventing infestations of insect pests like dermestid beetles. If possible, trays that hold the specimens should be frozen as well. Items should be put in a sealed plastic bag (extra large zip-lock) bag and placed in the ultracold freezer for a period of about 2-5 days at a temperature of -40 degrees or colder. Specimens should be dry so no crystallization occurs. Incoming specimens (including loans) should be frozen to kill any pests in shipping materials. Periodic fumigation should be done around cabinets and in the collection rooms. If possible, compounds that are safe for staff to work around will be used. Such things as diatomaceous earth, boric acid, and juvenile hormone analogs can help control insect pests.
- Randomly placed sticky traps are used as indicators of possible pest problems in the mammal section of the UCONHM.
- Another serious problem, especially in moist, warm climates, is mold that can grow on specimens. Once a specimen has become moldy, it is difficult to restore it. If only a small amount of mold is present on a specimen, they it might be possible to removed carefully with forceps or with a fine brush. The

specimen then should be dried in a warm oven. Keeping the collection room's environment dry (low humidity) will help prevent mold.

**XIV. EMERGENCY MANAGEMENT OF THE MAMMAL SECTION OF THE UCONHM** The health and safety of each individual associated with the mammal section of the UCONHM is paramount to all other issues.

- The Curators and Collection Manager of the mammal section of the UCONHM in conjunction with the UCO Safety and Environment Office are responsible for writing and implementing the emergency management plan of the mammal section of the UCONHM. This plan will promote preparedness and responsiveness to emergency situations.
- Museum personnel will respond quickly to emergency situations in order to reduce the risk of damage or disruption of the mammal collection.
- The mammal section should mark all emergency equipment and recovery supplies so they can be easily located.
- Employee and volunteer training should be provided to familiarize individuals with emergency procedures and equipment.
- For assistance in an emergency situation in the mammal section of the UCONHM, an updated list of prioritized contacts (names, addresses, and phone/fax numbers) will be maintained in the mammal museum area and they will be posted in places that are readily available and easily visible.
- The permanent, full-time staff should become familiar with the procedures for stopping and starting electrical power, ventilation, and water to the mammal section of the UCONHM facilities.
- The mammal section of the UCONHM will have mapped floor plans with routes of exit clearly marked and posted to facilitate evacuation during an emergency situation.
- During a community-wide emergency, stabilization and the basic security of the mammal section of the UCONHM properties should be established. All personnel will work together to protect the mammal collection.

Standard procedures should be outlined to handle the following possible disasters:

- Flooding from broken water lines, fire sprinkler systems, and other water sources
- Fire
- Smoke

**XV. HEALTH AND SAFETY CONCERNS IN THE MAMMAL SECTION OF THE UCONHM**

The mammal section of the UCONHM along with the University of Central Oklahoma is required to provide a safe and healthful environment for staff, volunteers, and visitors, as well as minimizing risks to the mammal specimens and associated materials in the collection. It is the goal of the mammal section of the UCONHM to conduct all activities in a safe manner by recognition, evaluation, and reduction or elimination of all health and safety risks.

**A. Authority and Responsibilities** The mammal section of the UCONHM will coordinate its safety efforts with the University Safety and Environment Office. Through this coordination, compliance with Federal, State and local laws and regulations should be met. This will be a shared effort of all involved with the mammal section of the UCONHM workers and visitors. The mammal section Curators and the Collection Manager are ultimately responsible for implementation, compliance and orientation of staff with all environmental health and safety policies. It is the staff, volunteers and visitors responsibility to observe and follow all policies; wear personal protective equipment that has been provided; use all equipment in a safe manner; and report any accident or unsafe or unhealthful condition.

**B. Safety Inspections of the Mammal Section of the UCONHM** The University of Central Oklahoma Safety and Environmental Office should be contacted on a regular schedule to conduct a safety inspection of the mammal collection areas to determine potential or actual safety, health,

or environmental hazards. Hazardous materials that could occur in a mammal area and in the mammal specimens include biological (e.g., blood, tissues), chemical (fixatives - formalin and alcohol, preservatives and pesticides - arsenic and paradichlorobenze, etc.), walkway obstructions, fire hazards and storage cabinets. Most hazardous materials have established permissible levels and can be easily monitored by safety inspectors. All the personnel working in the mammal areas of the UCONHM need to be made aware of the actual and potential sources of hazardous materials in the collections and prep areas, as well as historical and current treatments of specimens.

**C. Hazard Elimination or Control in the Mammal Areas of the UCONHM** The mammal section of the UCONHM will contain and utilize various types of safety equipment, supplies and practices to maintain the well being of its employees and visitors. The University of Central Oklahoma Safety and Environmental Office will assist in compiling a list safety equipment.

Examples include the following:

- First aid kits and emergency eyewash stations
- Fire detectors, fire alarms, fire extinguishers and room sprinkler systems
- Sharps and biohazard containers
- Fume hoods
- Protective clothing: gloves, goggles, respirators with high-efficiency particulate air and/or organic chemical cartridges

**D. Safety Training:** The University Safety and Environmental office will determine what training is necessary for museum personnel. The University of Central Oklahoma shall provide the mammal personnel with the necessary personal protective equipment and provide and/or make provisions for any necessary required training.

**E. Hazardous Waste Disposal in the Mammal Section of the UCONHM** A hazardous material is by definition any material which is particularly reactive, explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful and is likely to cause injury or death to persons exposed to them or they might be destructive of property. When these materials are no longer useable, they become hazardous wastes. Hazardous wastes might also be biological (biohazardous) and include infectious wastes such as bacteria, viruses, and bodily fluids. Refer to the University of Central Oklahoma's Safety and Environment Office's information regarding hazardous waste management guidelines for additional information.

**1. Authority and Responsibilities** The University of Central Oklahoma has delegated authority regarding the safe storage, use and disposal of hazardous wastes to the Office of Safety and Environment. However, the university and the mammal section of the UCONHM must provide a safe environment for its staff, volunteers, and visitors. The College of Mathematics and Science, the Biology Department and ultimately the mammal Curators and Collection Manager and the staff share the responsibility of ensuring compliance with all environmental health and safety policies. The mammal Curators and the Collection Managers must inform employees of all harmful agents associated with the work environment, as well as how to protect themselves. Employees are responsible in notifying the Collection Manager and mammal Curator of potentially harmful agent and unsafe conditions.

**2. Storage of Hazardous Materials** All hazardous materials used or associated with the mammal section of the UCONHM must be stored in approved (UCO health and Environmental Office) storage containers which meet OSHA (Occupational Health and Safety Administration) requirements, and they must be accompanied with Material Safety Data Sheets (MSDS). Small quantities used on a regular basis may be stored in a metal cabinet in other areas provided that the container and cabinet are labeled appropriately.

**3. Material Safety Data Sheets (MSDS)** are required for any hazardous chemical stored in the mammal section of the UCONHM at the University of Central Oklahoma and shall be clearly posted where the hazardous material is used or stored. The MSDS is "required

reading" for all employees or volunteers working at that worksite prior to initial use of the material.

