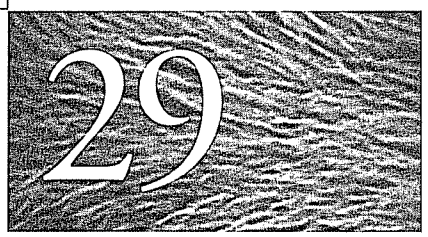
CHAPTER



RECORDING DATA

Field observations yield valuable data on mammal distribution, abundance, habitat tolerances, feeding habits, reproductive cycles, behavior, etc. In order to record these observations for later reference, it is essential to develop good note-taking practices. Accurate and complete field notes will be of value to the observer and to other scientists at later dates. With the passage of time, environmental conditions change, and old field notes can be valuable sources for documenting and analyzing changes.

Primary data refer to original notes, observations, or measurements made on a specimen, live animal, or habitat. These data can be recorded in field notes, tally sheets, specimen tags, tape recordings, or computer media. **Secondary data** refer to any of these observations after they have been subsequently transcribed (e.g., rewritten) or transferred to another medium (e.g., entered into a computerized database). When secondary data are utilized, the researcher must *proofread* the secondary data file against the primary data to insure that transcription of the primary data has been done accurately.

The format of the field notes should be flexible and permit changes to fit a given situation. A suggested method for recording data follows, with various examples of notes and labels. Additional suggestions can be found in Hall (1962) and Mosby (1969a:61–72; 1980:45–54).

EQUIPMENT

Paper and Notebook

Good quality white paper (of neutral or slightly alkaline pH) should be used for notes. A bond paper having a rag content of 50% to 100% is preferable. This paper is durable and will resist water damage and deterioration due to age. Sulfide papers (e.g., computer printout and most lightweight notepaper) should *not* be used because they are highly susceptible to deterioration and water damage. Paper with dimensions of 6 1/4" × 8 1/2" is of a convenient size to work with.

We recommend that the paper be placed in a sturdy three-ring binder or notebook. Index dividers may be used to separate different sections of the field notes. The use of a ring binder has advantages and disadvantages. With the binder, it is easy to lose a few sheets of paper and thus render your field notes incomplete. This possibility could be avoided by using a prebound volume of blank pages, as is often done on extended field expeditions. A danger to the field notebook is loss or damage in the field. Thus, many field-workers use two notebooks. One contains past field notes and is stored in a safe place in the office, whereas the other, containing only current notes, is taken into the field. At the end of each portion of fieldwork, the notes are removed from the field notebook and inserted into the permanent one. This system, impossible with a prebound volume, frees the bulk of the data from the chance of loss or destruction in the field.

Inks and Pens

A *black waterproof ink* should be used for writing field notes and data on specimen tags. The ink must also be resistant to alcohol and formalin, to grease and other animal fluids, and to the ammonia or detergent frequently used in cleaning skeletal material. Refer to Williams and Hawks (1986) for information on suitable inks. Ballpoint, nylon- or felt-tipped pens (or washable fountain pen inks), should *never* be used because these pens rarely use permanent ink or may have broad tips that bleed through the paper. If permanent ink is not

available, a No. 2 or 2 1/2 pencil can be substituted until a permanent-ink pen is available.

Permanent inks will quickly clog most fountain pens. The Rapidograph made by Koh-I-Noor and similar pens made by Pelikan, Castell, and other companies are among the few pens that will work with these heavy inks. Although less convenient (but more economical), a staff pen and point may be used. Some disposable pens (e.g., Uniball Deluxe) have fine tips and permanent ink and are suitable for writing on specimen tags. Some fine-tip permanent-ink felt pens are suitable for making marks on tubes to be placed in liquid nitrogen containers. *You should always verify that the ink in any pen used for writing data and specimen labels is permanent by independent testing under "real world" conditions.*

Specimen Labels

Labels for study skins, for tanned skins, skulls, and entire skeletons should be made of 100% rag stock white paper and should be of sufficient thickness to allow string to be attached without danger of tearing the paper. Labels for fluid preparations (entire animals, organs, etc.) must be made of heavy weight, 100% rag stock.

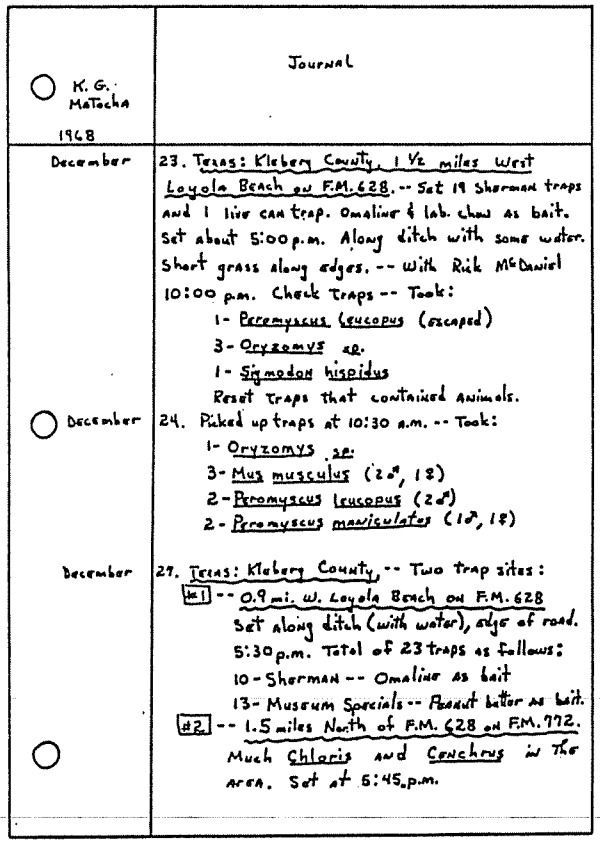
FIELD NOTES

Some mammalogists and other vertebrate biologists organize their field notes into three sections: (1) **journal,** (2) **catalog,** and (3) **species accounts.** The catalog, a numbered listing of all specimens preserved, is essential if any capture and preservation of mammals is done. The journal, a field diary of all activities and observations, is highly recommended for all types of fieldwork. The species account section includes detailed observations on particular species. Special data-recording forms (see: "Special Data Forms") may be filed separately or included with the journal and species accounts sections.

