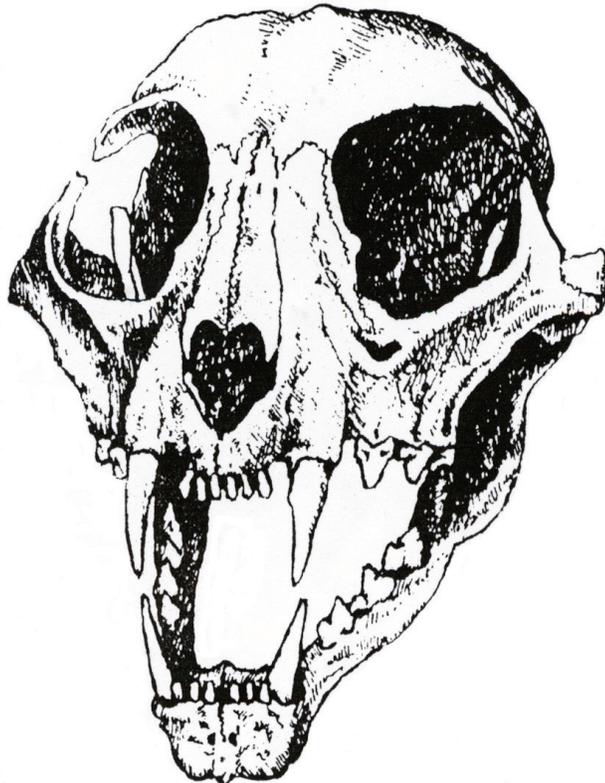


SKULL KEY of Pennsylvania mammals



7/19/2007

Illustrations by Steven Bair

Revised Edition – Parker Dam State Park

Species found in this key:

Order *Chiroptera* - Bats

Family *Vespertilionidae*

(Identified to Genus)

- Little Brown (*Myotis lucifugus*)
- Small-footed (*Myotis leibi*)
- Eastern Long-eared (*Myotis septentrionalis*)
- Indiana (*Myotis sodalis*)
- Silver-haired (*Lasionycteris noctivagans*)
- Eastern Pipistrelle (*Pipistrellus subflavus*)
- Evening (*Nycticeius humeralis*)
- Big Brown (*Eptesicus fuscus*)
- Red (*Lasiurus borealis*)
- Hoary (*Lasiurus cinereus*)
- Seminole (*Lasiurus seminolus*)

Order *Carnivora* - Flesh eaters

- Domestic cat (*Felix domestica*)
- Bobcat (*Lynx rufus*)
- Raccoon (*Procyon lotor*)
- River Otter (*Lutra canadensis*)
- Fisher (*Martes pennanti*)
- Pine Martin (*Martes americana*)
- Striped Skunk (*Mephitis mephitis*)
- Mink (*Mustela vison*)
- Long-tailed Weasel (*Mustela frenata*)
- Ermine, Short-tailed Weasel (*Mustela ermina*)
- Least Weasel (*Mustela nivalis*)
- Red Fox (*Vulpes vulpes*)
- Gray Fox (*Urocyon cinereoargenteus*)
- Coyote (*Canis latrans*)
- Domestic Dog (*Canis familiaris*)
- Black Bear (*Ursus americanus*)

Order *Insectivora* - Moles & Shrews

- Common Mole (*Scalopus aquaticus*)
- Hairytail Mole (*Parascalopus breweri*)
- Star-nosed Mole (*Condylura cristata*)
- Least Shrew (*Cryptotis parva*)
- Pygmy Shrew (*Microsorex hoyi*)
- Short-tailed Shrew (*Blarina brevicauda*)
- Northern Water Shrew (*Sorex palustris*)
- Smokey Shrew (*Sorex fumeus*)
- Masked Shrew (*Sorex cinereus*)

- Long-tailed Shrew (*Sorex dispar*)

Order *Rodentia* - Rodents

- Woodchuck (*Marmota monax*)
- Gray Squirrel (*Sciurus carolinensis*)
- Red Squirrel (*Tamiasciurus hudsonicus*)
- Southern Flying Squirrel (*Glaucomys volans*)
- Northern Flying Squirrel (*Glaucomys sabrinus*)
- Chipmunk (*Tamias striatus*)
- Fox Squirrel (*Sciurus niger*)
- Porcupine (*Erthizon dorsatum*)
- Beaver (*Castor canadensis*)
- Meadow Jumping Mouse (*Zapus hudsonius*)
- Southern Bog Lemming (*Synaptomys cooperi*)
- Muskrat (*Ondatra zibethicus*)
- Eastern Wood Rat (*Neotoma floridana*)
- Red-backed Vole (*Clethrionomys gapperi*)
- Woodland Vole (*Microtus pinetorum*)
- Rock Vole (*Microtus chrotorrhinus*)
- Meadow Vole (*Microtus pennsylvanicus*)
- Woodland Jumping Mouse (*Napaeozapus insignis*)
- White-footed Mouse (*Peromyscus leucopus*)
- Deer Mouse (*Peromyscus maniculatus*)
- Norway Rat (*Rattus norvegicus*)
- House Mouse (*Mus musculus*)

