

Key to the Skulls of Adult Mammals of Georgia and the Southeastern United States

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Introduction

Hikers, hunters, campers, naturalists and others who spend time in the outdoors will often encounter skull, bones, or skeletons. More often than not, these remains are from a mammal. Generally the cause of death is unknown. It may have been struck by a car, killed by a predator, or died of natural causes. Our natural curiosity often compels us to inquiry into the identity of the creature whose remains we have found. Cause of death is very difficult to determine. Identity can often be made if we have the skull of the animal. Having a complete (or nearly complete) skull makes it easier to identify the animal. Having both the skull and lower jaw is even better. However, identification can often be confirmed - or at least narrowed to a few likely candidates – with only the skull. This guide will help you determine the identity of the remains you have located. You will need some basic knowledge of the vocabulary of bones and teeth but this information is easy to get from websites or the pictures in this key.

If possible, get a skull as intact as possible. You can clean the skull by leaving it in the sun for several days or soaking it in a dilute solution of common household bleach for 1-3 hours. The time will depend on the size of the skull and the amount of hide and tissue still attached. Soaking in bleach will also sanitize the specimen and kill insects and bacteria. If soaked too long, it will become soft and may disintegrate. Once cleaned, your specimen will last for many years. Be sure to label it for future reference. Your label should include your name, the location and date you found it, and the identity of the animal. Studying mammals and natural history is a fascinating hobby. Good luck with your identification. Let's get started.

Disclaimer: All drawings and sketches in this document were obtained completely from non-copyright sources such as public domain websites including USDA Cooperative Extension Service, 4-H program guides, USDA Forest Service, and US Fish & Wildlife Service. Figures 1-6 were adapted from Paper No. FiW 76-2 Department of Fisheries & Wildlife Sciences, Virginia Tech, Blacksburg, VA (1952, rev. 1976).

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Labeled Parts of a Carnivore (Gray Fox) Skull

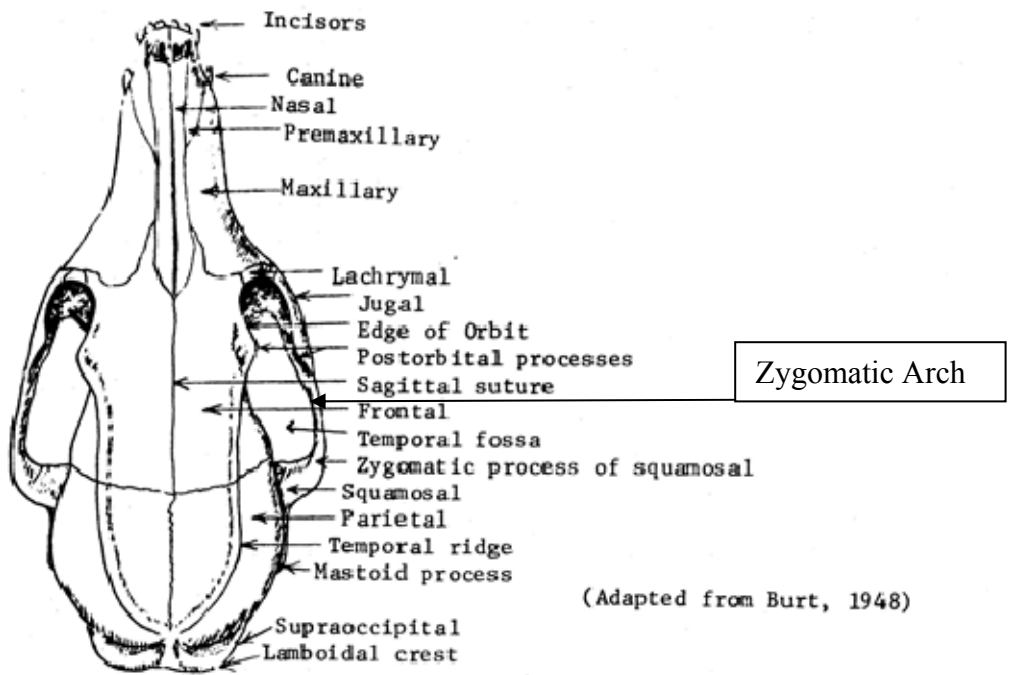


Figure 1. 3/4 X.