Journal

The field journal is a complete, chronological record of the activities and observations of an investigator. The what, when, where, who, and how of all fieldwork should be recorded here. Results of the work should be described, along with supplemental information on habitat, general impressions of mammal populations, conversations with residents of the area, and any additional information that is potentially helpful.

The name of the investigator and the year should be recorded at the top of each page. Number the pages consecutively beginning with 1. Record the exact locality and date of each observation or account. The locality should list country, state, county, and miles (or kilometers) and direction from a permanent map feature (e.g., town, city, mountain). The date should be written out fully (e.g., 14 July 2000). Figure 29.1 is an example of a journal page. Methods of recording location, date, and other data follow.


K. G. Matocha

1968

Journal

December — 23. Texas: Kleberg County, 1 ½ miles West Loyola Beach on F.M. 628. -- Set 19 Sherman traps and 1 live can trap. Omaline & lab. chow as bait. Set about 5:00 p.m. Along ditch with some water. Short grass along edges. -- with Rick McDaniel 10:00 p.m. Check traps -- Took:
1- Peromyscus leucopus (escaped)
3- Oryzomys sp.
1- Sigmodon hispidus
Reset traps that contained animals.

December — 24. Picked up traps at 10:30 a.m. -- Took:
1- Oryzomys sp.
3- Mus musculus (2♂, 1♀)
2- Peromyscus leucopus (2♂)
2- Peromyscus maniculatus (1♂, 1♀)

December — 27. Texas: Kleberg County, -- Two trap sites:
#1 -- 0.9 mi. W. Loyola Beach on F.M. 628
Set along ditch (with water), edge of road.
5:30 p.m. Total of 23 traps as follows:
10- Sherman -- Omaline as bait
13- Museum Specials -- Peanut butter as bait.
#2 -- 1.5 miles North of F.M. 628 on F.M. 772.
Much Chloris and Conchrus in the area. Set at 6:45 p.m.

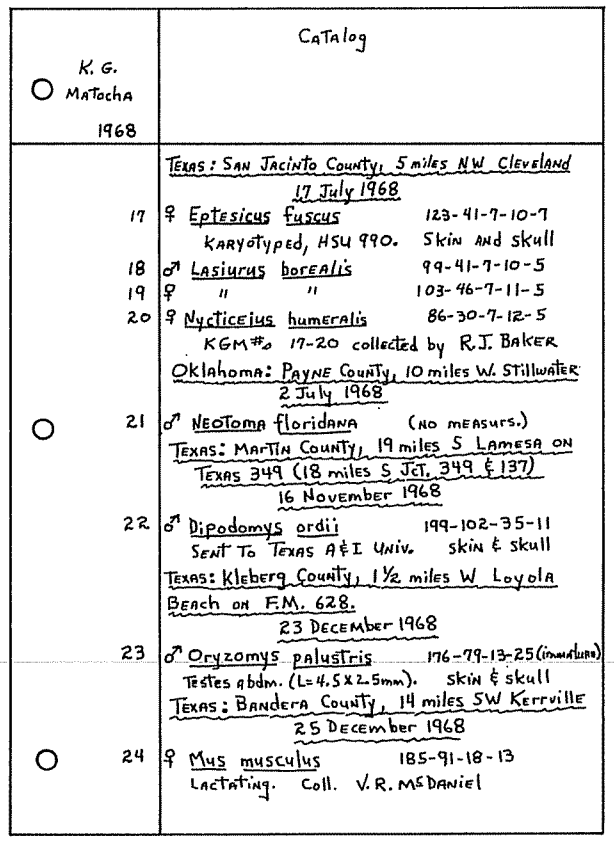
Figure 29.1 Sample field journal page. Original size 6 1/4 × 9 inches.
(K. G. Matocha)

Catalog

The catalog (Fig. 29.2) is a record of all specimens that are preserved in any manner. Each specimen is assigned a number that is associated with the name of the collector. If you have never captured and preserved animals previously, your first entry will be designated number 1. Throughout your life, *never repeat a number* once it has been used for an animal.

Species Accounts

This section of the field notes can be very useful when many observations are being recorded on a single species. Information on a particular species is called a species account. List the scientific name and common name of the animal at the top of the page. Give the date and location of the observation. As time permits, record



K. G. Matocha 1968

CATALOG

TEXAS: San Jacinto County, 5 miles NW Cleveland
17 July 1968

17 ♀ Eptesicus fuscus 123-41-7-10-7
KARYOTYPED, HSU 990. SKIN AND SKULL

18 ♂ Lasiurus borealis 99-41-7-10-5

19 ♀ " " 103-46-7-11-5

20 ♀ Nycticeius humeralis 86-30-7-12-5
KGM#s 17-20 collected by R.J. BAKER

Oklahoma: Payne County, 10 miles W. Stillwater
2 July 1968

21 ♂ Neotoma floridana (NO MEASURS.)

TEXAS: Martin County, 19 miles S Lamesa on
Texas 349 (18 miles S Jct. 349 & 137)
16 November 1968