Order *Lagomorpha* - Rabbits & Hares

- Snowshoe Hare (*Lepus americanus*)
- Eastern Cottontail (*Sylvilagus floridanus*)
- New England Cottontail (*Sylvilagus transitionalis*)

Order *Artiodactyla* - Even-toed Hoofed Animals

- Bison (*Bison bison*)
- Domestic Cow (*Bos taurus*)
- White-tailed Deer (*Odocoileus virginianus*)
- Elk (*Cervus canadensis*)

Read before using this key

This key deals with normal, adult mammals. However, abnormalities do exist, i.e. - a raccoon skull normally has a total of 40 teeth, but you may find one that has 42. Be aware that such skulls may not key to their proper place.

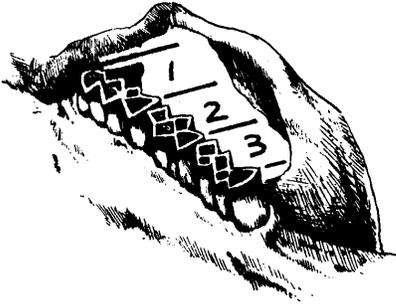
Examine the skull carefully! Take your time to understand what the key is asking. A glossary of terms is available in the back of this key. Go slowly when counting teeth or measuring the skull. Use a probe or needle to wiggle the tooth in the socket to see where one tooth ends and the next begins.



1. Some mammals have teeth for gnawing wood or cutting. These are called incisors (front teeth). Most large rodents (beaver, squirrel, etc.) will have large, flattened incisors. Other mammals may have small incisors between larger canines. In any case, the incisor teeth are the ones up front and center.

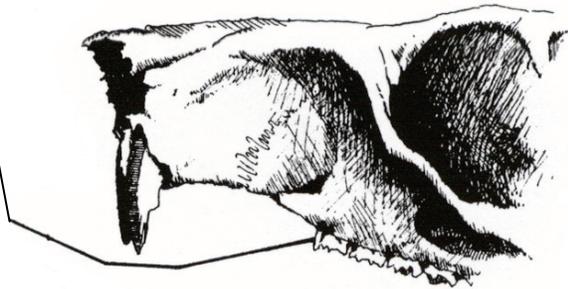
2. Some mammals have teeth designed for tearing - these large teeth are called canines (fangs). Carnivores, bats, and the Opossum will have large canines (in comparison to their other teeth).





3. Mammals have teeth for grinding their food called molars. Often these teeth may be difficult to count because they all seem to run together. (there are three teeth in this drawing.) Using the probe to wiggle the teeth one at a time will greatly help you in counting them. These teeth, together with the premolars, are also referred to as cheek teeth.

4. Remember to take your time and look closely. Some teeth are very small and are difficult to see or may be hidden by a larger tooth.



5. Some teeth may have fallen out of the skull. Be sure to count the missing ones. Often you can compare a matching jaw to see what and how many teeth may be missing. Remember too that some teeth have two roots (thus, two holes in the jaw), and some have only one.

Dental formula -- The number of teeth in an animal's mouth provides important clues as to its identity. Mammalogists use a convenient shorthand, or dental formula, to summarize and present this information.

The incisors, canines, premolars, and molars are represented in order by the number of teeth present in each quadrant of the upper jaw. Example: 2-1-2-3 would mean that there are 2 incisors, 1 canine, 2 premolars, and 3 molars in each side of the upper jaw (This key uses a formula that counts all the teeth in the upper or lower jaws). The numbers for each quadrant of the lower jaw are often the same, and the formula can also be represented thus: 2/2 - 1/1 - 2/2 - 3/3. This formula can be interpreted as: 2 upper incisors/2 lower incisors - 1 upper canine/1 lower canine - 2 upper premolars/2 lower premolars - 3 upper molars/3 lower molars.

There are some skulls that will have different numbers of upper teeth vs. lower teeth and will be represented by differing numbers in the formula, example: **2/3** - 1/1 - 3/3 - 3/3

Key to the common mammal skulls of Pennsylvania

- 1a. Incisors (front teeth) present in the upper jaw *Go to 2*
1b. Incisors absent in upper jaw *Order Artiodactyla* *Go to 54*
- 2a. Canine teeth (fangs) present and longer than teeth on either side *Go to 3*
2b. Canine teeth are not present or not longer than teeth on either side *Go to 6*
- 3a. Number of teeth is 50 - 26 above and 24 below
Order Marsupialia - pouched mammals
The Opossum is the only Marsupial in Pennsylvania (Didelphis virginiana)
3b. Number of teeth 42 or less *Go to 4*
- 4a. Length of skull less than 25 mm (1 inch); not more than two incisors on each side of upper jaw
Order Chiroptera - bats *Go to 8*
4b. Length of skull is 25 mm (1 inch) or more *Go to 5*
- 5a. Length of skull less than 50 mm (2 inches) *Go to 26*
Order Insectivora - insect eaters
5b. Length of skull 50 mm (2 inches) or more;
6 incisors on the upper jaw *Order Carnivora - flesh eaters* *Go to 13*
- 6a. A large space between incisors and cheek teeth *Go to 7*
6b. No large space between incisors and cheek teeth
Order Insectivora - insect eaters *Go to 26*
- 7a. Two incisors above *Order Rodentia - gnawing mammals* *Go to 35*
7b. Four incisors above, two small ones directly behind large ones *Order Lagomorpha - rabbits and hares* *Go to 53*