**4. Chemical Inventory List** A list of all hazardous (and potentially hazardous) chemicals shall be completed by the mammal section of the UCONHM and updated annually or as needed. The list should contain at least the following information: name of chemical, amount, and storage site. A copy of the list should be stored in at least two different sites and should be made available to the proper university offices. The mammal section of the UCONHM should minimize the quantity of hazardous chemicals and should evaluate on an annual basis the need to retain such chemicals. The update of the inventory is the responsibility of the Collection Manager.

**5. Container Labeling** All hazardous or potentially hazardous materials shall be stored in its original container with the original warning label listing the chemical name, hazardous ingredients, hazard warnings, and the manufacturer's name and address. Transfer of chemical products from one container to another is permissible provided that the new container is properly labeled and meets OSHA and NFPA (National Fire Protection Act) standards. Proper transfer protocols of flammable liquids should be followed (both containers are grounded and bonded together with a bonding wire).

**6. Training** Each mammal Curator, the Collection Manager, other staff and volunteers must be informed of all hazardous chemicals in the work areas at the time of initial assignments, and whenever new hazards are introduced into the work areas. Minimum training shall include a review of the UCONHM mammal section guidelines on hazardous materials, review of the MSDS sheets and other guidelines required by the university.

**7. Disposal of Hazardous Chemicals** Information related to the safe disposal of each type of hazardous material in the mammal section of the UCONHM should be listed on the appropriate MSDS. Hazardous wastes should not be disposed of down the drain or in the trash unless approved by the UCO Safety and Environmental office.

**F. Disposal of Biohazardous Wastes** All biohazardous wastes and materials should be sealed in an autoclavable "biohazard bag" and autoclaved. The UCO Safety and Environmental office should be contacted regarding the proper way to dispose of animal wastes on the university property. The material is stored in a "waste freezer" if it cannot be processed immediately.

## **XVI. GUIDELINES FOR THE PREPARATION OF MAMMAL SPECIEMENS FOR THE UCONHM**

**A. Permits Prior** to collecting mammal specimens, state authorities should be contacted in order to make sure the proper permits are acquired to make a scientific collection of mammals. In Oklahoma, this will be the Oklahoma Department of Wildlife Conservation (<https://www.wildlifedepartment.com>) ODWC PO Box 53465, 1801 N Lincoln, OKC, OK 73152). In addition, if associated with an educational institution, the research should be cleared with an animal use committee. If the mammal is a federally protected species then special permits will be required and the US Fish and Wildlife should be contacted for the proper permits. In some cases, a researcher might have to obtain special permits and permission to collect in certain areas (State Parks, certain Wildlife Management or Refuge areas, private land, etc.).

**B. Approved Methods of Collecting and Euthanizing Mammals.** Before collecting mammals in the field, researchers should familiarize themselves with The American Society of Mammalogists document that discusses approved methods of collecting, holding, and euthanizing mammals (<https://www.mammalsociety.org/committees/animal-care-and-use>).

**C. Unprepared Mammal Material** With approval of the Collection Manager any fresh (road kills, frozen in the field, recently euthanized but not frozen, etc.) material that has not been prepared as a specimen ready to be cataloged and deposited in the collection should be placed in

the freezer located in room 165. Do not allow the placement of any materials into the freezer without permission. Do not put unlabeled material into the freezer.

The freezer log and the container label with the specimen(s) should be completed indicating:

- collector
- date
- location where collected
- brief description of the item (roadkill, field collected, etc.)
- Number (if more than 1) in the container

**D. Storing Mammal Specimens in the Field.** As soon as a mammal specimen has been collected in the field and euthanized it should be properly prepared or stored to prevent deterioration. Each specimen should be sealed individually in a plastic bag with a field tag attached which contains

- species
- sex
- collector
- field number
- location
- date
- specimen measurements can be added later.
- The specimens should be kept cold while waiting preparation (ice chests, ice packs, etc.) If they are not to be prepared soon, then they should be frozen. Dry ice in an insulated ice chest will last several days in the field (depending upon environmental conditions). Some projects might require the use of liquid nitrogen.
- Fluid preservation (fixing in 10% formalin or in 70-95% ethanol - depending on research project requirements) of small mammals is described below. If possible several of the specimens should be prepared as dry skins because it is not possible to see or preserve hair colors in formalin and alcohol.
- Tissues may need to be taken in the field for DNA or other genetic or isotope analyses. See information below.

#### **E. Data to be Recording in the Field with Each Specimen**

**1. Field Data** Researchers must make sure that all specimens preserved in the mammal section of the UCONHM be accompanied by the proper location information, collection information and natural history notes. Without this information the specimens are of less value. These data should be recorded in a sturdy weather proof field notebook (labeled with collectors name, address, and contact information) on data sheets (100% rag bond paper) in the field as soon as possible after the mammal has been taken. Upon accession to the mammal section of the UCONHM the field data sections should be stored as archive material in a fireproof safe (in room 165 of the Science Lab Building). The following types of field data should accompany all specimens being accessioned into the mammal section of the UCONHM. Each page of the field data book should be labeled with the collector's name and year. Special data sheets may be helpful and examples can be found on line at various museum information sites..

**a. Collector's Catalog** The following information should be recorded:

- On the first line of the catalog record the precise locality where the mammal specimen was collected. Include the State; County; and the distance from a well-known town. Latitude and longitude should also be included.
- The date is usually placed on the line following the location information
- On the lines of the catalog following the date each mammal specimen collected should be given a unique number and the numbers are never

repeated. Devote one line to each specimen. Begin each line with the field catalog number, then the symbol for the sex, then the scientific name and then the traditional field measurements (all in mm: Total Length; Length of Tail; Hindfoot Length; Length of Ear from notch and the Weight in grams). If the specimen is not a conventional skin or skull specimen, then indicate the type of specimen (skeleton, skull-only, skin-only, alcoholic, tissue, etc.) next to the field number. Also record any reproductive information available.

**b. Collector's Journal** The following information should be recorded in a separate section of the field data book which is often referred to as the Field Journal.

- On the first line of the journal enter locality and date in the same manner as used for the catalog.
- In paragraph format journal in the following information:
  - who accompanied you.
  - the travel route to the collecting site
  - a sketch of the site where the trap lines or the collections were made
  - a description of the habitat and the number of traps set in each vegetative type
  - number and types of traps set; spacing of traps; bait used
  - weather conditions
  - number of each species of mammal collected and from which habitats

**c. Collector's Species Accounts**

- field accounts of species should be headed with the mammal's scientific name
- the date and locality for the account should be given on the first line
- only one species is written about on a single page
- include not only details and facts about the natural history of the species, but also include your interpretations and generalizations.
- it is wise to refer to the species by their field numbers.

## 2. Data to be Recorded from and Preserved with Each Specimen

A completely filled out (sex, reproductive information, collector's name and field number, collection date, location, and field measurements: total length, tail length, length of hind foot, ear from notch and weight—if a bat the forearm and tragus measurements should also be included) collection skin tag should be tied to the right hind foot of each specimen.

