

LLELA Small Animal Key for Owl Pellet Analysis

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Small Animal Key: Introduction

Lewisville Lake Environmental Learning Area (LLELA) covers 809ha of land undergoing conservation and restoration efforts. LLELA includes one of the final remaining Blackland Prairie Ecosystems, an ecosystem that once covered the majority of Texas. LLELA also supports two forest systems (the Eastern Cross Timbers and the Bottomland Hardwood Forests). The Elm Fork of the Trinity River runs through LLELA, creating aquatic ecosystems such as wetlands, ponds, and creek drainages.

The wide range of ecosystems present in LLELA allows for an even wider range of inhabitants. Owls, such as the Barn Owl and Long-Eared Owl, rely on LLELA's abundant small animal population to support themselves. In order to understand the relationships between predator and prey, it is important to understand which predators feed on which prey. Barn Owls and Long-Eared owls prey on a variety of small rodents and shrews. They will also feed on small birds and bats, though this rarely occurs.

A dichotomous key for identifying prey from owl pellets is listed below. The key below works to identify and characterize the possible prey of the Barn Owl and Long-Eared Owl in LLELA. The key includes two insectivores, *Cryptotis parva* and *Blarina carolinensis*, and seven rodents, *Neotoma floridiana*, *Sigmodon hispidus*, *Rattus rattus*, *Baiomys taylori*, *Mus musculus*, *Reithrodontomys* spp., and *Peromyscus* spp.

The goal of a dichotomous key is to eliminate other species from the list of possibilities and to eventually identify the specimen. Dichotomous keys are made up of a series of steps to help narrow down the specimen's species type. Each step has at least two parts listing variations of a specific characteristic. Directions stating what step to move on to according to the characteristics of the specimen are located to the right of each character variation; figures and species types are listed here also. Dichotomous keys do not illustrate phylogenetic relationships, nor should they be used as the sole means of identifying the specimen type. To achieve the most accurate results, utilize dichotomous keys, take measurements, and observe the type of fur present (if any).

The key below is split into skulls and mandibles. Often times while dissecting owl pellets, only portions of a skull are found. The first portion of the key will discuss how to identify species based on identifying characteristics of the skull. The second portion of the key discusses how to identify species when only the mandibles are present.

When going through the key with an unknown specimen, pay close attention to the size and shape of the skull, the incisors and teeth, and the coronoid, condyloid, and angular processes of the mandible. To aid in the identification process refer to the glossary of terms and labeled skulls provided on the following page.

Key Terms:

Angular process: sits below the condyle, usually right where the jaw bone begins to angle upwards

Anterior maxillary projections: projections that extend off the anterior end of zygomatic bone

Braincase or Cranium: part of skull that encases the brain

Cheek Teeth or Molars: teeth rooted in maxilla or mandible, behind the diastema

Condyle: rounded projection with a surface that can connect to another bone to form a joint. In this case, the condyle connects the mandible to the skull. (See condyloid process)

Condyloid process: where the mandible meets the skull

Coronoid: process that rises up on mandible, in between the last cheek teeth and the condyloid process

Diastema: space between incisors and cheek teeth

Fronto-parietal suture: suture that connects frontal and parietal bones

Groove: narrow depression that runs laterally down the length of the incisors

Hypsodont teeth: highly-crowned teeth (grooves will run from crown of tooth down to gumline)

Incisors: teeth at front of mouth in between canines or before the diastema

Mandible: lower jaw

Maxilla: bone that forms major portion of upper jaw

Notch: indentation present on the backsides of the incisors

Orbital Cavity: bony eye socket

Pre-maxilla: front tip of upper jaw, supports the incisors

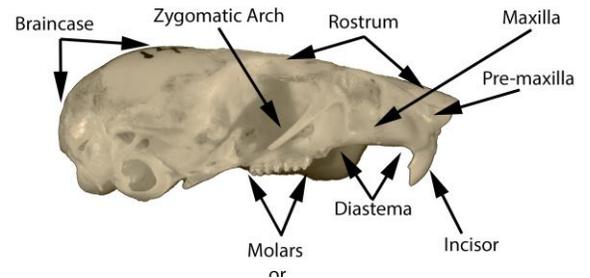
Ramus: main portion of lower jaw, holds the teeth