8. Order Chiroptera - True flying mammals - Bats

It is difficult at best to distinguish bat skulls to the species, but you can identify to the Genus using dental formulas. There are six genera of the family *Vespertilionidae* found in Pennsylvania representing 11 species.
(see 8a. & 8b. on next page)

- 8a. Number of teeth is 38, upper 4-2-6-6 lower 6-2-6-6 *Genus Myotis*
Four species found in Pennsylvania:



pre-molar less than 1/4 as tall as canine,
Myotis spp.

- Little Brown Bat** (*Myotis lucifugus*)
Small-footed Bat (*Myotis leibi*)
Eastern Long-eared Bat (*Myotis septentrionalis*)
Indiana Bat (*Myotis sodalis*)

- 8b. Number of teeth less than 38

Go to 9

- 9a. Number of teeth 36, Upper 4-2-4-6 Lower 6-2-6-6
Genus Lasiurus Only one of this genus is found in
Pennsylvania - **Silver-haired Bat** (*Lasiurus noctivagans*)

- 9b. Number of teeth less than 36

Go to 10

- 10a. Number of teeth 34, Upper 4-2-4-6 Lower 6-2-4-6
Genus Pipistrellus Only one of this genus is found in
Pennsylvania - **Eastern Pipistrelle** (*Pipistrellus subflavus*)

- 10b. Number of teeth less than 34

Go to 11

- 11a. Number of teeth 32

Go to 12

- 11b. Number of teeth less than 32
(Number of teeth 30) Upper 2-2-2-6 Lower 6-2-4-6
Genus Nycticeius - Only one of this genus is found in
Pennsylvania - **Evening Bat** (*Nycticeius humeralis*)



pre-molar, 1/4 to 1/3 as tall as canine,
Nycticeius humeralis

- 12a. Dental formula Upper 4-2-2-6 Lower 6-2-4-6
Genus Eptesicus Only one of this genus is found in
Pennsylvania - **Big Brown Bat** (*Eptesicus fuscus*)

- 12b. Dental formula Upper 2-2-4-6 Lower 6-2-4-6
Genus Lasiurus
Three species found in Pennsylvania:

- Red Bat** (*Lasiurus borealis*)
Hoary Bat (*Lasiurus cinereus*)
Seminole Bat (*Lasiurus seminolus*)