**a. How to Record External Measurements and Weight (mm & g)**

- Total Length - from the tip of the snout to the tip of the last vertebrae in the tail, dorsally
- Tail length: from the tip of the tail to its base adjacent to the anus
- Forearm length of bats: from the extremity of the elbow to the extremity of the carpus with the wings folded
- Tragus of bats – from its base to the tip
- Hind foot length: from the extremity of the heel behind the *os calcis* to the extremity of the longest digit, including the claw or nail
- Ear length: from the lower border of the external auditory meatus to the tip of the pinna



- Mass is recorded (in grams) using a suitable scale

### 3. Specimen Tags for Dry, Fluid and Skeletal Specimens

#### a. Skin Tag 100% rag bond paper

- The tags used should be printed with home institution identifying material - see example below
- Attach tag with cotton thread of durable weight on specimen's right hind foot
- The thread should be tied as shown in the below figure with the knot 1 inch from the tag.
- The tags should be completed using a pen having archival quality indelible ink or a pencil should be used
- The following information will be placed on each skin tag (also see example below)
- Sex (use proper symbol)
- Reproductive information in parenthesis –testes size, number of embryos right and/or left and crown to rump length of one representative)
- Collector's field catalog number
- Collector's name (followed by preparer's name if collector did not prep the specimen)
- Locality information in the following sequence : County; State or Province; County or Parish; number of miles/kilometers N S E or W (by road) of nearest city or town- also include (use Google Earth or GPS unit) the Latitude and Longitude of the collecting site
- Specimen measurements in the following sequence Total Length, Tail length, Hind Foot, Ear, (if a bat the Forearm and Tragus) and then the weight
- Date of Collection (use the following format 3 November 1946)- do not use a numerical format (3-12-46) because of the possibility of confusing the month and day as well as specimens having been collected in 1646 and 1946)

#### b. Skull Tag for Any Skull Separated from the Skin 100% rag bond paper

- attached by cotton thread through mandible and not damaging any portion of cranium
- should contain the following information
  - Original field collector's number
  - Species name
  - Sex

#### c. Skeleton Tags 100% rag bond paper

- attached by cotton thread through mandible and not damaging any portion of cranium
- should contain the following information
  - Original field collector's number
  - Species name
  - Sex

**F. Voucher Specimens** Once a specimen has been legally collected and euthanized using a humane method, then it can be prepared as a voucher specimen. A voucher specimen is usually a whole animal that is preserved (skin, skull, skeleton or fluid specimen) and retained in a museum as a permanent reference. It is best to prepare mammal specimens as soon after collection to avoid deterioration, slippage of skin and freezer burn, etc. Some large species in certain regions (e.g. deer, bear, porcupine) are readily identified and/or well represented in museum collections

and can be documented through photographs at least for particular geographic areas or hair samples and track castings. Depending on the type and format and design of the research project, often two whole voucher specimens (preferably one male and one female) can be collected from a trap site and preserved as voucher specimens. In an analysis of geographic or population variation, several of each sex and age might have to be preserved.

**1. Plaster Cast of Tracks** There are good references available that describe where to search for tracks, how to make casts of them and how to identify the species. Two of these are by Elbroch (2003) and Lowery (2006). The mammal section of the UCONHM prefers that the tracks be cast inside a thin round or square cardboard frame (this standardizes the shape of the final product) and that a hole (place a small stick or pencil near the track inside the frame prior to pouring in the plaster) be left in the plaster. This hole allows a standard field tag to be tied to the plaster cast when it is dry and collected. The tag (100% rag bond paper) should be filled out in the same fashion with the same information as a specimen tag. It should include the following information:

- The tags used should be printed with home institution identifying material - see example below for skin tag.
- Attach tag with cotton thread of durable weight through the hole in the cast
- The thread should be tied as shown in the skin tag figure with the knot 1 inch from the tag.
- The tags should be completed using a pen having indelible ink or a pencil should be used
- The following information will be placed on each skin tag (also see skin tag example)
- Sex (use proper symbol) – if able to determine or indicate unknown
- Collector's field catalog number
- Collectors name (followed by preparer's name if collector did not prep the specimen)
- Locality information in the following sequence : County; State or Province; County or Parish; number of miles/kilometers N S E or W (by road) of nearest city or town- also include (use Google Earth or GPS unit) the Latitude and Longitude of the collecting site
- Date of Collection (use the following format 3 November 1946)- do not use a numerical format (3-12-46) because of the possibility of confusing the month and day as well as specimens having been collected in 1646 and 1946)

**2. Photographs** (see instructions for use of individual field cameras) Photographs will be archived in the same fashions as field catalogs and other associated mammal materials

**3. Wet or Fluid Specimens** Fluid preserved mammal specimens provide more potential research material (e.g. musculature, organs, and other soft tissues) than traditional skin and skulls. Therefore it is recommended that in addition to the traditional skin preps that whole fluid-preserved mammal specimen be made in conjunction with the skin and skull. This usually involves the 'fixing' or initial preserving of the specimen in 10% formalin or 80-90% ethanol (depending upon research project), and then storing the specimen in a jar of ethanol. This preserves a complete specimen with all of the internal and external anatomical structures, intact. However, the color of the hair often fades.

**a. Museum Fluid Preparation Method**

- Traditional skin measurements should be taken before pickling because the process can sometimes alter the actual length of some specimens.
- If needed and time permits, hair samples should be taken prior to fixing (see description of storing hair below).

- If the skull is needed, it is easier to extract the skull prior to fluid fixing (see description below that describes how to extract a skull from a specimen that will be fluid fixed).
- All fluid fixed specimens should have a completed specimen tag attached to the right hind foot. Each skin tag should contain the following information (see an example in the section dealing with traditional dry skins)
  - Skin Tag should be 100% rag bond paper
  - The tags used should be printed with home institution identifying material - see dry skin example below
  - Attach tag with cotton thread of durable weight on specimen's right hind foot
  - The thread should be tied as shown in the dry skin tag example below figure with the knot 1 inch from the tag.
  - The tags should be completed using a pen having indelible ink or a pencil should be used
  - The following information will be placed on each skin tag (also see example below)
  - Sex (use proper symbol)
  - Reproductive information in parenthesis –testes size, number of embryos right and/or left and crown to rump length of one representative)
  - Collector's field catalog number
  - Collector's name (followed by preparer's name if collector did not prep the specimen)
  - Locality information in the following sequence : County; State or Province; County or Parish; number of miles/kilometers N,S E or W (by road) of nearest city or town- also include (use Google Earth or GPS unit) the Latitude and Longitude of the collecting site
  - Specimen measurements in the following sequence Total Length, Tail length, Hind Foot, Ear, (if a bat the Forearm and Tragus) and then the weight
  - Date of Collection (use the following format 3 November 1946)- do not use a numerical format (3-12-46) because of the possibility of confusing the month and day as well as specimens having been collected in 1646 and 1946)
- A syringe can be used to inject the internal body cavities with 10% formalin (this is considered a hazardous material and proper care should be taken in its use and exposure). Wear proper gloves and work in a well ventilated area. In some cases, a small incision can be made through the body wall to allow the preservative to fix the internal organs.