Rostrum: in front of braincase; include nasal cavities and mouth

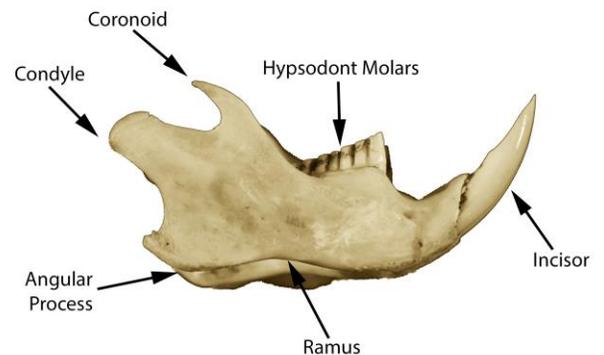
Unicusp Teeth: teeth with only one cusp

Zygomatic arch: cheek bone

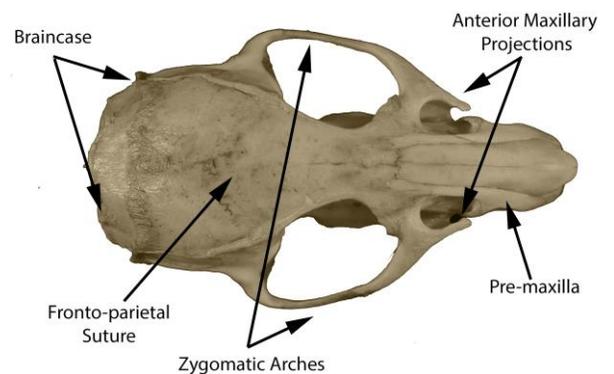
Peromyscus spp. Skull,
Lateral View



Neotoma spp. Mandible,
Labial View



Sigmodon hispidus Skull,
Upper View

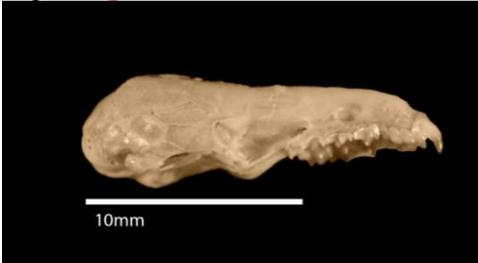
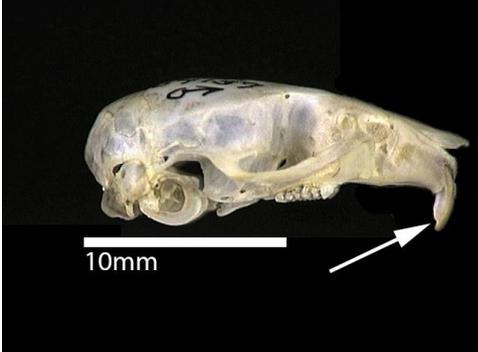


Small Animal Key: Maxillary Skull

1. (a) Braincase sits high, relative to nasal portion.
Nasal portion extends to form a beak **Bird (Aves) (Fig. 1)**
(b) Braincase is not distinct, relatively flat with snout **2 (Fig. 2)**
2. (a) Incisors and pre-maxillary bones are separated from each other at front of skull
by a distinct notch. Teeth are white in color **Bat (Chiroptera) (Fig. 2)**
(b) Pre-maxillary bone bears and incisors are connected
The incisor is large **3 (Fig. 3)**
3. (a) Shape of skull is straight, tips of teeth are typically tinted with a reddish or
blackish pigmentation
Lacking a diastema and zygomatic arch **Shrew (Soricidae) (Fig. 3A)**
(b) Skull is convex, tips of teeth lack pigmentation
Diastema and zygomatic arch are present **Rodent (Rodentia)(Fig. 5)**
4. (a) Five unicuspid teeth are present. The fifth is often hidden when viewed
laterally **Blarina carolinensis (Fig. 3B)**
(b) Four unicuspid teeth are present **Cryptotis parva (Fig. 4)**
5. (a) Upper incisors have a notch on the backside **Mus musculus (Fig. 5A & B)**
(b) Upper incisors have distinct grooves when viewed
frontally **Reithrodontomys spp. (Fig. 6A & B)**
(c) No distinct characteristic on upper incisor **6 (Fig. 7A)**
6. (a) Zygomatic bones have anterior maxillary extensions **7 (Fig. 8)**
(b) Zygomatic bones do not have anterior maxillary extensions **8 (Fig. 9A)**
7. (a) Anterior maxillary extensions are present
but not elongated **Rattus rattus (Fig. 7B)**
(b) Anterior maxillary extensions are present and elongated
Molar pattern resembles a “W” **Sigmodon hispidus (Fig. 8A & B)**
8. (a) Molars are hypsodont, skull is fairly large in size
>56.0mm in length **Neotoma floridana (Fig. 9B & C)**
(b) Molars are not hypsodont, skull is smaller in size
<30.0mm in length **9 (Fig. 10)**
9. (a) The zygomatic arch does not pass in front of the
cheek teeth **Peromyscus spp. (Fig. 10)**
(b) The zygomatic arch dips past the gum line **Baiomys taylori (Fig. 11)**