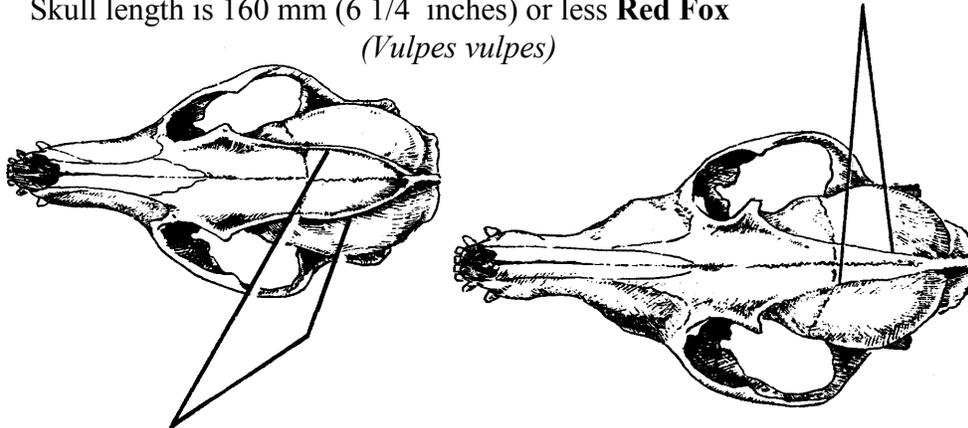


pre-molar, 1/2 as tall as canine,
Eptesicus fuscus

Order Carnivora - Flesh eaters

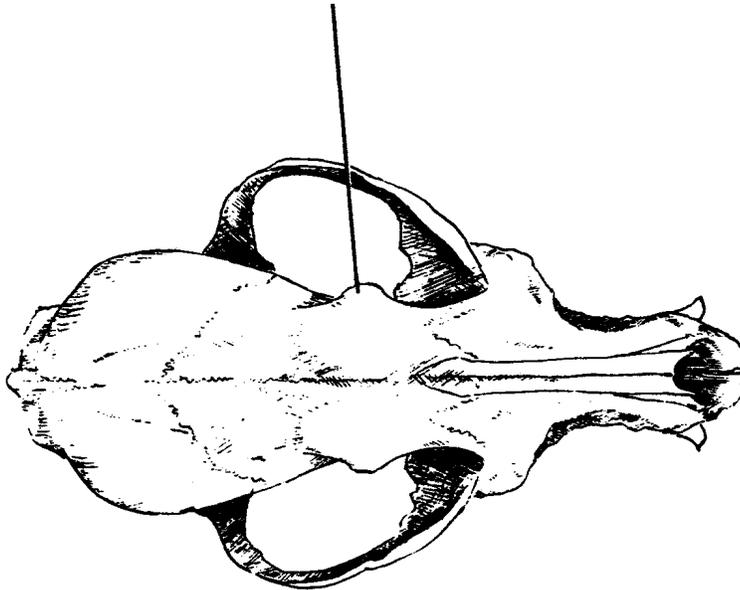
- 13a. Number of teeth 30 or less *Go to 14*
13b. Number of teeth 34 or more *Go to 15*
- 14a. Four cheek teeth behind each canine (fang) on each side of upper jaw **Domestic cat** (*Felix domestica*)
14b. Three cheek teeth behind each canine (fang) on each side of the upper jaw **Bobcat** (*Lynx rufus*)
- 15a. Length of skull is more than 170 mm (6 3/4 inches) *Go to 25*
15b. Length of skull is less than 170 mm (6 3/4 inches) *Go to 16*
- 16a. Number of teeth is 40 **Raccoon** (*Procyon lotor*)
16b. Number of teeth is more or less than 40 *Go to 17*
- 17a. Number of teeth 38 or less *Go to 18*
17b. Number of teeth 42 or more *Go to 24*
- 18a. Five cheek teeth behind each canine (fang) on each side of upper jaw *Go to 19*
18b. Four cheek teeth behind each canine (fang) on each side of upper jaw *Go to 21*
- 19a. Number of teeth 36. **River Otter** (*Lutra canadensis*)
19b. Number of teeth 38. *Go to 20*
- 20a. Length of skull less than 95 mm (3 3/4 inches) **Pine Martin** (*Martes americana*)
20b. Length of skull more than 95 mm (3 3/4 inches) **Fisher** (*Martes pennanti*)
- 21a. Last upper cheek tooth (molar) is squarish - distinctly larger than the tooth in front of it **Striped Skunk** (*Mephitis mephitis*)
21b. Last upper cheek tooth not squarish - about the same size as the tooth in front of it (not larger) *Go to 22*
- 22a. Length of skull is more than 55 mm (2 3/16 inches) **Mink** (*Mustela vison*)
22b. Length of skull is less than 55 mm (2 3/16 inches) *Go to 23*
- 23a. Length of skull is 34 mm (1 3/8 inches) or more **Long-tailed Weasel** (*Mustela frenata*)
or
Ermine, Short-tailed Weasel (*Mustela erminea*)
23b. Length of skull is less than 34 mm (1 3/8 inches) **Least Weasel** (*Mustela nivalis*)

24a. Low ridges on top of the skull form a narrow, sharp “V,” sometimes with a crest.
Skull length is 160 mm (6 1/4 inches) or less **Red Fox**
(*Vulpes vulpes*)



24b. Low ridges on top of the skull form a long, broad “U.”
Skull length is 130 mm (5 1/8 inches) or less **Gray Fox**
(*Urocyon cinereoargenteus*)

(25. Postorbital processes are rounded and point down.)



25a. Hard palate does not extend beyond the last molars. Last upper molar is not 1 1/2 times longer than wide.

Coyote (*Canis latrans*) **or Domestic Dog**

(*Canis familiaris*) Note: These skulls are very difficult to distinguish from one another.

25b. Hard palate extends beyond the last upper molar.

The last molar on each side of the upper jaw is 1 1/2 times longer than wide.

Black Bear (*Ursus americanus*)

Order *Insectivora* Moles and shrews

26a. Length of skull 29 mm (1 1/8 inches) or more; teeth not dark tipped **Moles** *Go to 27*

26b. Length of skull is less than 29 mm (1 1/8 inches); teeth usually dark tipped **Shrews** *Go to 29*

27a. Number of teeth is 36, 20 above and 16 below, width of skull is 15 mm (9/16 inch) or more
Common Mole (*Scalopus aquaticus*)

27b. Number of teeth is more than 36; width of skull is less than 15 mm (9/16 inch) *Go to 28*

28a. Upper incisors curve slightly inward; hard palate extends beyond the last molar

Hairytail Mole (*Parascalopus breweri*)

28b. Upper incisors project forward; hard palate ends in front of the last molar **Star-nosed Mole** (*Condylura cristata*)