**b. Field Containers for Fluid Storage of Mammal Specimens** Plastic containers with tight sealing lids and appropriate gaskets are best because of the possibility of breakage of glass containers. Do not use metal containers which might corrode and stain mammal specimens. Preservatives should fill as much of the container as possible so that there is no air pockets. During transport the preservatives might slosh around and damage delicate specimens. Do not overfill the containers with too many specimens in the container because this will distort the animals shape and possibly crush delicate structures.

### c. Cataloging and Storing Fluid Mammal Specimens

When the fluid fixed specimens arrive at the museum, they should be carefully and safely processed because they might contain hazardous materials (e.g. formalin). (I am going on memory here and we need to find a good source about this).

- formalin or field used fixative should be decanted off into a waste storage container.
- the specimens are washed in fresh water
- the water with the formalin wash or other fixatives might be considered hazardous (check with your safety office about how to dispose of the wash water and fixatives)
- after washing the specimens, they are laid on a tray with the tags hanging over the edge
- the specimens are covered in moist paper towels to prevent them from drying out too much
- after the tags dry (a hair dryer can speed up the drying of the tags), they can then be cataloged – each given a unique accession number (written on the skin tag) and the data for each one entered into the main catalog.
- the specimens are then placed into the jars in which they will be stored in the collection
- mammal specimens should be stored in air-tight jars (glass jars, covered by a polyethylene lid) which contain 70% ethyl alcohol
- jars should not be overfilled with specimens because it could damage/squash soft tissues.
- jars should contain only one species (e.g. only specimens of *Myotis velifer*) and only specimens from one locality
- each jar should be labeled (use a standardized label for all jars) with the following information:
  - species name
  - locality
  - museum numbers (accession numbers) of specimens contained in jar
- oversize mammal specimens can be stored in polycarbonate pails
- jars should be kept in the dark and not exposed to artificial or sunlight because the specimens will fade.
- black paper can be placed over glass cabinet doors to eliminate light
- jars should be checked on a regular schedule to ensure that the specimens remain below the level of the alcohol

**4. Hair Samples** Hair samples can be saved from individual mammal specimens when they are collected or for larger mammals from hair collection stations.

#### a. Hair Collecting from an Individual Mammal

- Carefully remove hairs from body being sure to obtain the root and place each hair sample from each area of the body (venter, dorsum, rump, etc.) of the mammal in a different envelope marked with the following information:
  - Species
  - Collector
  - Sex
  - Age
  - Location where collected

- Date collected
- Part of body collected from
- All the separate hair sample envelopes from one animal should be placed in a larger envelope with the following information:
  - Species
  - Collector
  - Location where collected
  - Date collected
  - After the mammal has been cataloged, then the accession number should be added to the envelope
- Hair samples and envelopes can be dried and stored in a supercold freezer or dried and stored in a cool, moisture-free cabinet.

**b. Hair Taken at Collection (Snare or Rub) Stations**

- Hair capture stations should be checked often and carefully to ensure that all hairs present are collected
- Place each hair sample (i.e., all the hair from one barb or rub site) in a different envelope marked with the hair station number. All the separate hair sample envelopes from one site should be put in a larger envelope.
- All the envelopes from one station should be placed in a larger envelope with the following information:
  - Species
  - Collector
  - Location where collected
  - Date collected
- Record site information details in the collector's field notebook and on the envelop.
- Hair samples and envelopes can be dried and stored in a supercold freezer or dried and stored in a cool, moisture free cabinet.

**5. Tissue Samples** Tissues from about 30 specimens of a species from a locality are recommended to be sampled for the frozen tissue collection. If more specimens are collected, then they can be preserved as alcoholic fluid specimens (or alcoholic and skulls) with the organs left in the body.

**a. TK Data Sheet** The NK sheet is the link among all mammal specimen tissue preparations and preserved materials from an individual mammal. Without a properly completed TK sheet, a sample quickly loses its scientific value.

- TK sheets are prenumbered pages for the mammal section of the UCONHM Frozen Tissue Collection.
- Only one TK number, and one TK sheet, is assigned to each individual mammal collected. All the separate tubes of tissue that are preserved have the same TK number and are referenced on the same TK sheet.
- All embryos taken from a female mammal which are sampled, or frozen whole in cryotubes are considered separate individuals and given separate TK numbers. Their relationship to maternal sample should be noted on their TK sheet.
- TK sheets should be completely filled out and the data from the TK sheets should be entered into the mammal collection database as soon as possible.
- Nalgene lab markers are suitable for labeling specimen tubes and the ink should be archival quality. Pencil is preferable to water soluble ink on TK sheets.

**b. Information Entered on TK Sheet:**

- The scientific name of the mammal
- TK Number
- The country, state, county e.g. USA/Oklahoma/Logan
- Specific locality-The most precise description of the site where the specimen was collected. It can include references to natural landmarks that are referenced on maps and gazetteers. Roads, city parks, and motels are less dependable than cities, mountains, and rivers.
- Latitude & Longitude are used to relate specimen data to geographic databases. The format should be: degrees-minutes-seconds. Label longitudes with E(ast) or W(est) and latitudes with N(orth) or S(outh).
- The name of the collector who acquired the specimen and their affiliation  
*e.g.*: John Doe, ODWC
- The name of the person who prepared the samples and who completed the TK sheet.
- The collector's catalog field number is used to associate different parts of the specimen, associated materials, and data sheets.
- The date of collection (and the date of death) should be entered. The day that the specimen was collected may not be the date that it died. Add clarifying information as needed. Dates should be in this format: 3 November 1946.
- The Date of Preparation is when the tissues were removed from the mammal. The preferred format is: e.g. 3 November 1946
- Voucher: in this area of the TK form enter information about anything else that is being submitted as a voucher for the tissues. Examples include skin and skull, fluid specimen, photograph, skull only, frozen specimen, etc.
- **Measurements:** Record standard mammal measurements (see how to skin a mammal below for how to take the measurements). Lengths in mm and weight in grams. Standard measurements for mammals are:
  - **Total length:** measure mammal from tip of nose to tip of fleshy part of tail
  - **Tail length:** (mammal on stomach) bend tail at a right angle, measure from the bend on the back to tip of the fleshy part of tail.
  - **Hind foot length:** (from bottom of the foot) measure from heel to the end of the longest toenail
  - **Height of ear from notch:** from notch at bottom of ear to outer edge of ear
  - **Weight:** in grams
- **Reproductive Condition:** Record as detailed information as possible about the reproductive condition of the mammal specimen: e.g. size of testes, number and size of embryos and which horn of the uterus they are in, condition of mammary tissues, lactating, post lactating, nonscrotal, scrotal, etc.
- On the Preserved Material line on the TK data sheet, indicate the number of cryotubes of each tissue being preserved. If heart and kidney were frozen together in one tube, write "1" under #tubes for "heart & kidney" and "Fz" for frozen, under pres.