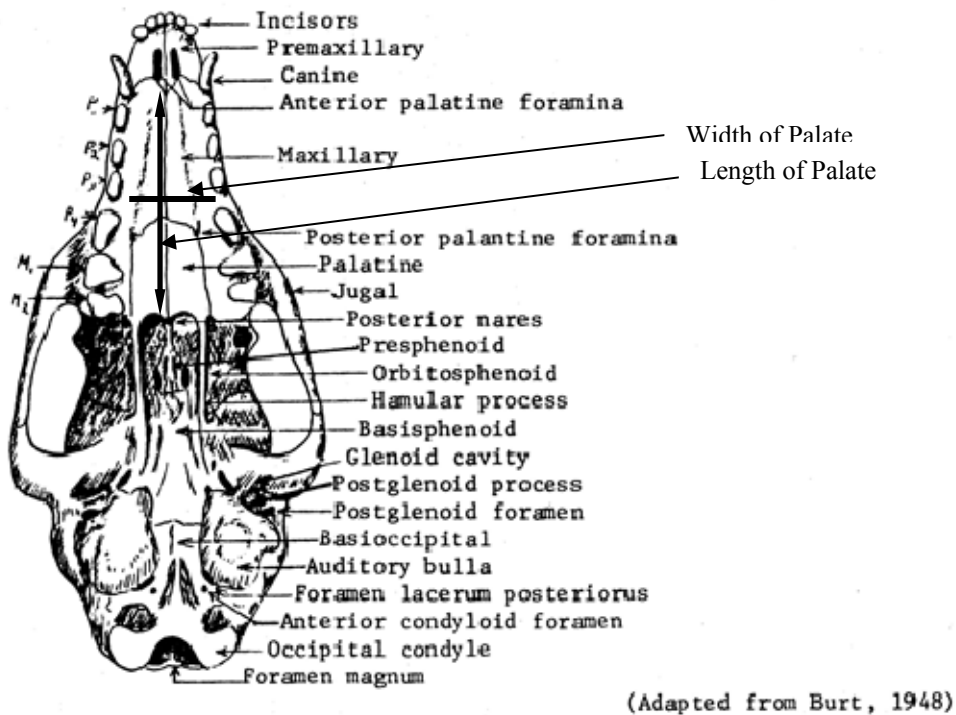


Figure 2. 3/4 X.