29a. Number of teeth is 30; 18 above and 12 below; skull width is 7.5 mm to 8.3 mm (approx. 1/4 inch)
Least Shrew (*Cryptotis parva*)

29b. Number of teeth is 32; 20 above and 12 below *Go to 30*

30a. Width of skull is 7 mm (1/4 inch) or less
Pygmy Shrew (*Microsorex hoyi*)

30b. Width of skull is more than 7 mm (1/4 inch) *Go to 31*

31a. Width of skull is 11 mm (7/16 inch) or more
Short-tailed Shrew (*Blarina brevicauda*)

31b. Width of skull is less than 11 mm (7/16 inch) *Go to 32*

32a. Fourth unicuspid is slightly larger than the third
Northern Water Shrew (*Sorex palustris*)



32b. Fourth unicuspid is not larger than the third *Go to 33*



- 33a. Width of skull is 8.5 mm (5/16 inch) or more
Smokey Shrew (*Sorex fumeus*)
- 33b. Width of skull is less than 8.5 mm (5/16 inch) Go to 34
- 34a. Fifth unicuspid is difficult to see; not always visible in side view; skull length is 16 mm (inch) to 17.4 mm (inch) **Masked Shrew** (*Sorex cinereus*)
- 34b. Fifth unicuspid is easily seen in the side view; skull length is 17.3 mm (inch) to 18.2 mm (inch)
Long-tailed Shrew (*Sorex dispar*)

Order Rodentia Rodents

- 35a. Number of teeth is 22, 12 above and 10 below Go to 36
- 35b. Number of teeth is less than 22 Go to 39
- 36a. Length of skull is more than 70 mm (2 3/4 inches) incisors whitish **Woodchuck** (*Marmota monax*)
- 36b. Length of skull is less than 70 mm (2 3/4 inches), incisors yellow to orange Go to 37
- 37a. Length of skull is 55 mm (2 3/16 inches) or more
Gray Squirrel (*Sciurus carolinensis*)
- 37b. Length of skull is less than 55 mm (2 3/16 inches) Go to 38
- 38a. Length of skull is more than 41 mm (1 5/8 inches)
Red Squirrel (*Tamiasciurus hudsonicus*)
- 38b. Length of skull is less than 41 mm (1 5/8 inches)
Southern Flying Squirrel (*Glaucomys volans*)
or
Northern Flying Squirrel (*Glaucomys sabrinus*)
- 39a. Number of teeth is 20, 10 above and 10 below Go to 40
- 39b. Number of teeth is less than 20 Go to 44
- 40a. Length of skull is 50 mm (2 inches) or more Go to 42
- 40b. Length of skull is less than 50 mm (2 inches) Go to
- 41
- 41a. Length of skull is more than 41 mm (1 5/8 inches)
Red Squirrel (*Tamiasciurus hudsonicus*)
- 41b. Length of skull is less than 41 mm (1 5/8 inches)
Chipmunk (*Tamias striatus*)

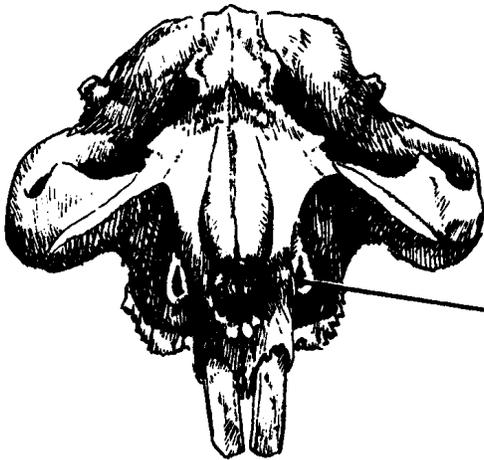
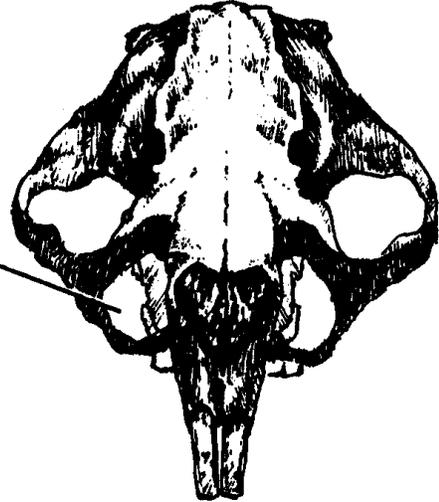
42a. Length of skull is less than 73 mm (2 7/8 inches)

Fox Squirrel (*Sciurus niger*)

42b. Length of skull is more than 73 mm (2 7/8 inches)

Go to 43

43a. Infra-orbital foremen large (facing the skull eye to eye) **Porcupine** (*Erthizon dorsatum*)



43b. Infra-orbital foremen small, less than 4 mm (3/16 inch) wide.
Beaver (*Castor canadensis*)

44a. Number of teeth is 18, 10 above and 8 below
Meadow Jumping Mouse (*Zapus hudsonius*)