- Record the method used to preserve each tissues. Abbreviations such as Fz (frozen), Form (formalin), EtOH (70% ethanol), can be used as long as the abbreviations are clearly explained on the TK sheet.
- In the “**Other**” section of the TK sheet, list associated materials that were preserved: stomach samples, feces, ear clippings, etc.
- It is useful to other researchers to grade the tissues collections on a scale of 1 to 5 for freshness. On the TK data sheet, indicate the condition of the tissue sample.

**5** - The best tissues - from a freshly killed mammal (not dead longer than 30 minutes) and put into liquid nitrogen.

**4** - These tissues are from mammal specimens that are a few hours postmortem and at cool temperatures. However, these tissues should not have been previously frozen and thawed.

**3** - These tissues are mammals that have been dead for less than sixteen hours at cool temperatures, or they are tissues taken from a mammal that was frozen soon after death and then thawed for preparation. None of the fur is slipping.

**2** - These tissues are from mammals that are beginning to decompose

**1** - These tissues are flaccid and autolyzed. They probably smell bad.

**c. How to Fill and Label Cryotubes** In the mammal museum’s frozen tissue collection, tissue samples from mammals are generally stored in color coded 1.8 milliliter plastic cryotubes.

- The cryotubes should be labeled with a Nalgene lab marker permanent marker prior to cooling. If the tubes are not labeled before cooling, it might be necessary to rewarm the cryotubes in order to write on them.
- The standard tissues saved are heart, kidney, liver, and spleen. For small mammalian species entire organs are each stored in one cryotube. For larger animals, a sample of the organ is taken and placed in a cryotube. In some cases, muscle, skin, or blood may be collected.
- Tissue specimens should be kept as clean as possible, but are not necessarily sterile. However, it is imperative that cross contamination between individuals be avoided. All instruments and work surfaces should be cleaned after each individual mammal is sampled. A 10% solution of chlorine bleach works well to clean instruments. The instruments are wiped dry, rinsed in clean water, and then wiped until dry with a clean tissue paper. The bleach destroys DNA and is also an excellent disinfectant. Alcohol preserves DNA and therefore should not be used to clean instruments.

- **Tube Colors:**

*Gray* = Spleen

*Lavender* = Brain

*Orange* = Kidney (by itself, not with heart)

*Red* = Heart, Kidney, Spleen, and Lung

*White* = Whole frozen Embryo or Parasites

*Yellow* = Liver

- **Common Cryotube Problems:**

- If a cryotube is overfilled with tissue and fluid, it can split when the materials freezes and expand. Fill only to the fill line (approximately 2/3 full).

- Tighten caps firmly. Loose caps might allow the tissue to spill out and if alcohol is used it will evaporate.
- Poor handwriting and faulty/improper labeling pens can lead to problems. Write TK numbers on the tubes at least twice, as well as on the cap.

#### **d. How to Preserve Tissue Samples in Ethanol for DNA Analysis**

Mammal tissue samples for DNA analysis can be preserved in ethyl alcohol.

- Tissue samples (about 0.3 g = about the size of a small green pea) can be preserved in ethyl alcohol. Using scissors or a scalpel cut or nick it several times. This will increase the alcohol penetration into the tissue.
- Place the nicked sample in a cryotube and add 95% ethanol to the fill line of the tube. Cap tightly and gently agitate it so that the tissue sample is floating free.
- After 24 hours, replace the original alcohol with fresh alcohol. Recap the tube tightly to prevent the alcohol from evaporating.
- Be careful when labeling each cryotube. If possible, do not use a Sharpie because alcohol will dissolve the ink. It is best to place all samples from one individual mammal into a separate storage container and label that with an alcohol-proof label (pencil or Uniball Deluxe pen) Also attach a waterproof label with ID information (in pencil or Uniball Deluxe pen ) to each tube.

**6. Traditional Museum Skin and Skull Specimens.** The traditional way of preparing a mammal specimen for long-term storage in the mammal section of the UCONHM is as a study or museum skin and skull. In this process, the organs, musculature, and most of the skeleton of the specimen are removed, and the body cavity is filled with cotton. This method leaves the outer skin and the distal portion of the legs and feet containing the limb bones. The objective is to maintain the original shape and size of the mammal specimen. In some cases, when the mammal specimen is not suitable for preparation as a study or museum specimen, the specimen might be prepared in a different manner, such as a skeleton or a fluid specimen...

**a. Preparing a Traditional Mammal Study Skin** after all the measurements have been taken and recorded in the field catalog and the skin and skull tags are completely prepared then the following steps can be used as a guide on how to prepare a traditional skin and skull specimen.

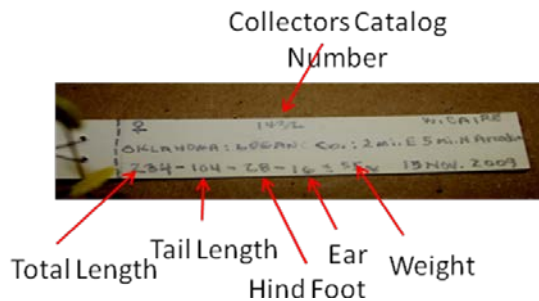
**Making a study skin will require the following instruments and supplies:**

- Collectors Catalog – to record measurements
- Rolled cotton (similar that used in making quilts) for the body.
- Long fiber first aid cotton for use in the tail.
- Wire (various thicknesses for different sized mammals)
- Skin and skeleton tags (use those prepared by the museum where the specimen will be deposited)
- Wire cutters
- Pen with waterproof ink or pencil to record data on the tag and in catalog
- Cornmeal
- Needle and thread (various size needles and colors of thread to match the hair color)
- Metric ruler
- Cardboard or Styrofoam for pinning the specimen while it is drying
- Top loading scale or Pesola scale



- Trays or plate on which to do the skinning and paper towels
- Gloves (optional – some will want to use gloves for safety reasons)
- String (100% cotton – similar to that used in crocheting)
- Long map pins or other pins with large heads

**Before the specimen is skinned the following measurements should be taken and recorded in the collectors catalog and written on the tag that will be tied on the specimen after it is skinned.** All measurements are recorded in millimeters or grams. Some species may require other measurements for example bats – forearm and tragus are also measured. Weigh and measure the specimen and record these data and the sex on a museum data sheet. Include any field number and locality data from field notes that is available



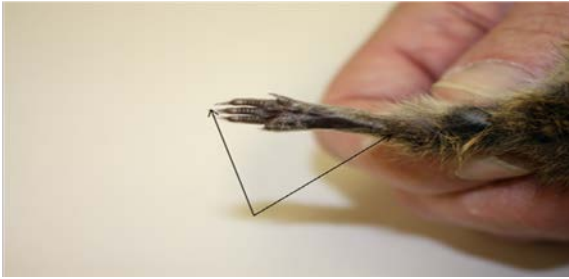
- Total length (tip of nose to tip of tail along dorsal surface; see figures)



- Tail length (from base to tip of tail)



- Foot length (hind foot, from heel to tip of longest toe)



- Ear length (form notch to tip of pinna)



- Weight (g) – this is shown using a Pesola scale



**Preparing a Traditional Mammal Study Skin** - after all the measurements have been taken and recorded in the field catalog and the skin and skull tags are completely prepared:

- Roll the specimen in clean dry cornmeal



- Pinch the skin of abdomen between the fingers of one hand so that it is separated from the muscular body wall and make a longitudinal incision through the skin to a point just anterior to

the anus. Do not cut into the abdominal wall. If it is perforated, wedge in a small piece of cotton to keep contents from getting on the skin.