Small Animal Key: Maxillary Skull Figures

<p>Fig. 1. Birds, note the distinct braincase and its separateness from the nasal region. The nasal portion extends to form a beak. Bird skulls also lack teeth.</p>	<p>NEED IMAGE</p>
<p>Fig. 2. Bat, note the notch between the pre-maxillary bones. Also, note the teeth are white in color, no diastema is present, but specimen does have zygomatic arches.</p>	 <p>photo from adv</p>
<p>Fig. 3A. <i>Blarina carolinensis</i>, skull shown to the right is <i>Blarina brevicauda</i>, there are few differences between the species. Compare the difference between the braincase in this skull to the bird skull (Fig. 1). This braincase is less distinct. Also, note the straight shape of the skull from the braincase to the nasals. This figure displays pigmentation on the teeth and indicates the lack of a diastema, and zygomatic arches. These are common characteristics of the Soricidae family.</p> <p>Fig. 3B. Note the five unicuspid teeth present. The fifth unicuspid tooth is hidden unless viewed from underside.</p>	 <p>Fig. 3A</p>  <p>Fig. 3B photo from adv</p>
<p>Fig. 4A. <i>Cryptotis parva</i>, all characteristics are the same, or very similar to <i>Blarina</i> spp. (Fig. 3A), excluding the number of unicuspid teeth. Note that only four unicuspid teeth are present.</p>	

<p>Fig. 4B. <i>Cryptotis parva</i> is also smaller in size when compared to <i>Blarina carolinensis</i>.</p>	<p>Fig. 4A photo from adw</p>  <p>Fig. 4B</p>
<p>Fig. 5A. <i>Mus musculus</i>. The skull curves downwards from the braincase to the nasals. Notice the notch on the upper incisor; this is a distinguishing characteristic of <i>Mus musculus</i>.</p>	 <p>Fig. 5A photo from adw</p>
<p>Fig. 6A. <i>Reithrodontomys</i> spp., the upper incisor has a longitudinal groove when viewed from the front. This groove is a distinguishing characteristic of <i>Reithrodontomys</i> spp..</p>	 <p>Fig. 6A photo from arctos</p>
<p>Fig. 7A. <i>Rattus rattus</i>. Note the lack of distinguishing characteristics on the incisor</p> <p>Fig 7B. The image shows the presence of anterior maxillary processes (circled in white), but indicates their shorter length. Compare anterior maxillary process length to <i>Sigmodon hispidus</i> (Fig. 8). The arrows point to ridges on the braincase. The zygomatic arches are also relatively parallel.</p>	<p>Fig. 7A</p> <p>Fig. 7B</p>

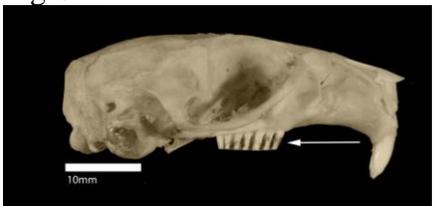
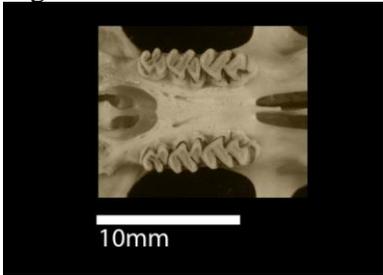
<p>Fig. 8A. <i>Sigmodon hispidus</i>, the anterior maxillary processes are elongated (circled in white in Fig. 8A). The incisor is also lacking distinguishing characteristics (not pictured). Braincase has ridges from interorbital to occipital area.</p> <p>Fig 8B. Notice the “W” shaped pattern on the molars.</p> <p>Molar pattern and elongated anterior maxillary processes are distinguishing features of <i>Sigmodon hispidus</i>.</p>	<p>Fig. 8A</p> <p>Fig. 8B</p>
<p>Fig. 9A. <i>Neotoma floridiana</i>. Notice the lack of anterior maxillary processes (see figs 7B and 8A to compare). Does not have ridges on braincase.</p> <p>Fig. 9B. Hypsodont molars with grooves running from crown to gum line.</p> <p>Fig. 9C. When viewed from the top, the molar crowns are triangular in shape.</p>	 <p>Fig. 9A</p>  <p>Fig. 9B</p>  <p>Fig. 9C</p>