44b. Number of teeth is 16, 8 above and 8 below

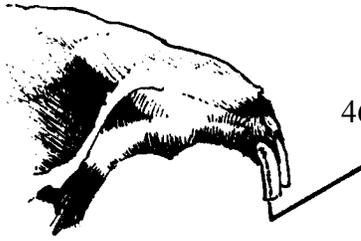
Go to 45

45a. Cheek teeth have folded enamel loops

Go to 46



45b. Cheek teeth not as above Go to 50



46a. Upper incisors have a length-wise groove on the front, outside edge of each tooth

Southern Bog Lemming

(Synaptomys cooperi)

46b. Upper incisors not as above

Go to 47

47a. Length of skull is 50 mm (2 inches) or more

Muskrat *(Ondatra zibethicus)*

47b. Length of skull is less than 50 mm (2 inches)

Go to

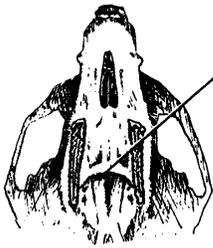
48

48a. Length of skull is 45 mm (1 3/4 inches) or more

Eastern Wood Rat *(Neotoma floridana)*

48b. Length of skull is less than 45 mm (1 3/4 inches)

Go to 49



49a. Back edge of palate without middle projection or support

Red-backed Vole

(Clethrionomys gapperi)

49b. Back edge of palate with middle projection or support sloping downward

Woodland Vole *(Microtus pinetorum)*

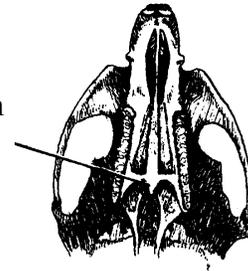
or

Rock Vole *(Microtus chrotorrhinus)*

or

Meadow Vole

(Microtus pennsylvanicus)



50a. Upper incisors have a deep, length-wise groove on the front, outside edge *Similar to 46a.*

Woodland Jumping Mouse *(Napaeozapus insignis)*

50b. Upper incisors are not as above

Go to 51

51a. The back edge of palate does not extend beyond the last upper cheek teeth

White-footed Mouse *(Peromyscus leucopus)* or

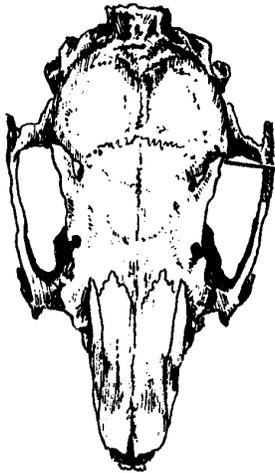
Deer Mouse *(Peromyscus maniculatus)*

51b. The back edge of palate extends beyond the last cheek teeth

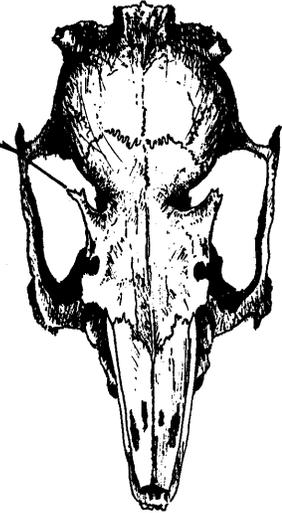
Go to 52

- 52a. Length of skull is more than 25 mm (1 inch)
Norway Rat (*Rattus norvegicus*)
- 52b. Length of skull is less than 25 mm (1 inch)
House Mouse (*Mus musculus*)

Order Lagomorpha - Rabbits and Hares



- 53a. Supraorbital process is not joined to the skull at the back end
Snowshoe Hare (*Lepus americanus*)



- 53b. Supraorbital process is usually joined to the skull at the back
Eastern Cottontail (*Sylvilagus floridanus*) or
New England Cottontail (*Sylvilagus transitionalis*)

Order Artiodactyla - Even-toed Hoofed Mammals

- 54a. One lacrimal foramen on or just within anterior orbital rim; head ornamentation consisting of permanent bony cores covered by permanent horny sheaths Go to 55
- 54b. Two lacrimal foramen on or just within anterior orbital rim; head ornamentation consisting of permanent bony cores surmounted by deciduous bony antlers Go to 56
- 55a. Zygomatic arch not visible from above; premaxillae in contact with nasals; horn cores curve sharply upwards; skull massive
Bison (*Bison bison*)
- 55b. Zygomatic arch visible from above; premaxillae not in contact with nasals; horn cores, when present, curve slightly upwards; skull long and narrow
Domestic Cow (*Bos taurus*)
- 56a. Upper canines absent; 32 teeth (12 teeth in skull); antlers, when present, with main beam curving far forward over head; premaxillae not reaching nasals
White-tailed Deer (*Odocoileus virginianus*)
- 56b. Upper canines present; 34 teeth (14 in skull); antlers, when present, with main beam curving backward from head; premaxillae in contact with nasals
Elk (*Cervus canadensis*)

Glossary of terms related to skull keying

Canines - The four teeth in the front corners of the mouth. Usually large and pointed in carnivores, but may be small or absent in herbivores. They are the first teeth in the maxilla, called eye-teeth in humans.