- If skinning a male, evert the penis and sever this organ between the skin and body as close to the body wall as possible so that the penis remains attached to skin and everted



- Gently tease the skin back over the leg to expose the knee joint and down to the ankle. Cut through the lower bones of the leg leaving the bones in the foot and in the skin



- Continue to sprinkle in cornmeal as you skin in order to absorb any fluids
- When both legs are free down to the ankles, cut through the rectum and reproductive tracts to free the skin from the carcass



- Pinch the skin on the tail base between the thumb and forefinger nails and begin wiggling the base of the tail of the carcass and pulling at the same time until the tail vertebrae and attached muscles slide out the tail skin without the skin turning inside out



- Working forward on the body, continue to tease the skin loose from the body being careful to not stretch the skin



- Free the front legs in the same manner as the hind legs and then cut through the lower limb bones leaving the bones of the foot in the skin. On a bat do the wings in the same way as the legs but cut through the humerus above the elbow to ensure the forearm measurement can be taken



- Dissect forward onto the head until the base of the ears are visible and then cut the cartilage of the auditory canal as close to the entrance of the skull as possible



- After freeing both ears, continue to carefully dissect forward until the posterior edges of the eyes are located



- Very carefully hold the skin slightly away from the head and using a scalpel or razor blade, cut through the membrane just over the eye. Do this slowly so that a large hole is not produced and the eyelids are retained.



- Continue past the eyes until the lips are reached and then cut the lips from the skull



- Carefully cut the nasal cartilage to release the skin from the body



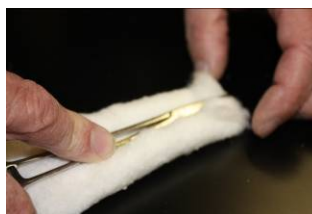
- Remove any pieces of flesh or blood still on the skin



- Sew the mouth shut using a baseball stitch (Y shape). Start on the bottom lip – then over to one side of the mouth and then the other – pull tight and tie off



- Form a cotton body by rolling cotton into a tapered cylinder about the size of carcass that was removed



- Clamp the nose end of the cotton body with locking hemostats and turn the inside out skin back over the cotton body.



- Position the nose on the cotton and release the hemostats



- Run short pieces of wire down into each of the feet



- Slide a straight wire (with fine first-aid cotton spun around it to mimic the thickness of the tail that was removed) into the tail skin - the wire should exceed the length of the tail and extend up into the body in order to provide extra support for tail and body.



- Sew up the incision with needle and cotton thread



- Brush all the cornmeal from the skin.



- Prepare a skin tag and attach the string on the tag according to the picture. The string is inserted through the holes of the tag to form a loop, twisted and then the thread is passed back through the loop and pulled tight against the tag. A knot is tied in the string 1 inch from the tag.



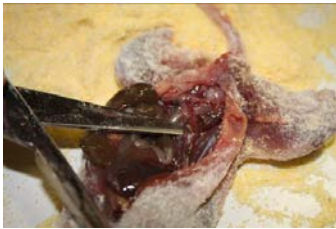
- Tie the specimen tag to the right hind foot



- Pin out the specimen (see picture – a pin through each front foot – tuck front feet under chin; pin tail straight - cross pins over distal portion of tail and near base of body; place a pin next to each ankle to keep hind legs near tail; pins through hind feet and position hind feet near tail).



- Examine the reproductive tract of females for the presence of embryos and placental scars. Count the number of embryos on each side of the uterus and record that on the skin tag and in the catalog. Also measure the crown to rump length of a representative embryo and record that. On males measure the length of a testical and record whether the testes are scrotal, inguinal or descended.



- Remove the head from the body (if the postcranial part of the body is not being skeletonized). Complete a skull tag for the head and tie it to the skull. It is tied to the head by carefully inserting one end of the string between the rami of the lower jaw and then out through the cheek. The skull is then dried and prepared for the beetle colony.



**7. Mammal Skeletal Material** During the preparation of a mammal specimen skin or a pelt it is possible to extract a nearly complete skeleton. Incomplete skeletons are also valuable. When some mammal specimens are damaged and/or would not make a good museum skins or pelts, they can become skeletal preparations. If the bones are left disassociated from each other, this is called a disarticulated skeleton, and is useful when mammalogists need to study the individual bones of a mammal. If the bones are connected in their original order, this is an articulated skeleton which allow the study of the interrelationships of bones as a complete skeleton. Skeletons and individual bones are useful for those who conduct systematic, biomechanic, evolutionary, and paleontology, and forensic investigations.

**a. Skull Extraction From/Before Making a Fluid Specimen** Most skulls are removed from the body after a specimen has been skinned and stuffed and then placed in a dermestid beetle colony for cleaning. However, the steps listed below will assist in extracting a skull from a previously fluid stored specimen or from a specimen that is freshly caught and being prepared for fluid preservation

- Carefully extend a cut from the corner of the mouth on one side of the head posterior to enlarge a hole through which the skull will be extracted
- Peel the facial skin back from the mandible and rostrum using a combination of forceps, small blunt probe, a razor and/or small scissors
- When dissecting the skin free in the nasal region, avoid damaging any noseleaf or other appendages present
- Do not cut or damage the zygomatic arches
- Be careful around the eyes to ensure that the skin does not end up having unnaturally large eye openings



- The auditory meatus must be severed on each side of the skull to free the ears. This should be done near the surface of the skull to avoid making an unnecessary hole in the skin.
- When cutting the skull free, be careful to cut the cervical spine in order to avoid cutting the occipital section of the skull
- A skull tag with the field number and information which corresponds to that on the leg of the fluid preserved specimen should immediately be attached to the extracted skull to ensure that there is no subsequent confusion or loss of information related to the skull