22 ♂ Dipodomys ordii 199-102-35-11
SENT TO TEXAS A&I UNIV. SKIN & SKULL

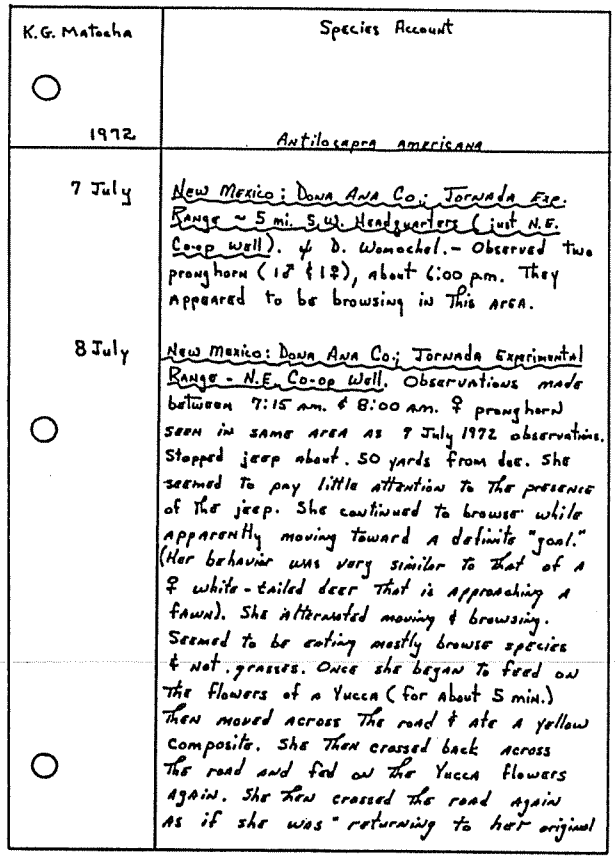
TEXAS: Kleberg County, 1½ miles W Loyola
Beach on F.M. 628.
23 DECEMBER 1968

23 ♂ Oryzomys palustris 176-79-13-25 (immature)
Testes abdm. (L=4.5x2.5mm). SKIN & SKULL

TEXAS: Bandera County, 14 miles SW Kerrville
25 December 1968

24 ♀ Mus musculus 185-91-18-13
Lactating. Coll. V.R. McDANIEL

Figure 29.2 Sample field catalog page. Original size 6 1/4 × 9 inches.
(K. G. Matocha)



K.G. Matocha 1972

SPECIES ACCOUNT

Antilocapra americana

7 July

New Mexico: Dona Ana Co.; Tornada Exp. Range ~5 mi. S.W. Headquarters (just N.E. Coop well). ♀ D. Womochel. - Observed two prong horn (1♂ 1♀), about 6:00 pm. They appeared to be browsing in this area.

8 July

New Mexico: Dona Ana Co.; Tornada Experimental Range - N.E. Co-op Well. Observations made between 7:15 am. & 8:00 am. ♀ prong horn seen in same area as 7 July 1972 observations. Stopped jeep about 50 yards from doe. She seemed to pay little attention to the presence of the jeep. She continued to browse while apparently moving toward a definite "goal." (Her behavior was very similar to that of a ♀ white-tailed deer that is approaching a fawn). She alternated moving & browsing. Seemed to be eating mostly browse species & not grasses. Once she began to feed on the flowers of a Yucca (for about 5 min.) Then moved across the road & ate a yellow composite. She then crossed back across the road and fed on the Yucca flowers again. She then crossed the road again as if she was "returning to her original

Figure 29.3 Sample species account page. Original size 6 1/4 × 9 inches.
(K. G. Matocha)

observations made on the species, even those that may seem insignificant at the time. These additional observations may prove valuable in later analyses of data. Reference can be made to pages in the journal for additional information. Figure 29.3 is an example of a species account.

LOCALITY

Geographic Information Systems, Maps, and Map Scales

August (1993) provided a very useful and detailed discussion of how to create accurate locality data for use in geographic information systems (GIS). His account is must reading for anyone interested in creating accurate geographic data and using those data in GIS applications. Manufacturers of GIS software, global positioning system (GPS) receivers, state agencies, and universities also have vast quantities of information available. Using search terms such as *GIS, GPS,* or *mapping,* will help you find this material. The sections that follow and the paper by August (1993) will also help guide you in the search for information and data.

Accurate determination of locality depends on an understanding of maps and map scale. Typically, the scale of a map is determined by the representative fraction. The **representative fraction** of a map is the ratio between the map distance and the ground distance between equivalent points (Campbell 1998). The representative fraction is independent of units, although typically maps are designed to be multiples of either metric or English measuring units. For example, the standard quadrangle map (quad) in the United States is the 7 1/2 minute series that has a representative fraction of 1:24,000. For this **large-scale map,** 1 inch on the map is equal to 24,000 inches on the ground or 2,000 feet; in a 1:50,000 scale map, 1 mm on the map is equivalent to 50,000 mm (50 meters) on the ground. The larger the denominator of the representative fraction, the less detail will be present on the map. On a typical 7 1/2 minute quadrangle map, one can theoretically plot a location to about ± 31.25 feet (calculated by dividing 2,000 feet by 64, where the 64 represents the denominator of a 1/64 inch fine pencil line). On a 1:250,000 **small-scale map,** that same1/64 inch line could mark a position accurate to only about ± 325.52

feet (calculated by dividing 20,833.33 feet by 64). United States Geological Survey map standards state that a given point has only a positional accuracy of ± 40 feet on a 1:24,000 scale map, and a positional accuracy of ± 443 feet on a 1:250,000 scale map (Ian Martin, *in litt.*). Scale on published maps is often indicated by a graphic scale drawn on the map. A graphic scale on a map has an advantage when the map is enlarged or reduced because the scale will always be correct no matter what the ultimate size of the published map.

Large-scale (e.g., 7 1/2 minute quads) and small-scale (e.g., 1:100,000 or 1:250,000) maps are available in the United States from the U.S. Geological Survey, special depository libraries, or private vendors. All of these maps are available in digital form (usually distributed on CDs) from private vendors (e.g., TopoDepot, SureMaps, or LandInfo) or, in the small-scale versions, from federal and state agencies. You can find these federal and state agencies and the private companies by Internet searches or by checking the appendices in references such as Campbell (1998).

Universal Transverse Mercator, State Plane, and Latitude/Longitude

In the United States, standard quadrangle topographic maps (7 1/2 minute) have important reference marks (called **tics**) positioned along the neat line of the map. The **neat line** of the map is the line that forms the boundary of the map. This neat line is inset from the paper boundary of the map, and at each corner of the neat line you will see the latitude and longitude values for that corner. The 7 1/2 minute quads in the United States are referenced to the **1927 North American Datum (NAD 27).** The quad maps updated in recent years also show position marks for the **1983 North American Datum (NAD 83),** which is a geographically more accurate datum (August 1993; Campbell 1998). Position data derived from the NAD 27 maps can be corrected to the 1983 datum by using routines in GIS software *or* by setting a GPS receiver to receive data in the updated datum.