Cheek teeth - The teeth behind the canines, often divided into molars and premolars.

Cranium - The skull without the lower jaw.

Deciduous - Falling off or shed seasonally.

Diastema - A long natural gap in a row of teeth, especially that between the incisors (or canines) and the cheek teeth in herbivores.

Dorsal - Concerning the top: e.g. "dorsal view" is a view from the top.

Foramen - Hole in a bone for nerves and blood vessels.

Horn core - Porous bone projecting from the frontal bone, on which the horn grows.

Incisors - Front teeth, between the canines. Incisors grow from the premaxilla, but other upper teeth grow from the maxilla.

Infraorbital foramen - A large hole in the side of the maxilla, usually in front of or below the orbit.

Lacrimal foramen - Holes in the lacrimal bone (forms the front edge of the orbit) for nerves and blood vessels.

Lateral - Concerning the side. e.g. "lateral view" is a view from the side.

Maxilla - Bone forming the main part of the upper jaw on each side, supporting the canines and cheek teeth.

Molars - The rear cheek teeth, which do not have equivalent milk teeth.

Occipital bone - Forming the back of the skull. Contains the foramen magnum.

Occipital crest - A ridge formed where the parietal bones join the occipital bone, across the top, back part of the skull.

Orbit - The eye socket.

Orthodont - Normal rodent upper incisors, pointing downwards. (see pro-odont)

Palate - The surface forming the roof of the mouth.

Parietal bones - Form the top, back part of the skull.

Posterior - Towards the rear.

Postorbital process - Projection from the frontal bone that marks the rear, upper edge of the eye socket.

Premaxillas - Bones forming the front tip of the upper jaw.

Premolars - Cheek teeth lying between the canines (or incisors, if canines are absent) and the molars.

Pro-odont - Rodent incisors which point forwards. (see orthodont)