#### **b. Manual Cleaning of Skulls After Extraction From a Fluid Preserved Specimen**

- The skull after extraction from the fluid preserved specimen, with its temporary skull label attached, should be suspended in gently boiling/simmering water (instant immersion very hot boiling water may crack the skull)
- Small mammal skulls should remain in simmering water for about 15 minutes, 20 minutes for medium sized skulls and 30 minutes for larger skulls. The length of time will vary slightly depending on the method of fluid preservation, number of years in the preservative, etc. Times will have to be adjusted accordingly. If a skull is boiled too long, the skull will tend to fall apart along suture lines and teeth might fall out.
- After boiling, the skulls should be allowed to air cool and then temporarily placed in cold water (after 24-36 hours the skulls might begin to smell and after longer time periods putrefaction sets in which will damage the skulls.
- A dissecting microscope will be useful for cleaning small skulls.
- The tongue can be removed by carefully cutting around the inside of the mandible and extracting the tongue with a pair of forceps
- Muscles on the braincase and all other parts of the skull should be peeled/scraped off with very fine pointed forceps, small scalpels and scissors. Do not damage the fine bones of the skull such as the hamular processes and the post palatal spine if present
- Mandibles can then be gently teased away from the braincase – be careful to not break the zygomatic arches
- Brain remains can be removed through the foramen magnum using a hooked probe, forceps and gentle water jets
- After cleaning, the skull should be allowed to dry in a specimen box with its label pinned alongside it
- Once cleaned (and dry), the skull is labeled in permanent ink with the accession number- each half of the mandible as well as the cranial portion
- The skull with its label should be stored in a glass vial
- Skulls are placed in an archival cardboard tray in the cabinet near the skins

#### **c. Cleaning Skull and Skeletal Material With Dermestid Beetles**

A colony of dermestid beetles is one of the most efficient ways to produce exceptionally well cleaned mammal skulls and skeletal material. However, extreme caution must be taken to ensure that the beetles do not escape into the main collection. for care use and maintenance of a dermestid colony.

##### **(1) Drying & Preparation Mammal Skulls & Skeletons for Dermestid**

**Cleaning** Mammals vary in the degree of preparation for cleaning by dermestid beetles. The beetles do not eat through skin very well and do not like moist specimens; therefore it is important to dry out each specimen for a number of days before presenting it to the bugs. If chemicals were used to kill the specimen or were placed on it after death, be sure to clean the specimen with warm water inside and out. If the animal was placed in some type of preservation (e.g. Formalin or Ethyl Alcohol) the bugs will not eat the specimen.

**(a) Small Mammals (Bats, Mice, Squirrels)**

- remove all skin
- remove all internal organs
- eyes and brain may remain in the cavity.
- dry for 2 days

**(b) Medium/Large Mammals (Rabbits, Coyotes, Deer)**

- removed all skin
- remove all internal organs
- remove eyes and brain
- remove as much muscle mass from the body as possible
- disarticulate major limbs from body so that they will fit into the bug colony
- dry for 4 to 6 days - turning the specimen to make sure each side dries

**(2) After Drying the Specimen** How you prepare a dried specimen for the bugs is critical. If this step is not done properly you will lose bones and/or ID tags.

**(a) Skulls** If only preparing a skull the work is limited.

- Make sure you have an ID tag - often prepared by person making the skin
- Tie the tag around the lower jaw- if not already in place. To do this, take a pair of tweezers, while holding one end of the string from the tag between the tweezers, and push the tweezers tip through the floor of the bottom jaw. Then release the tweezers and hold onto the string. Then tie the two strings together (one will run under the lower jaw the other will run above the lower jaw). This allows the bugs to eat all around the skull without the tag falling off.

**(b) Small Full Skeleton (e.g. Shrews, Bats, Mice)**● **1<sup>st</sup> Method:**

- Take out a role of cheese cloth, appropriate to the size of the animal, and unfold it to its thinnest layer.
- Place the small animal, along with the appropriate ID tag, on the cloth and
- begin to roll and wrap the specimen like you would a sub sandwich.
- After you have rolled and wrapped the specimen several layers deep,
- tie a string around it to keep the cheese cloth from coming undone.
- Since the larval bugs are the ones who actually eat the meat from the bones it will be no problem for them to move through the cloth. This method prevents most bones from being removed from the cloth.

● **2<sup>nd</sup> Method:**

- Gather small cardboard boxes and lower the walls of the boxes to 3-4 in high.
- Place specimen into the box and place into the bugs. The cardboard is rough enough that the bugs can grip the surface and move easily into and out of the box. However, the bones are too heavy for the bugs to drag over the walls of the box.

- You can create dividing walls and place several specimens in one box. Make sure that the divider is secure to the bottom and sides of the box so the bugs can not move it.

**(c) Large Full Skeleton (Badgers, Deer)** Each disarticulated bone needs to have its own personal ID tag, or you may put all the bones into one colony and tag one bone for identification. Make sure it is the only specimen in that colony.

**(3) Into the Dermestid Colony** Once the specimen has been dried, prepared and placed in the bug tank,

- you will need to check the specimens daily or every other day depending on the size of the animal and how hungry your colony is.
- spray specimens with water at least every other day. Use only 2-3 sprays per tank - do not over moisturize the area. - if the area feels moist to the touch do not spray it that day -too much water will cause the bugs to get beetle lice and kill the colony
- time to get cleaned varies depending on animal size, temperature and humidity-also influenced by the season - in winter months the colony will slow down and not eat as rapidly as in summer and spring
- small animals such as bats and mice should only take a couple of days
- larger animals will take weeks to months- depends on colonies taste (some prefer one type of meat over another).
- Watch the specimens carefully; when the bugs are extremely hungry they can clean a specimen very quickly. This can cause disarticulation of ribs and vertebrae.

**(4)After Removal From the Beetle Colony** After the beetles have cleaned the bones, remove the specimen from the colony.

- place the specimens into trays and immediately place them in to a freezer. The bugs should die in about a week - make sure that all the bugs are dead.
- soak the skeleton in ammonia for approximately 10 min. This will make sure any larvae or eggs are killed.
- clean the bones of the bug feces - use warm water, soap and a toothbrush and gently clean the skull or skeleton - clean it until water runs clear over the parts
- the next step is optional - to whiten the bones more - soak the skull/skeleton in 3% solution hydrogen peroxide overnight. Obviously the higher percent solution you go the better results you will get and the less time you will have to soak.
- Do not soak the skull or skeleton in bleach - bleach will eat through the cartilage and into the pores of the bone, making the specimen fragile and disarticulated.
- lay the bones (skull & skeleton) on white paper towels to dry – do not let them get mixed up with those from another specimen.

**(5) Mammal Skull & Skeleton Labeling and Storage**

- once cleaned (and dry) the skull and or the individual bones (if large enough) are labeled in permanent ink with the accession number- each half of the mandible as well as the cranial portion and each individual bone
- the skull with its label should be stored in a glass vial
- skulls are placed in an archival cardboard tray in the cabinet near the skins

**8. Preparing a Baculum** The baculum or os penis is a bone in the penis of some species of bats and other mammals that can be used as an aid in identification. It can be removed from the skin, cleared, stained and stored in a vial near the specimen.