Fig. 10. *Peromyscus* spp. The zygomatic arch does not dip as low as the gum line.

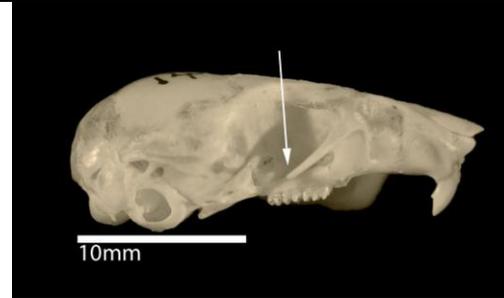


Fig. 10

Fig. 11. *Baiomys taylori*, the smallest rodent found in the United States. The zygomatic arch dips in line with, or just past, the gum line.

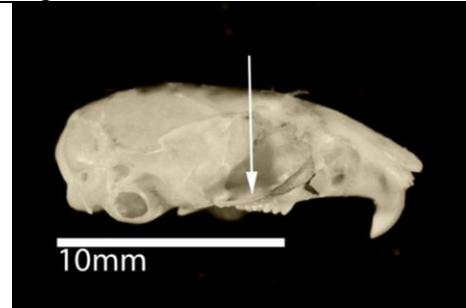


Fig. 11

Small Animal Key: Mandibles *Missing Rattus rattus*

1. (a) Mandible does not have teeth, may have ridges..... **Aves (Fig. 12)**
 (b) Mandibles do have teeth..... **2 (Fig. 13)**

2. (a) Three incisors are present on each side for a total of six
 The left and right mandible, when found still attached,
 are fused together into
 a curved angle **Vespertilionidae (Fig. 13)**
 (b) One incisor is present on each side for a total of two
 The left and right mandible, when found still attached,
 are fused together into a sharp, acute angle **3 (Fig. 14A)**

3. (a) Incisor is straight. Tips of teeth are typically tinted with a reddish or blackish
 pigmentation
 Diastema is not present **Soicidae, see 4 (Fig. 14B)**
 (b) Incisor is re-curved and chisel-like. Tips of teeth lack reddish or blackish
 pigmentation
 Diastema is present **Rodentia, see 5 (Fig. 16)**

4. (a) The coronoid process angles forward..... **Cryptotis parva (Fig. 14A & B)**
 (b) Anterior surface of coronoid process is
 concave **Blarina carolinensis (Fig. 15)**

5. (a) Coronoid process sits below condyle **6 (Fig. 16)**
 (b) Coronoid process sits above condyle **7 (Fig. 18)**

6. (a) Coronoid process is short projection
 Typically, the jaw is longer than 12mm long **Peromyscus spp. (Fig. 16)**
 (b) Coronoid process is short, slender, and re-curved projection
 Typically, the jaw is less than 12mm long..... **Reithrodontomys spp. (Fig. 17)**

7. (a) Coronoid process is long and slender **Mus musculus (Fig. 18)**
 (b) Coronoid process is short and slender..... **8 (Fig. 19)**

8. (a) Condylloid process is broad **9 (Fig. 20)**
 (b) Condylloid process is short and blunt **Baiomys taylori (Fig. 19)**

9. (a) Steep drop from anterior of cheek teeth to diastema
 Ventral step from body of mandible to slope of
 angular process..... **Sigmodon hispidus (Fig. 20)**
 (b) Drop from anterior of cheek teeth to diastema is not steep.
 Concave ventral outline below
 posterior teeth..... **Neotoma floridana (Fig. 21)**