Labeled Parts of a Rodent (Beaver) Skull

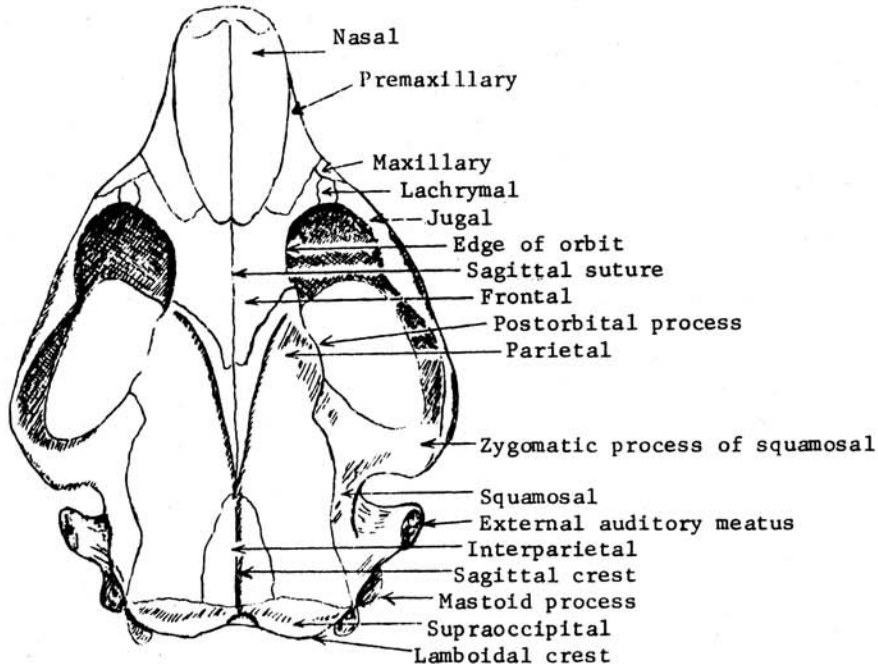
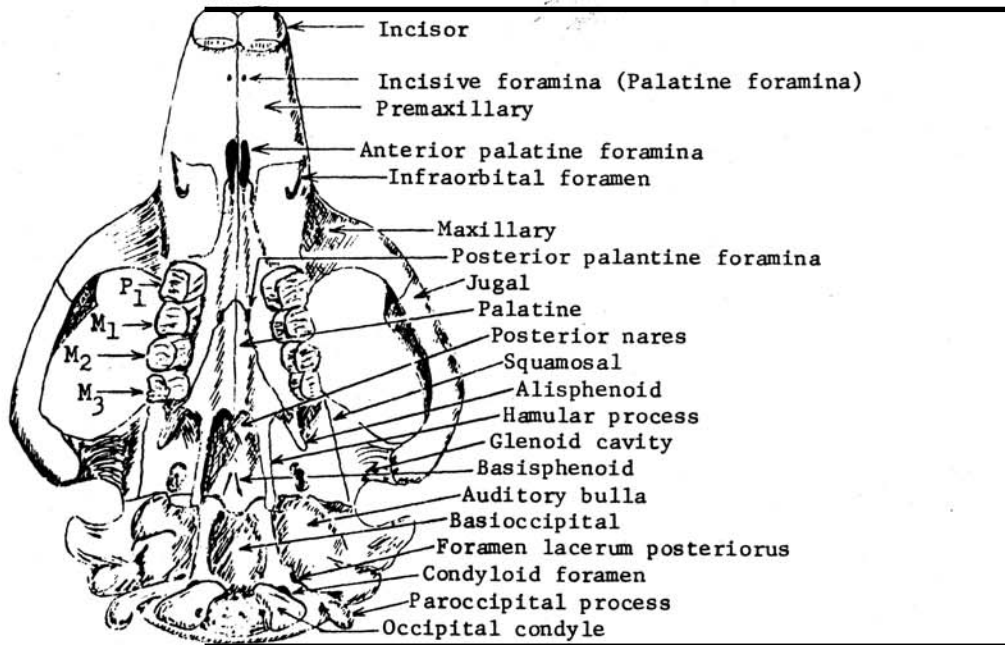


Figure 3. 1 X.

(Adapted from Burt, 1946, and Glass, 1951)



Total Length of Skull.

Figure 4. 1 X.

(Adapted from Burt, 1946, and Glass, 1951)

Labeled Parts of a Carnivore (Gray Fox) Jaw

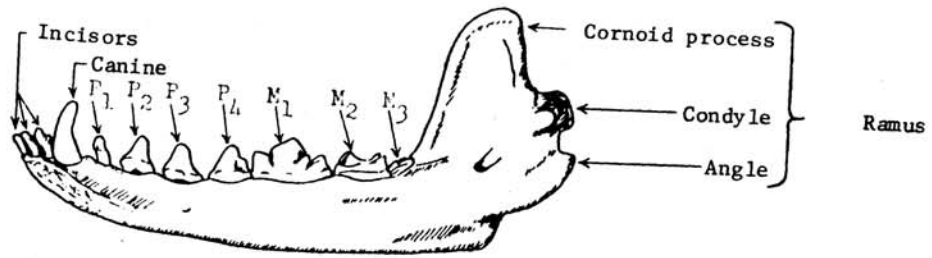


Figure 5. 1 X.

(Adapted from Burt, 1951)

Labeled Parts of a Rodent (Beaver) Jaw

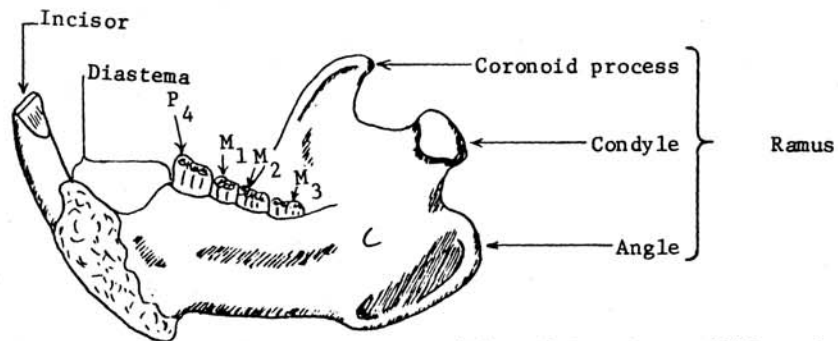


Figure 6. 1 X.