**a. Equipment for Baculum Preparation and Storage**

- Small plastic or glass tubes
- Glycerin
- Alizarin red powder
- 5% Potassium hydroxide solution
- Forceps
- Labels – museum quality paper for fluid storage
- Permanent ink pen with ink that can be used for fluid storage labels

**b. Steps in Baculum Preparation and Storage**

- Remove the penis by cutting off the organ as close to the surface of the body as possible and place it in a small glass or plastic tube with a secure lid
- Label the tube with collector's field number and add the museum accession number when it is cataloged into the museum.
- Using forceps, take the penis from the container and place it in a test tube half filled with water and bring to the boil and simmer for 2 minutes
- Invert the tube on to a fine wire mesh suspended over a beaker, so that the penis is visible
- Half fill the original container with 5% KOH (potassium hydroxide) and a pinch of alizarin red powder (stains the baculum a pink color) add the baculum and leave for 24 hours.
- Dissect the baculum from the tissue under a dissecting microscope with fine forceps
- Empty and wash the original tube and half fill with glycerine and return the baculum to the tube
- Make sure the tube is labeled with
  - Collectors original field number which should be the same as that of the fluid specimen, the body, skull or skeleton
  - Date of collection
  - Locality and geographical co-ordinates
  - Museum accession number which should be the same as the body. The museum catalog and database should indicate that there is a baculum associated with the specimen
- Store in an upright position

**XVII. EXPENSES ASSOCIATED WITH CURATING THE MAMMAL SECTION OF THE**

**UCONHM** At first glance, it may appear that the expenses associated with curating a mammal collection might be relatively inexpensive. Inventory personnel might collect the mammal specimens and associated materials and deliver them to a museum to handle. However, when carefully considered in detail, it is apparent that the costs of collecting mammal specimens are just a fraction of the total financial picture. The cost of a mammal collection includes not only the cost of collecting a mammal specimen in the field, but the costs associated with curation: preparing, storing, and maintaining the collection as well as the staff. All such components must be considered when preparing a museum budget for a mammal collection.

## XVIII. SUPPLIERS OF MAMMAL CURATORIAL EQUIPMENT IN THE UNITED STATES

Specifications	Company	Address	Tel:	E-mail:	Web page
Large Skin Case					
Small Skin Cases					
Small boxes					
Medium boxes					
Large boxes					
Drawers	Small, 25 per case	each			
Drawers	Large, 10 per cabinet	each			
Trays					
Jars					
Lids					
Skinning Cotton					
Tail Cotton					
Drawer liners					
Skull vials					
Plastic containers for fluid specimens					
Wire					
Ultracold freezer					
A 45 gallon drum of 99% isopropanol is approximately \$280.00 and a 5 gallon pail of 95% ethanol is approximately \$100.00.					
Other					

---

**A good Source for Vendors of museum supplies can be located at:**

**Society for the Preservation of Natural History Collections web site**

**<http://140.247.98.87/?q=resources/vendors.html#vendors>**

**XIX. LITERATURE CITED .....**

- Animal Care and Use Committee Guidelines for the capture, handling, and care of mammals As approved by The American society of Mammalogists Prepared by the American Society of Mammalogists [https://www.mammalsociety.org/uploads/committee\\_files/CurrentGuidelines.pdf](https://www.mammalsociety.org/uploads/committee_files/CurrentGuidelines.pdf)
- Elbroch, M. 2003. Mammal Tracks and Signs, A guide to North American Species. Stackpole Books. Mechanicsburg, PA 779 Pp.
- Hafner, M. S. W. L. Gannon, J. S.-Bravo, and S.T. Alvarez-Castañeda. 1997. Mammal Collections in the Western Hemisphere, American Society of Mammalogist. A Survey and Directory of Existing Collections American Society of Mammalogists. Pp 97.
- Hall, E. R. 1962. Collecting and preparing study specimens of vertebrates. Univ. Kansas Misc. Pubs., 30:1-46.
- Lowery, J. C. 2006. The tracker's field guide. The Globe Pequot Press, Guilford Connecticut 408 pp.
- McLaren, S. B., P. V. August, L. N. Carraway, P. S. Cato, W. L. Gannon, M. A Lawrence, N. A. Slade, P. D. Sudman, R. W. Thorington Jr., S. L. Williams, and S. M. Woodward. 1996. Documentation standards for automatic data processing in mammalogy Version 2.0.7 American Society of Mammalogists Committee on Information Retrieval. Pp 68.
- Nagorsen, D. W., and Peterson, R. L. 1980 Mammal collector's manual: A guide for collecting, documenting, and preparing mammal specimens for scientific research. Life Sciences Miscellaneous Publications, Royal Ontario Museum.
- Wilson, D. E. and D. M. Reeder. 2005. Mammal species of the world: a taxonomic and geographic reference. Smithsonian Institution Press. 1206 pp.



**B. Mammal TK Form****UCONHM – Mammal Section TK Sheet**

Species \_\_\_\_\_ TK # \_\_\_\_\_

Country \_\_\_\_\_ State \_\_\_\_\_ County \_\_\_\_\_

Specific Locality \_\_\_\_\_

Lat and Long. \_\_\_\_\_

Elevation \_\_\_\_\_

Collector \_\_\_\_\_ Collection Date \_\_\_\_\_

Preparator \_\_\_\_\_ No. \_\_\_\_\_ Preparation Date \_\_\_\_\_

VOUCHER \_\_\_\_\_ Skin \_\_\_\_\_ Skull \_\_\_\_\_ Post-cranial skeleton \_\_\_\_\_ Fluid \_\_\_\_\_

Other \_\_\_\_\_

UCONHM Mammal Section Catalog Accession Number \_\_\_\_\_

**MEASUREMENTS** \_\_\_\_\_

\_\_\_\_\_ TL Tail Hind Ft. Ear Wt FA Tragus \_\_\_\_\_

\_\_\_\_\_ Male \_\_\_\_\_ Female Reproductive Condition \_\_\_\_\_

**TISSUE:**

\_\_\_\_\_ Heart/Kidney \_\_\_\_\_ Lung \_\_\_\_\_ Reproductive Organ

\_\_\_\_\_ Heart \_\_\_\_\_ Spleen \_\_\_\_\_ Entire Specimen

\_\_\_\_\_ Kidney \_\_\_\_\_ Brain \_\_\_\_\_ Lysis buffer \_\_\_\_\_

\_\_\_\_\_ Liver \_\_\_\_\_ Blood \_\_\_\_\_ Alcohol \_\_\_\_\_

\_\_\_\_\_ Muscle \_\_\_\_\_ Embryo \_\_\_\_\_ Other \_\_\_\_\_

**OTHER PREPARATIONS:**

\_\_\_\_\_ Mitotic \_\_\_\_\_ Meiotic \_\_\_\_\_ Tissue Culture

\_\_\_\_\_ Sperm \_\_\_\_\_ Karyotype \_\_\_\_\_ Other \_\_\_\_\_

**MISCELLANEOUS:**

Age: \_\_\_\_\_ Juvenile \_\_\_\_\_ Subadult \_\_\_\_\_ Adult

\_\_\_\_\_ Molting \_\_\_\_\_

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_