As you move away from the corners of the map, you will see three different tic marks that are positioned at right angles to the neat line of the map. These tic marks will specify the **latitude/longitude** positions, the **state plane coordinates,** and the **Universal Transverse Mercator (UTM) coordinates**. (Some older quad maps may not have UTM coordinates.) These marks are easy to recognize once you understand the labeling system, as follows:

State plane coordinate values: Black lines that cross the neat line on either side. *These lines are 10,000 feet apart* and *show all digits* of the state plane values. These numbers may or may not have feet associated with the printed number.

UTM coordinate values: Blue lines that also cross the neat line. *These lines are 1,000 meters apart.* The numbers for the UTM values *will not show the last three zeros* in the number and will have an "m" for meters at the end of the written number. Newer 7 1/2 minute quads and 1:100,000 scale maps will have the 1,000 × 1,000 UTM grid superimposed onto the topographic maps, which makes alignment and measurement much more precise.

Latitude and longitude coordinate values: These values are indicated by the corners of the map and by *black lines at 2.5′ intervals* that end at the neat line and do not go into the white space beyond the neat line. Because the distance between successive minutes of longitude depends on one's location on earth, there is no set distance between a minute of longitude for all maps. For example, at the equator (0 latitude), a degree of longitude is 111.319 kilometers (km), while at a latitude of 35°, a degree of longitude would be only 91.288 km (Campbell 1998). There is also a very slight difference between successive minutes of latitude due to the flattening of the earth at the polar regions (Campbell 1998).

Latitude and longitude values are often converted to decimal degrees to avoid the complexity of dealing with degrees, minutes, and seconds and to facilitate processing of data by GIS software. For example, in decimal degrees, a latitude of 35 degrees, 30 minutes, and 15 seconds would be 35.504167 and would be calculated as follows:

decimal degrees	35.000000	
decimal minutes	0.500000	[30/60]
decimal seconds	0.004167	[15/3600]
Sum of values =	35.504167 decimal degrees	

Once you have found your location on a map, the appropriate tic marks on the neat line of the map can be used to interpolate your position with respect to a given coordinate system. Use a straight edge, triangle, and a finely sharpened pencil to make the north/south line (the X-values or "eastings") and east/west lines (the Y-values or "northings") on the map. Then, measure from these map lines to the locality and either subtract or add the appropriate distances to get the coordinate values that are closest to the position you are trying to describe. (Fig. 29.3 shows the procedure for UTM coordinates.) Be sure to align the ruler carefully because even a slight movement of the ruler can introduce hundreds of feet of error into the final result. In the map legend, you will see information about the correct zone for either the state plane coordinates or the UTM coordinates. These zones must be recorded along with the appropriate coordinates to correctly locate the position on the face of the earth. The zone information is also required in GIS software when digital map positions are converted to a different coordinate system (e.g., projecting latitude and longitude values to state plane coordinates). Also make note of the datum (e.g., NAD 27 or NAD 83) if coordinate conversions are anticipated.