(Adapted from Burt, 1948, and Glass, 1951)

Key to the skulls of adult mammals of Georgia and the Southeastern United States.

1. Teeth uniformly peg-like:

ORDER CINGULATA
Family Dasypodidae
Dasypus novemcinctus (Nine-banded Armadillo)

Teeth heterodont (2 or more types of teeth) and not peg-like: ----- 2

2 (1). Total of 10 upper incisors; total # of upper teeth 26:

ORDER DIDELPHIMORPHA
Family Didelphidae
Didelphis virginiana (Virginia Opossum)

Total of 6 upper incisors or fewer, absent in some species; total # of upper teeth < 26: ----- 3

3 (2). Anterior end of skull has a U-shaped notch, which separates the incisors into distinct halves:

ORDER CHIROPTERA (Bats) ----- 8

Anterior end of skull lacking a U-shaped notch (Fig 7): ----- 4

U-shaped notch at front of skull.

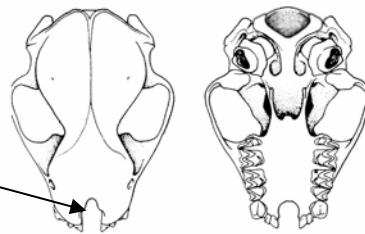


Figure 7. Bat Skull.

4 (3). Canines present and about equal in size to or smaller than the incisors:

ORDER INSECTIVORA ----- 19

Canines absent or, if present, obviously longer than incisors: ----- 5

5 (4). Total of 2 or 4 upper incisors: ----- 6

Total of 6 upper incisors, or incisors absent: ----- 7

6 (5). 2 pairs of upper incisors, second pair of incisors small, peg-like, and located immediately behind the first pair; anterior part of facial bones web- or net-like:

ORDER LAGOMORPHA ----- 30

1 pair of upper incisors; anterior part of facial bones solid:

ORDER RODENTIA ----- 33

7 (5). Canine teeth present and round or oval in cross-section; skull < 200 mm in length:

ORDER CARNIVORA ----- 61

Canine teeth absent or, if present, triangular in cross section; skull > 200 mm in length:

ORDER ARTIODACTYLA ----- 75

ORDER CHIROPTERA

8 (3). Total # of upper teeth 10: ----- 9

Total # of upper teeth > 10: ----- 10

9 (8). Total length of skull (Fig. 4; Condylbasal length -- from tip of nose to farthest point on braincase) < 15.5 mm; sagittal crest absent or poorly developed; when viewed from the side, a space is present between the tips of incisor and canine:

Nycticeius humeralis (Evening Bat)

Total length of skull > 16.0 mm; sagittal crest well developed; when viewed from the side, a space is present between the tips of incisor and canine:

Lasiurus intermedius (Northern Yellow Bat)

10 (8). Total # of upper teeth 14: ----- 11

Total # of upper teeth >14: ----- 15

11 (10). Total of 4 upper incisors and 2 upper premolars (Fig. 7):

Eptesicus fuscus (Big Brown Bat)

Total of 2 upper incisors and 4 upper premolars: ----- 12

12 (11). Distance between tips of upper incisors ≤ 1 mm; triangular-shaped skull:

Tadarida brasiliensis (Brazilian free-tailed bat)

Distance between tips of upper incisors > 1.5 mm; rectangular-shaped skull: -----13

13 (12). Total length of skull > 16 mm: *Lasiurus cinereus* (Hoary Bat)
 Total length of skull < 15 mm: -----14

14 (13). Ridge in front of eye socket distinct (Lacrimal ridge): *Lasiurus borealis* (Red Bat)
 Ridge in front of eye socket indistinct: *Lasiurus seminolus* (Seminole Bat)