Small Animal Key: Mandibles

Fig. 12. AVES , lower mandible may have ridges but no teeth	NEED IMAGE
Fig. 13. <i>Nycticeius humeralis</i> , mandibles do have teeth. When left and right side are found together, they form a rounded angle at point of fusion.	
<p>Fig. 14A. <i>Cryptotis parva</i>, illustrates the angle the left and right mandible form when they are attached.</p> <p>Fig. 14B. The double headed arrow indicated the straight angle of the incisor. The figure also circles the coronoid process, notice how the whole process angles forwards. Compare to <i>Blarina brevicauda</i> (Fig. 15).</p>	<p>Fig. 14A</p> <p>Fig. 14B</p>
Fig. 15. <i>Blarina carolinensis</i> , the figure shows <i>Blarina brevicauda</i> , the two are very similar. The arrow in the figure points to the anterior surface of the coronoid. Notice the concavity.	
Fig. 16. <i>Peromyscus</i> spp., the curved, double-headed arrow indicates the curved incisor, the straight double-headed arrow indicates the diastema. The dotted line highlights the coronoid position in relation to the condyloid. Lastly, the circle illustrates the size of the coronoid process.	
Fig. 17. <i>Reithrodontomys</i> spp., the circle highlights the recurved coronoid process. Compare the curvature, shape, and length to <i>Peromyscus</i> spp. (Fig. 16).	
Fig. 18. <i>Mus musculus</i> , the dotted line indicates the coronoid in relation to the	

condyloid process. The figure circles the coronoid to highlight the length and shape.	
Fig. 19 <i>Baiomys taylori</i> ,	NEED IMAGE
Fig. 20. <i>Sigmodon hispidus</i>	NEED IMAGE
Fig. 21. <i>Neotoma floridana</i>	NEED IMAGE

Measurement Ranges for Shrews and Rodents

Table 1. The table below describes the dental pattern, length of skull, braincase breadth, and distinguishing features for each species. The dental formula reads as follows: upper/lower, I=incisor, C=cuspid, P=premolar, M=molar. The first measurement listed provides a range in mm describing the length of the skull from the occipital bones to the end of the rostrum. The second measurement describes the breadth of the braincase at the widest point. The final column points out an identifying feature for each species. Some species lack identifying characteristics, in this instance skull size serves as a good indication of the genus or species.

Species	Dental Formula	Length of Skull	Braincase Breadth	Distinguishing Features
<i>Blarina carolinensis</i>	I 4/2, C 1/0, P 2/1, M 3/3	18.0-20.0mm	<11.5mm	Dark red pigment on tips of teeth
<i>Cryptotis parva</i>	I 3/2, C 1/0, P 2/1, M 3/3	12-15.0mm.0	~6.0mm	Dark red pigment on tips of teeth
<i>Baiomys taylori</i>	I 1/1, C 0/0, P 0/0, M 3/3	20.4-22.5mm	8.0-9.1mm	Smallest rodent skull found in LLELA
<i>Mus musculus</i>	I 1/1, C 0/0, P 0/0, M 3/3	20.4-22.5mm	10.4-11.5mm	Upper incisors have a notch on the backside
<i>Neotoma floridana</i>	I 1/1, C 0/0, P 0/0, M 3/3	47.9-55.6mm	18.2-21.3mm	Larger skull with hypsodont molars
<i>Peromyscus leucopus</i> ; <i>Peromyscus maniculatus</i>	I 1/1, C 0/0, P 0/0, M 3/3	22.0-29.5mm	12.3-13.9mm	Skull lacks identifying characteristics. The small size and lack of ridging on the skull in an indicator for <i>Peromyscus</i> .
<i>Rattus rattus</i>	I 1/1, C 0/0, P 0/0, M 3/3	38.0-41.84mm	20.5-22.2mm	Anterior maxillary projections are present but not elongated
<i>Reithrodontomys fulvescens</i> ; <i>Reithrodontomys montanus</i>	I 1/1, C 0/0, P 0/0, M 3/3	22.0-25.0mm	~12mm	Upper incisors have vertical grooves when viewed frontally
<i>Sigmodon hispidus</i>	I 1/1, C 0/0, P 0/0, M 3/3	40.5-44.6mm	15.5-17.6mm	Prominent anterior maxillary projections

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