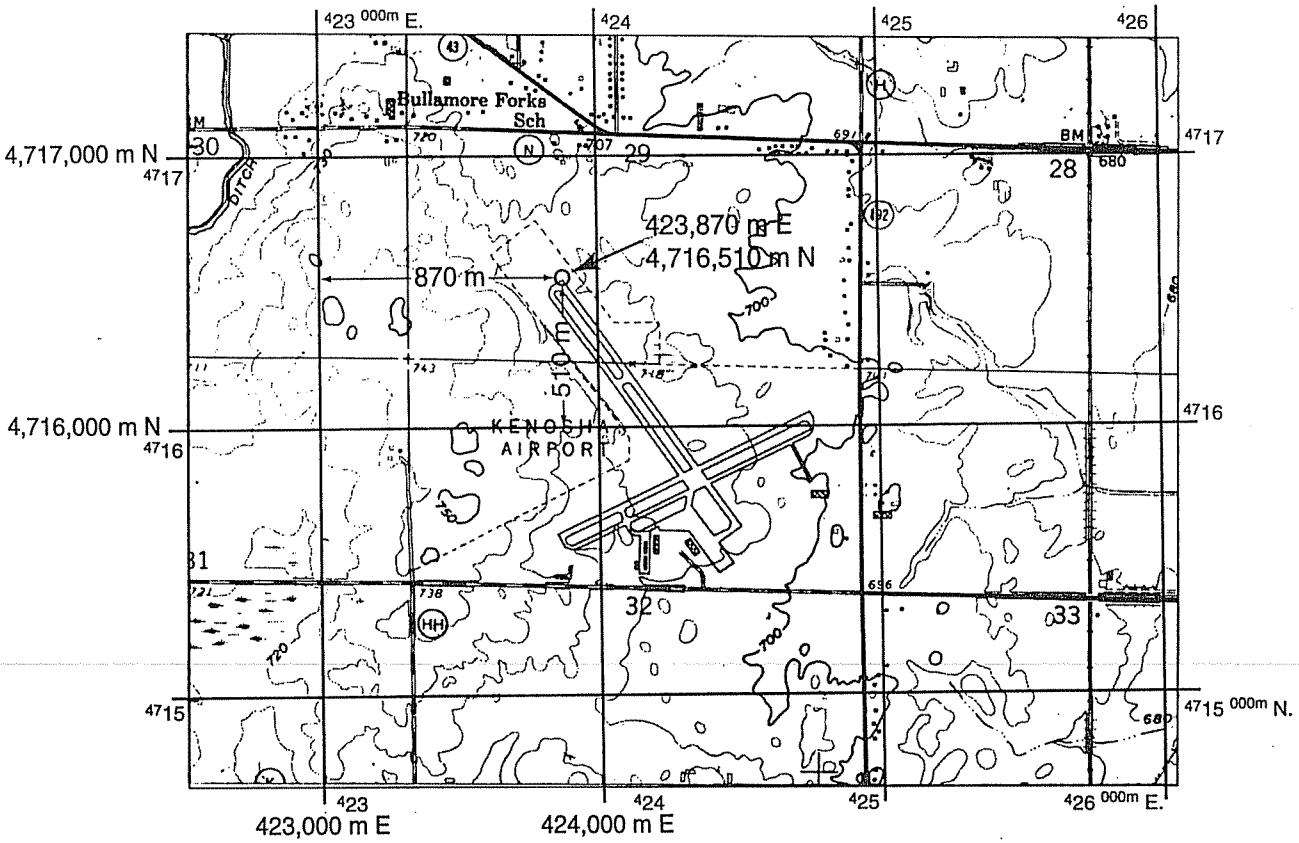


Figure 29.4 Use of a UTM coordinate grid on a portion of a standard 7 1/2 minute topographic quadrangle map, Pleasant Prairie, Wisconsin, 1:24,000 scale, 1971 edition. In this example, the UTM coordinate grid is shown drawn on the map, and the located feature (the Kenosha Airport) is indicated by an arrow. The UTM coordinates for this position would be 4,716,510 m N, 423,870 m E, Northern Hemisphere, Zone 16.
(Campbell 1998:57)

In Figure 29.4, the UTM coordinates for the north end of the Kenosha (Wisconsin) airport are indicated by the arrow. The coordinates for this position are 4,716,510 m N, and 423,870 m E, Northern Hemisphere, Zone 16. This information, along with the state and county, would also be part of the locality description in a journal entry or specimen tag. The UTM coordinates and zone would be sufficient for use by GIS software.

Typical Locality Descriptions

As described by Williams et al. (1977), there are two principal systems for written locality descriptions: *specific to general* and *general to specific.* Various institutions have adopted standard ways for locality descriptions to be written on specimen labels. In this manual, we give examples of the general to specific scheme because, among other things, it clearly has a distinct advantage for retrieval using data-processing techniques. Data for localities in the United States should include *state, county* (or *parish*), and *miles* (or *kilometers*) and *direction* from a recorded permanent map feature such as a courthouse (or a principal intersection in smaller towns).

TEXAS: Hockley County; 3 m N Ropesville or
TEXAS: Hardeman County; 2 mi. N, 3 mi. E Quanah

For locations in countries other than the United States, use country, political subdivision (e.g., department, province), and kilometers (or miles) from a recorded prominent map feature.

IRAN: Fars Province; 15 km N Shiraz

More precise locality data are valuable and should be recorded when possible (see "Other Coordinate Systems" section that follows). Geographic coordinates (latitude and longitude, accurate to minutes and seconds; UTM coordinates), legal land descriptions, and elevations provide the most accurate and lasting data.

NEW MEXICO: Doña Ana County; south edge of Red Lake, T 18S, R 1E, SW 1/4 of Section 27

or

NEW MEXICO: Doña Ana County; south edge of Red Lake, 32°42′ N, 107°10′ W

In decimal degrees, the latitude and longitude values for the New Mexico example would be 32.7000000 N,

107.1666667 W, although this implies more precision than is actually present in the original data.

Sometimes the reference landmark may be in one county (or other political subdivision), while the specimen was actually taken in an adjacent county. Always list the county in which the specimen was taken.

> OKLAHOMA: Harper County; 3 miles N Fort Supply (Note: Fort Supply is a town in Woodward County, Oklahoma)

We recommend that only cardinal compass directions (N, S, E, W) be utilized and that N or S precede E or W, where appropriate. A direction given as NE is imprecise and difficult to pinpoint (i.e., is the specified NE direction *exactly* 45 degrees from the N-S axis?). In addition, one should avoid use of road junctions or railroad intersections as locality descriptors for specimens. If used, they should be listed as additional comments in the journal.

> CHILE: Santiago Province; 1 km N, 0.5 km E Cerro Manquehue

Other Coordinate Systems

Crawford (1983) proposed using a grid system for more accurately specifying specimen localities. Under this system, a specimen taken in North America can be pinpointed to about 111 meters by using decimal degrees (latitude and longitude with minutes accurate to 0.001). Hamaker and Koeppl (1984) described a method for transferring points on a map to geographic coordinates. These coordinates could then be used to prepare an updated map on the same or another projection. Geographic Information Systems (GIS) is a multidisciplinary field that links geographic coordinate data with an information database of attributes. Mammalogists are advised to collect geographic data in a manner that is suitable for use in GIS programs. See McLaren and Braun (1993) for additional information on the use of GIS in mammal studies. Also, refer to the "Coordinate Data from Global Positioning Receivers" and the "Universal Transverse Mercator, State Plane, and Latitude/Longitude" sections in this chapter for methods to generate the most accurate locality data and make these data suitable for use in a GIS.

Coordinate Data from Global Positioning Receivers

Several systems are available worldwide to receive coordinate data from global positioning satellites. In the United States, the Department of Defense has a system of 24 or more satellites that send position data by radio signals. On the ground or in the air, civilian **global positioning system (GPS)** receivers provide very accurate coordinate data ***if*** *care is taken to correct the data for the effects of selective availability.* **Selective availability (SA)** is an intentional random error introduced into the GPS signal by the U.S. Department of Defense so that the position data on civilian GPS receivers may be off by ± 100 meters (± ca. 300 feet). At some locations, this error in the position can be corrected by use of **differential correction,** which uses data from a known location, contemporaneous in time with the GPS receiver (the **rover**) data, to correct the coordinate data collected by the rover.

Through purchase of a subscription, differential data can be received in *real time* by the GPS rover through a radio signal received from satellites (e.g., *Omnistar*) or from radio signals received from certain FM stations (Differential Corrections, Inc.). Close to the coast and along navigable rivers, the U.S. Coast Guard provides radio signals with differential data that can be picked up at no cost by radios and transmitted to the GPS receiver for real-time correction. Alternatively, one can *postprocess* the rover data using differential data from a known location. Often, manufacturers of GPS equipment have links to GPS reference station data that can be accessed on the Internet and downloaded to your computer for postprocessing. Universities and state agencies (e.g., Texas Department of Transportation) also provide differential data on the Internet to be used for postprocessing.