15 (10). Total # of upper teeth 16: ----- 16
 Total # of upper teeth 18: *Myotis* spp. (Myotis species)

16 (15). Total length of skull < 13.5 mm: *Pipistrellus subflavus* (Eastern Pipistrelle)
 Total length of skull > 14 mm: -----17

17 (16). Dorsal skull profile flat: *Lasionycteris noctivagans* (Silver-haired Bat)
 Dorsal skull distinctly rounded: ----- 18

18 (17). First upper incisor with a single cusp: *Corynorhinus townsendii* (Townsend's Big-eared Bat)
 First upper incisor with 2 cusps: *Corynorhinus rafinesquii* (Rafinesque's Big-eared Bat)

ORDER INSECTIVORA

19 (4). All teeth completely white; zygomatic arch complete and auditory bullae present:
Family Talpidae ----- 20
 Anterior teeth dark red or black at the tips; zygomatic arch (Fig. 1) incomplete and auditory bullae absent:

Family Soricidae ----- 22

20 (19). Total # of upper teeth 20: *Scalopus aquaticus* (Eastern Mole)

- Total # of upper teeth 22: ----- 21
- 21 (20). First upper incisors project anteriorly; tip of nasals well short of premaxillae:
Condylura cristata (Star-nosed Mole)
- First upper incisors not projected anteriorly; tip of nasals even with tip of premaxillae:
Parascalops breweri (Hairy-tailed Mole)
- 22 (19). Total # of upper teeth 18; 4 unicuspid upper teeth:
Cryptotis parva (Least Shrew)
- Total # of upper teeth 20; 5 unicuspid upper teeth (1 or 2 may be tiny, with only 3 or 4 easily visible from the side): ----- 23
- 23 (22). 3rd and 5th upper unicuspid greatly reduced in size; only 3 unicuspid visible from the side:
Sorex hoyi (Pygmy Shrew)
- 3rd upper unicuspid not greatly reduced in size; 4 or 5 unicuspid visible from the side: ----- 24
- 24 (23). 4 upper unicuspid easily visible from the side (5th greatly reduced in size and hidden on inside of tooth row): ----- 25
- 5 upper unicuspid visible from the side : ----- 26
- 25 (24). Total length of skull \geq 20 mm:
Blarina brevicauda (Northern Short-tailed Shrew)
- Total length of skull $<$ 20 mm:
Blarina carolinensis (Southern Short-tailed Shrew)
- 26 (24). Total length of skull \geq 16.5 mm: ----- 27
- Total length of skull $<$ 16.5 mm: ----- 29
- 27 (26). 3rd upper unicuspid smaller than the 4th :
Sorex palustris (Water Shrew)
- Size of the 3rd upper unicuspid larger than or equal to the 4th : ----- 28

28 (27). From side view, tip of 1st incisor even with tip of 2nd incisor (1st incisor anteriorly projected):
Sorex dispar (Rock Shrew/Long-tailed shrew)

From side view, tip of 1st incisor well below tip of 2nd incisor:
Sorex fumeus (Smokey Shrew)

29 (26). 3rd upper unicuspid smaller than the 4th; flattened braincase:
Sorex longirostris (Southeastern Shrew)

3rd upper unicuspid larger than or the same size as the 4th; rounded braincase:
Sorex cinereus (Masked Shrew)

ORDER LAGOMORPHA

30 (6). Anterior extension of supraorbital process present:
Sylvilagus floridanus (Eastern Cottontail)

Anterior extension of supraorbital process absent or present only as a tiny knob: ----- 31

31 (30). Posterior extension of supraorbital process free from fusion with skull; basilar length < 57 mm:
Sylvilagus obscurus (Appalachian Cottontail)

Posterior extension of supraorbital process fused to skull for most of extent; basilar length > 60 mm: ----- 32

32 (31). Total length of skull < 63 mm; depth of rostrum at Point 1 < 17 mm):
Sylvilagus palustris (Marsh Rabbit)

Total length skull > 65 mm; (depth of rostrum at Point 1 > 20 mm):
Sylvilagus aquaticus (Swamp Rabbit)

ORDER RODENTIA

33 (6). Total # of upper teeth 12: ----- 34

Total # of upper teeth < 12: ----- 38

34 (33). Anterior border of orbit even with the 2nd cheek tooth (usually between 1st and 2nd cheek teeth): ----- 35