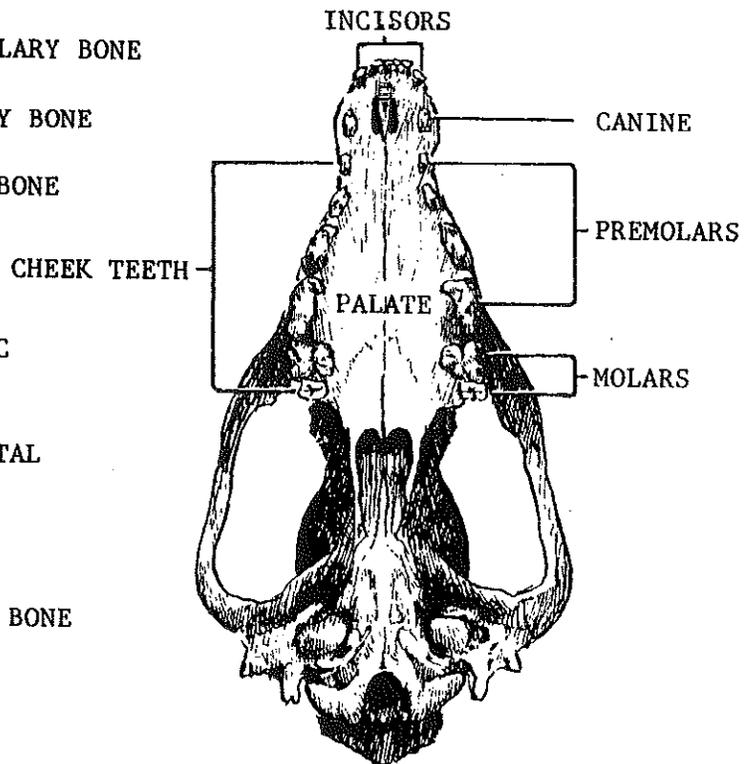
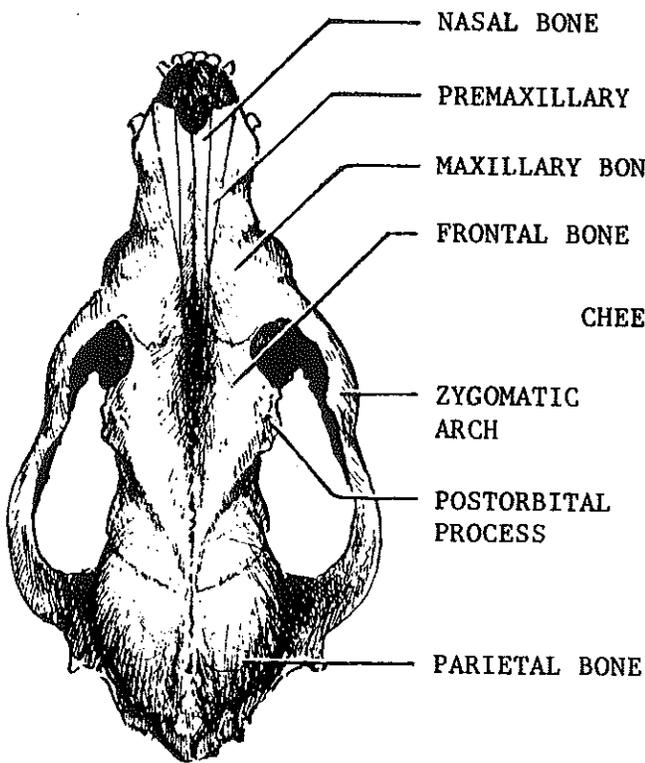
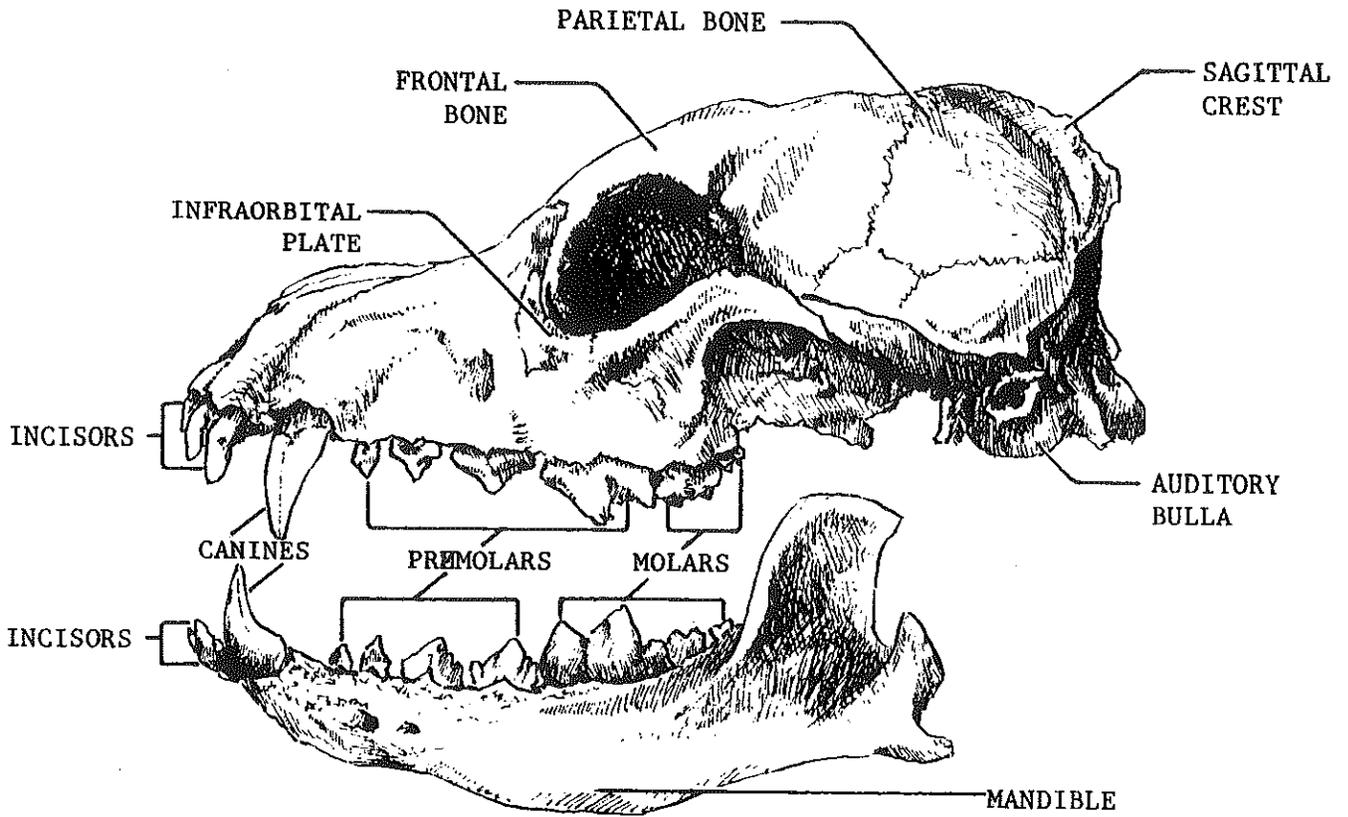
Ramus - The main horizontal part of the lower jaw.

Sagittal crest - Ridge running lengthwise along the top of the braincase.

Selenodont - Teeth with a crown pattern of longitudinal crescentic ridges.

Unicuspid - Teeth with a single cusp or point, e.g. the simple conical teeth of insectivores.

Zygomatic Arch - The cheekbone. Curved bone forming an arch along the side of the skull below the orbit.





Commonwealth of Pennsylvania
Department of Conservation and Natural Resources
Office of Parks and Forestry
Bureau of State Parks
Parker Dam State Park