Low-cost GPS receivers generally do not have the capability for postprocessing of coordinate position data. Thus, unless you are able to receive a radio link to have these rover data processed in real time by a radio link, then you must be satisfied with coordinate data with an error of ±100 meters. Even these position data can be better than locality coordinates determined using odometers on a car (typically ±528 feet when read to 0.1 mile) or localities determined using typical small-scale highway maps or other small-scale maps with scales of 1:100,000 or 1:250,000.

Date

The date of collection should be written out completely. Do not write "4/1/00" because this may be interpreted as either "1 April 2000" or "4 January 2000." Likewise, never use only the last two digits (e.g., "00") for the year. Because collections have lasted and should last for hundreds of years, the above date could in the future be interpreted as "1 April 1800" or "1 April 1900." The recommended method for writing the date is "1 June 2000" or "15 February 2000" because placing the numeral before the month eliminates the necessity of a comma. If the specimen is taken alive and dies or is killed at a later date, the date of death and the date when captured should both be recorded.

Measurements, Weight, and Sex

Mammal specimens should be measured prior to preparation. The standard measurements for a mammal are always listed in the following order: (1) *total length,* (2) *tail length,* (3) *hindfoot length,* (4) *ear length,* and in bats,

(5) *tragus height,* and (6) *forearm length.* The measurements are taken in millimeters, and each measurement is separated by hyphens because this punctuation mark is unlikely to be interpreted as a numeral. The weight is recorded in metric units: grams or kilograms.

The sex should be recorded using the symbols ♂ for male and ♀ for female. Write "sex?" if the sex cannot be determined. Indicate immature, juvenile, or subadult if one of these terms is appropriate.

Refer to Chapter 31 for the techniques of measuring, weighing, and sexing mammals.

Reproductive Condition

If the specimen is a male, measure and record the length (exclusive of epididymis) and breadth of a testis. For example, if the testis measured 15 mm in length and 7 mm in breadth, the notation on the tag might read **Testis 15 × 7 mm.** If the species is one in which the testes descend seasonally, record their position, such as **testis descended** or **scrotal,** or **testis abdominal** or **nonscrotal.** If the specimen is a female, check the uterus for embryos, and record your observations. If embryos are present, record their number, their locations in the uterus, and their crown-to-rump length (CR) in millimeters. For example, if a female specimen had six 15-mm embryos, of which two were in the right uterine horn and four in the left uterine horn, then the abbreviated notation on the label might read: 6 Embs. = 15 mm CR, 2R, 4L. If the female is lactating, make note of this. If embryos or any portion of the reproductive tract are preserved for later examination, attach a label with the collector's initials and catalog number of the female and note the type of preservation (see Table 29.1) in the catalog. Refer to Chapter 31 or to Taber (1969), Larson and Taber (1980), or Brown and Stoddart (1977) for additional information on ascertaining the reproductive condition of a specimen and for precautions to be observed when doing the necropsy.

Parasites

In epidemiological surveys, extensive records are kept on individual hosts. An ectoparasite survey data sheet utilized by personnel of the Division of Mammals, Smithsonian Institution, is shown in Figure 29.5. One data sheet was completed for each host captured and sampled for ectoparasites. See Chapter 32 for additional information on collecting and preserving ectoparasites.

Portions Preserved (Type of Preservation)

The usual mammal specimen consists of a study skin and skull. If the postcranial skeleton, baculum, embryos, stomach contents, or any other portions of the specimen are preserved, these should be noted in the catalog and on the skin tag (if any). If ecto- and/or endoparasites are preserved, these should be mentioned. If the specimen is preserved in liquid or in any manner other than a standard study skin and skull, note this fact. If either the skin or skull is badly damaged, or if, for some reason, it is not preserved, then record exactly what is included as a specimen.

Table 29.1 Types of Preservation Often Found in Collections of Mammals*

Code	Definition
AL	Alcoholic
SS	Skin and skull
SB	Skin, skull, and body skeleton
SN	Complete skeleton
SK	Skull only
SO	Skin only
SA	Alcoholic with skull removed
KB	Skin and body skeleton (no skull)
AN	Anatomical
PS	Partial skeleton
CO	Cranium only
HM	Head mount
BM	Body mount
SC	Skin, skull, and alcoholic carcass
BS	Body skeleton
OT	Other, with explanation in comments
HO	Horn(s) only
AO	Antler(s) only
BO	Baculum only
MO	Mandible only
TH	Tooth(teeth) only
TK	Tusk(s) only
SM	Skin, skull, and baculum

*Refer to American Society of Mammalogists Committee on Information Retrieval (1996) for additional information.

Standard types of preservation (Table 29.1) recognized by the Committee for Information Retrieval of the American Society of Mammalogists can be found in Williams et al. (1979) and American Society of Mammalogists Committee on Information Retrieval (1996). Explain the nature of the specimen if it does not fit one of the standard categories.

Methods of Collection

A brief mention should be made of the method used to secure the specimen. "Snap-trapped" or "shot" are examples of adequate catalog or label descriptions, but more detailed notes should be made in the journal. The abbreviation **DOR** is frequently used to designate an animal found dead on the road. If the animal is caught in a baited trap, it is useful to name the bait used.