Anterior border of orbit even with the 3rd cheek tooth (usually between 2nd and 3rd cheek teeth): ----- 37

- 35 (34). Total length of skull (condylobasal length) > 45 mm:
Tamiasciurus hudsonicus (Red Squirrel)
- Total length of skull (condylobasal length) < 45 mm: ----- 36
- 36 (35). Total length of skull (condylobasal length) > 36 mm:
Glaucomys sabrinus (Northern Flying Squirrel)
- Total length of skull (condylobasal length) < 36 mm:
Glaucomys volans (Southern Flying Squirrel)
- 37 (34). Supraorbital processes at right angles to the skull; condylobasal length > 70 mm:
Marmota monax (Woodchuck)
- Supraorbital processes at acute angles to skull; condylobasal length < 70 mm:
Sciurus carolinensis (Eastern Gray Squirrel)
- 38 (33). Total # of upper teeth 10: ----- 39
- Total # of upper teeth 8: ----- 44
- 39 (38). Total length of skull > 92 mm: ----- 40
- Total length of skull < 75 mm: ----- 41
- 40 (39). Infraorbital foramen (Fig. 4) larger than the foramen magnum; paraoccipital processes elongated past the plane of the upper molars:
Myocastor coypus (Nutria)
- Infraorbital foramen smaller than the foramen magnum; paraoccipital processes not elongated past the plane of the upper molars:
Castor canadensis (Beaver)
- 41 (39). Infraorbital opening oval when viewed from front of skull, > 1 mm wide:
Zapus hudsonius (Meadow Jumping Mouse)
- Infraorbital opening minute and round or slit-like, < 1 mm wide: ----- 42
- 42 (41). Total length of skull > 50 mm:
Sciurus niger (Fox Squirrel)
- Total length of skull < 50 mm: ----- 43
- 43 (42). Face of incisors with 2 longitudinal grooves; infraorbital opening a small canal:
Geomys pinetis (Southeastern Pocket Gopher)
- Face of incisors smooth; infraorbital opening a small foramen in the zygomatic plate:

Tamias striatus (Eastern Chipmunk)

- 44 (38). Total length of skull > 28 mm: ----- 45
Total length of skull < 28 mm: ----- 52
- 45 (44). Infraorbital region of skull with a prominent median crest; postorbital processes shelf-like and nearly right-angled: ----- 46
Infraorbital region of skull without a prominent median crest; postorbital processes not shelf-like or right-angled: ----- 47
- 46 (45). Condylobasal length > 50 mm; length of maxillary toothrow > 15 mm:
Ondatra zibethicus (Muskrat)
Condylobasal length < 50 mm; length of maxillary toothrow < 14 mm:
Neofiber alleni (Round-tailed Muskrat)
- 47 (45). Total length of skull > 40 mm: ----- 48
Total length of skull < 38 mm: ----- 50
- 48 (47). Skull lacking prominent supraorbital and temporal ridges; cusps of upper molars in 2 longitudinal rows:
Neotoma floridana (Eastern Woodrat)
Skull with prominent supraorbital and temporal ridges; cusps of upper molars in 3 longitudinal rows: ----- 49
- 49 (48). Temporal ridges bowed outward; diastema (the space between the incisors and cheek teeth) between upper incisors and molars slightly longer than the length of the cheek toothrow :
Rattus rattus (Black Rat)
Temporal ridges not bowed outward and relatively parallel; diastema between upper incisors and molars almost twice as long as the cheek toothrow:
Rattus norvegicus (Norway Rat)
- 50 (47). Total length of skull > 28 mm: ----- 51
Total length of skull < 28 mm: ----- 52
- 51 (50). Distinct anterior projection (≥ 1 mm) on the zygomatic arch; no openings in palate behind molars; last 2 upper molars flat-surfaced with tooth outlines forming an S-shaped pattern:
Sigmodon hispidis (Hispid Cotton Rat)
Zygomatic arch without an anterior projection, or projection present only as a raised bump; pair of openings in palate behind the molars; upper molars with pointed cusps and tooth outlines having no S-shaped patterns:

Oryzomys palustris (Marsh Rice Rat)