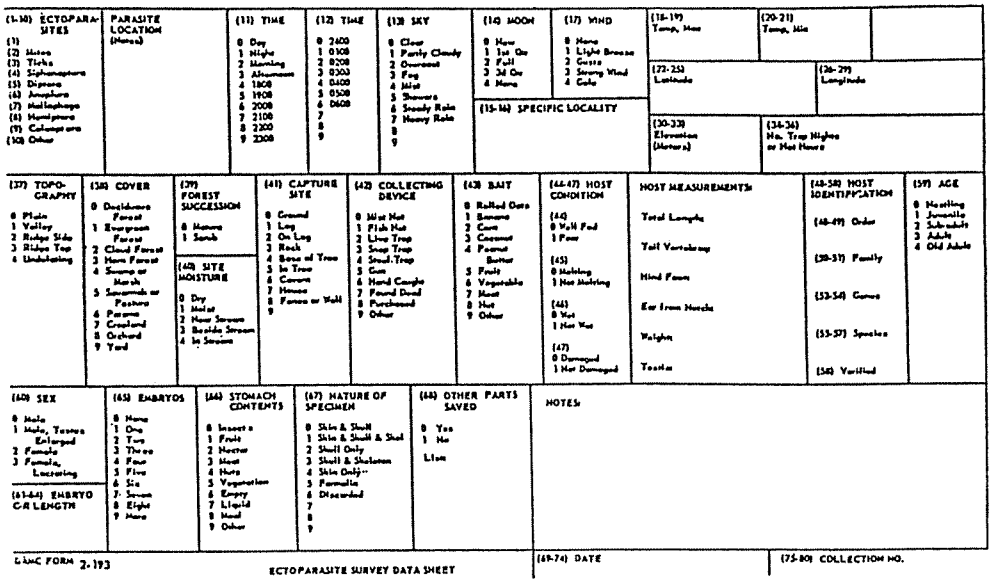


Figure 29.5 Ectoparasite survey data sheet. Original size 5 1/2 × 8 1/2 inches.
(Division of Mammals, Smithsonian Institution)

The six items or elements of data listed earlier (total length, tail length, hindfoot length, ear length, tragus height, and forearm length) are usually included with each catalog entry and on skin tags. The locality, date, sex (if ascertainable), and type of preservation are essential elements that must be included with each entry. At times, it may not be possible to record the other data. For example, it is not possible to record tail length, sex, or reproductive data for a weathered skull found in the field.

SPECIMEN LABELS

For each specimen recorded in the field catalog, a corresponding data tag (or tags) should be attached to the specimen (and to each of its separate parts). Depending upon the specimen preparation technique, several different kinds of tags may be required for each mammal. If you are collecting for a museum or university collection, the institution will usually provide you with the necessary specimen tags. If these are not provided, use the types of paper recommended earlier.

STUDY SKINS

Labels or tags for study skins are usually about 3" × 3/4". All of the data from the catalog entry should be recorded on the tags in permanent ink. Include your field catalog number, first initials, and entire surname (Fig. 29.6). The exact arrangement of data on the tag

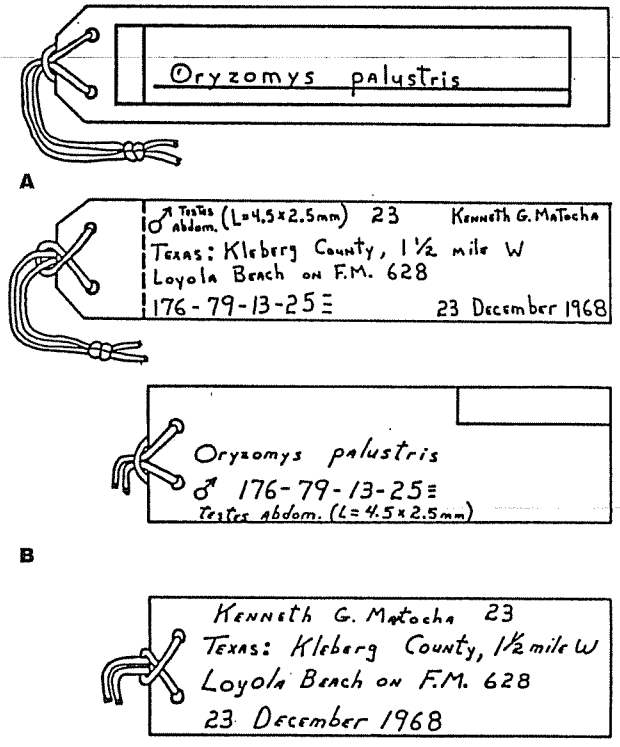


Figure 29.6 Both sides of two specimen tags. (A) The style used by the University of Kansas Museum of Natural History. (B) The style used by the Oklahoma State University Museum. Note that a space is always left blank for the museum's catalog number.
(K. G. Matocha)

varies from collection to collection. If you are collecting for an institution, use the preferred format. All data (except, perhaps, ecological notes) should generally go on one side of the tag. This will make your specimens easier to work with. Although most of the data are entered in permanent ink, the identification (scientific or common name) will be entered in pencil once identification is made at the museum collection.

Thread the tag through two holes punched at least 1/8 inch from one end and tie an overhand knot in the string about 1 inch from the tag. See Figure 29.6A for the correct way to string a tag. Use a square knot to securely attach the tag just *above the right ankle* of a study skin. With bat skins, the label is sometimes attached above the knee joint to allow for greater visibility of the calcar and to protect the feet (see Fig. 31.21).

Use the same type of label for a skull or any other bones (e.g., a weathered skull or skeleton) that will not require cleaning.

Skulls and Skeletons to Be Cleaned

The type of label described earlier will usually not survive the cleaning processes used for skeletal material. Thus, the skull tag is usually a small piece of resistant paper that has only the collector's name and field catalog number and the sex of the specimen. After the skull or skeleton has been cleaned, a permanent label, including data from the museum catalog, will be placed with the specimen.

Figure 29.7 illustrates a skull tag. Again, the string should be knotted about 1 inch from the tag. Attach the tag loosely around a mandibular ramus of an uncleaned skull, and secure with an overhand knot incorporating both strands (see Fig. 31.22). Attach the tag to the pelvis of a complete skeleton or to secure locations on each portion of a partly disarticulated skeleton.

Figure 29.7 A skull tag. Note that a knot is tied in the string about 1 inch from the tag.
(K. G. Matocha)

Skins to Be Tanned

Because few tags can survive the tanning process, either of the two types described earlier may be attached to a skin to be tanned. A secure point of attachment for the tag is through an eye hole. Prior to tanning, special code marks are punched into the skins to insure correct reference to the catalog number of the specimen. After the specimen has returned from the tanner, the permanent specimen tag bearing complete data will be reattached to the skin.

Fluid Preservation

The type of specimen labels described earlier are usually not substantial enough to survive long immersion in alcohol or formalin. Thus, special, heavy-duty tags (usually parchment) are required (Fig. 29.8). Complete data from the field catalog are entered on these tags with permanent ink. If a whole animal is preserved, tie the tag securely *above the ankle* of the *right hindfoot.* Several specimens may then be placed in one container.