52 (50). Upper incisors with longitudinal grooves: ----- 53

Upper incisors without longitudinal grooves: ----- 54

53 (52). Total length of skull < 20 mm; nasals relatively even with premaxillae; infraorbital opening V- shaped (wider at top than at bottom):

Reithrodontomys humulis (Eastern Harvest Mouse)

Total length of skull > 20 mm; nasals extend well past premaxillae; infraorbital opening oval shaped:

Napaeozapus insignis (Woodland Jumping Mouse)

54 (52). Cheek teeth with cusps, and outline of teeth rounded; when viewed from bottom of skull, length of molar tooththrow much less (at least 3 mm) than length of orbit: ----- 55

Cheek teeth without cusps, and outline of teeth triangular; when viewed from bottom of skull, length of molar tooththrow almost equal (< 1 mm) to the length or the orbit: ----- 56

55 (54). Cusps of upper molars in 3 longitudinal rows; 3rd upper molar about twice as wide as 1st upper molar:

Mus musculus (House Mouse)

Cusps of upper molars in 2 longitudinal rows ; 3rd and 1st upper molars relatively the same width (much less than twice as wide): ----- 57

56 (54). Paired openings in palate located midway between front and back of molar tooththrow (between 1st and 2nd molars):

Peromyscus spp.

Note: Peromyscus species are very difficult to distinguish. Identification may be made based on pelage, geographic location and/or DNA analysis

Paired openings in palate located nearer to the back of the molar tooththrow than the front (between 2nd and 3rd molars):

Ochrotomys nuttali (Golden Mouse)

57 (55). Posterior border of palate a straight, thin-edged shelf extending directly between the two posterior molars:

Clethrionomys gapperi (Southern Red-backed Vole)

Posterior border of palate rounded or supported by a median spine: ----- 58

58 (57). Incisors with longitudinal groove near outer edges:

Synaptomys cooperi (Southern Bog Lemming)

Incisors without longitudinal grooves: ----- 59

59 (58). 2nd upper molar has 5 “islands” of dentine:
Microtus pennsylvanicus (Meadow Vole)

2nd upper molar has 4 “islands” of dentine : ----- 60

60 (59). 3rd upper molar with 5 closed “triangles” :
Microtus chrotorrhinus (Rock Vole)

3rd upper molar with 2 closed “triangles” :
Microtus pinetorum (Pine/Woodland Vole)*

OR *Microtus ochrogaster* (Prairie Vole)*

* These species cannot be distinguished from skull alone; pelage and geographic range may aid in identification

ORDER CARNIVORA

61 (7). Total # of upper cheek teeth 12: ----- 62

Total # of upper cheek teeth < 12: ----- 67

62 (61). Posterior border of palate extends well past the molars: ----- 63

Posterior border of palate even with the molars: ----- 64

63 (62). Total length of skull > 270 mm; teeth rows parallel:
Ursus americanus (Black Bear)

Total length of skull < 150 mm; teeth rows not parallel:
Procyon lotor (Raccoon)

64 (62). Total length of skull < 160 mm; temporal ridges join at rear of cranium ----- 65

Total length of skull > 160 mm; temporal ridges join near midpoint of cranium ----- 66

65 (64). Temporal ridges join to form a lyre or U shape; postorbital processes with a deep depression; length of palate (palatilar length) < 60 mm:
Urocyon cinereoargenteus (Gray Fox)

Temporal ridges join to form a V shape; postorbital processes with a shallow depression or flat; length of palate (palatilar length) > 60 mm:
Vulpes vulpes (Red Fox)

66 (64). Front part of cranium with a relatively straight or gently sloping profile; length of cheek toothrow is NOT three times greater than the width of palate at first premolar; skull generally less than 8 inches (200 mm) long; palate > 2x as long as wide:

Canis latrans (Coyote)

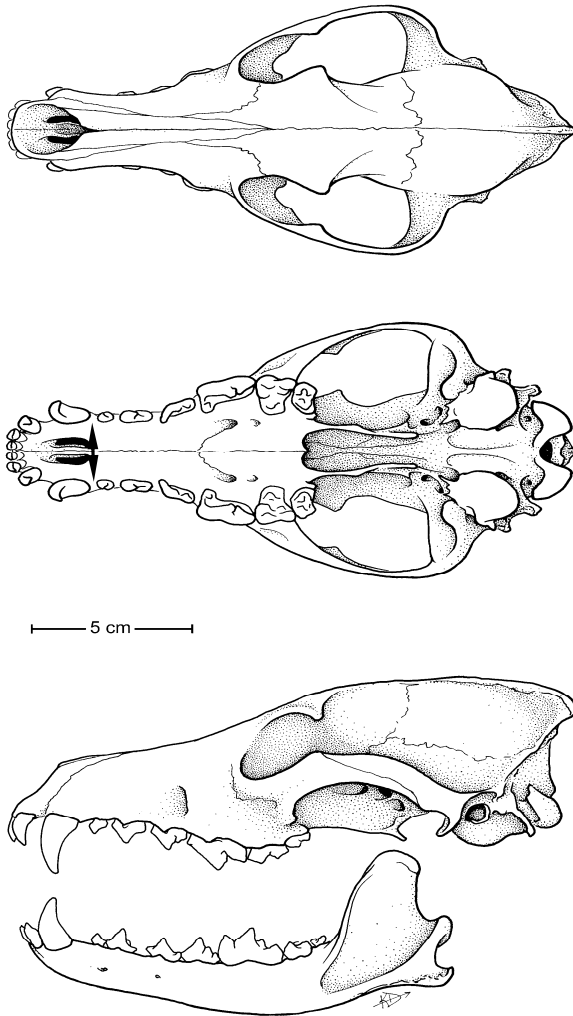


Figure 8. Coyote skull.

Front part of cranium with a convex profile, usually arched above the orbit; length of cheek toothrow is three times greater (or more) than the width of palate at first premolar; width of rostrum is > 18% of the greatest length of the skull; skull usually < 8 inches (200 mm) long; palate < than 2x as long as wide.

Canis familiaris (Domestic Dog)

67 (61). Total # of upper cheek teeth 10:

Lontra canadensis (River Otter)

Total # of upper cheek teeth < 10: ----- 68

- 68 (67). Cranium globular; long, sharp projections on both the postorbital process and the zygomatic arch: ----- 69
- Cranium gently rounded or flattened; no sharp projections on postorbital process or zygomatic arch ----- 71
- 69 (68). Total # of upper cheek teeth 6:
Lynx rufus (Bobcat)
- Total # of upper cheek teeth 8: ----- 70
- 70 (69). Total length of skull > 170 mm:
Puma concolor (Mountain lion)
- Total length of skull < 100 mm:
Felis catus (Domestic cat)
- 71 (68). Posterior border of palate even with molars; length of auditory bullae about half the length of the orbit: ----- 72
- Posterior border of palate extending well past the molars; length of auditory bullae relatively equal to the orbit length: ----- 73
- 72 (71). When viewed from side, interorbital (between the eyes) region convex; auditory bullae small and round :
Mephitis mephitis (Striped Skunk)
- When viewed from side, interorbital region flat; auditory bullae inflated and elongated:
Spilogale putorius (Spotted Skunk)
- 73 (71). Greatest length of skull > 55 mm; length of cheek toothrow greater than the auditory bullae length; postpalatal (behind the tooth row) length < 50% of total skull length:
Neovison vison (Mink)
- Greatest length of skull < 55 mm; length of cheek toothrow less than auditory bullae length; postpalatal length > 50% of total skull length: ----- 74
- 74 (73). At the posterior border of the palate, orbit width greater than palatal width; from the dorsal view, orbit square-shaped:
Mustela frenata (Long-tailed weasel)
- At the posterior border of the palate, orbit width less than palatal width; from the dorsal view, orbit elongated into a rectangle:
Mustela nivalis (Least weasel)

ORDER ARTIODACTYLA

75 (7). Total # of upper teeth 26 (incisors and well-developed canines present):
Sus scrofa (Feral hog)

Total # of upper teeth < 26: ----- 76

76 (75). Total # of upper teeth 14 (small canine present); total length of skull > 400 mm:
Cervus canadensis (Elk)

Total # of upper teeth 12; total length of skull < 350 mm:
Odocoileus virginianus (White-tailed Deer)

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