If embryos, stomach contents, parasites, or some detached portion or portions of the specimen are preserved in fluid, a separate container must be used for each, *or* each portion may be securely tied in cheesecloth and a tag attached to each cheesecloth package. Several of these packages can then be placed in one container (*Note!* This recommendation holds only if mixing of fluids from several specimens would not alter the results of subsequent studies; mixing might be a problem with certain biochemical studies.) A label with complete data should be inserted *into* the container. Labels attached to the outsides of the containers all too frequently come off and are lost.

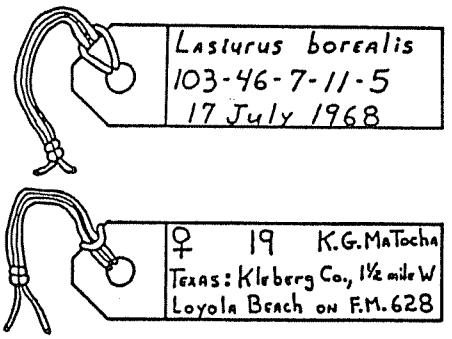


Figure 29.8 The two sides of a tag for a specimen preserved in fluid.
(K. G. Matocha)

PERMANENT RECORD ( ) PLOT_____ INCLUSIVE DATE_____

DATE	TOT. NO.	Species	Coordinates	Wt.	Sex	Sexual Condit.	Hat. Stag	No.	Remarks

Figure 29.9 Data recording sheet for small mammal censusing. Original size 8 1/2 × 11 inches.
(P. L. Meserve)

Special Data Forms

In many situations, it is appropriate and convenient to utilize special forms for recording data in the field and laboratory. In live-trapping studies, data on spatial location, condition of animal, and other information must be maintained. For these purposes, a tally sheet (Fig. 29.9) or a more elaborate form is utilized to facilitate subsequent transcription of the records onto computer disks or other input media.

Recording Measurements

For quantitative analyses, extensive measurements are generally recorded on coding sheets that permit accurate transcription to computer databases. Semiautomatic systems for making linear measurements are in use (Anderson 1972; Calaprice and Ford 1969; Sneath and Sokal 1973:452–53). Consult advertisements in the journals *Science* and the *Journal of Mammalogy,* among others, for details on some of the available systems. Voice-activated tape recorders and voice-activated computers also offer the capability for data entry.

Recording Behavior

Because behavioral events can occur in quick succession, coding sheets are designed for rapid recording. Even so, instrumentation and keyboards are usually necessary for recording sequences of behavior. Instrumentation is available for direct recording and transcription of behavioral events under field conditions (Butler and Rowe 1976; Lehner 1996; Stephenson et al. 1975). With the advent of notebook and palm computers, there is increasing use of these devices to gather primary data under field and laboratory conditions. Techniques for recording behavior were described by Altmann (1974) and Lehner (1996) and were briefly summarized by Feldhamer et al. (1999:29).

Computers

Computers provide fast and relatively easy means for getting handwritten or typed primary **data** into a **database.** These devices also serve as a primary method for entering data in the laboratory or in the field. *Notebook computers* and *palm computers* are miniature versions of these microcomputers. Voice-activated data entry is also available but not yet very reliable. Most database programs on the market today offer the capability to transfer information from one computer system or database to another kind. To effect this transfer, data can be transferred by *modem,* or the two computer systems can be directly connected through a network, a cable, or infrared beam. In all cases, the user is encouraged to proofread data after transfer to a database or after transfer to another system, to insure that no errors in characters or formatting have been introduced as a result of the transfers. Texas Tech University developed a relational database (Wildcat III) to capture primary data (field notes, personal preparation catalog, and specimen tags) in the field for later transfer, following verification, into the museum's collection database (King et al. 2000).

Documentation Standards for Museum Specimens

Williams et al. (1979) drafted a set of "Documentation Standards for Automatic Data Processing in Mammalogy," under the auspices of the Committee on Information Retrieval in Mammalogy of the American Society of Mammalogists. In 1996, version 2.0 of these standards was published under the auspices of the Carnegie Museum of Natural History and the American Society of Mammalogists Committee on Information Retrieval (American Society of Mammalogists Committee on Information Retrieval 1996). In the updated version 2.0 standards, the data fields were divided into *essential, preferred,* and *optional* categories of data (Table 29.2). The essential data fields would be those data elements that should be transmitted between institutions that have networked connections. The preferred fields would be those categories of data that are useful for research or collection management. The optional fields would be data categories that might be useful to some but not all collections.

Mammalogists and other investigators working with mammals should strive to record specimen data in accord with these standards. This will not only promote consistency in data recording but will help insure more accurate and useful specimen data for researchers. In Table 29.2, we have listed the essential, preferred, and optional categories that are used for specimen data. Refer to the earlier publication by Williams et al. (1979) and the 1996 publication (American Society of Mammalogists Committee on Information Retrieval 1996) for additional comments about these data categories.

TABLE 29.2 Essential, Preferred, and Optional Data Categories Used in Collections of Mammals

Data Category		
Essential Data Categories	*Preferred Data Categories*	*Optional Data Categories*
Institutional acronym (for data transfer only)	Availability status	Divisional acronym
Collection catalog number	Accession number	Special number
Genus	Family	Donor
Species	Subspecies	Date cataloged
Type of preservation	Specific locality or reference point/reference point modifier	Published records
Sex		Type description
Date collected	Elevation	Order
Collector or preparator or both	Latitude and longitude (for old specimens)	External measurements
Collector's number or preparator's number or both	UTM (for old specimens)	Weight
Country		Age
State, province (first-level political subdivision)		Reproductive data
County, district (second-level political subdivision)		Ecological notes
Ocean		Continent
Sea		Township and range
Bay, inlet, strait, gulf, channel, major island group		Coordinate precision index
		Remarks or comments
Latitude and longitude (for new specimens)		Ancillary collections
UTM (for new specimens)		Specimen condition reporting

Refer to American Society of Mammalogists Committee on Information Retrieval (1996) for additional information.