

FOSSIL LAND CARNIVORES OF FLORIDA

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INTRODUCTION

The order Carnivora includes such related groups of flesh-eating mammals as dogs, cats, raccoons, weasels, hyenas, bears, skunks, mongooses and their kin. Shrews, porpoises, possums, and man, although they too eat meat, are excluded as they show physical characteristics relating them to other groups. Conversely some of the Carnivora, especially the bears and raccoons, eat many things besides flesh. The name Carnivora is often familiarized as "the carnivores," which is then understood to include all members of this particular order and to exclude unrelated types even though they may be carnivorous. Including both man's closest companions and fiercest competitors, the carnivores are a particularly intriguing group to the paleontologist.

Three major groups, the ancestral Miacoidea, the marine Pinnepeda (walrus and seals), and the terrestrial Fissipeda are included in the Carnivora. The Miacoidea were prominent terrestrial forms in the early Cenozoic era, but were replaced by their descendants, the fissipeds, in the Eocene epoch. Only fissipeds and pinnipeds are known from Florida. This issue of the PLASTER JACKET deals with the modern land carnivores, the Fissipeda, with emphasis upon the groups which the Florida paleontologist is likely to encounter.

Many readers may be introduced to dental formula by this issue. This "shorthand" represents the number of teeth of each type from the front to the back of one side of the jaw. For example, an adult human has two upper and two lower incisor teeth, an upper and a lower canine tooth, two upper and two lower premolars, and three upper and three lower molars, or, more simply

$$\begin{array}{cccc} 2 & 1 & 2 & 3 \\ 2 & 1 & 2 & 3 \end{array}$$

As the formula describes only half of the dentition, it must be doubled to obtain the total tooth number. The total number of teeth in man is 32.

A similar "shorthand" featuring the first letter of the tooth group (I for incisor, C for canine, P for premolar, and M for molar) and the number of its position, designates a particular tooth's position in the jaw half. For example, I_2 would be a second

lower incisor, and M^1 would be a first upper molar.

Key characters shared by all Fissipeda include:

(1) Teeth adapted for meat eating. Long canine teeth puncture and hold prey. A carnassial (meat shearing) pair (P^4 and M_1) is present in the rear of the jaw (Figure 1). In a few omnivorous groups (principally the bears and raccoons) the carnassial teeth have been modified into grinders. Incisor teeth range in shape from conical to spatulate, and are used to assist the canine teeth in holding and in stripping meat from bones. In the families adhering most strictly to a meat diet, the teeth before and behind the carnassial pair are reduced in size and number.

(2) "Primitive" feet with five-clawed toes. One toe of each foot may be reduced in size (the dew-claw) or completely lost. No carnivore has hooves. The lower leg bones (radius and ulna in the front and tibia and fibula in the rear) never fuse together as they tend to do in the grazing animals (Figure 2). Similarly the metapodial (mid-foot) elements do not elongate or fuse into "cannon bones" as is common in more specialized runners.

(3) Jaws specialized for snapping. The lower jaw is powerful with the condyle or ball riding in a deep, well-enclosed socket (the glenoid fossa) of the skull (Figure 6). Rapid, snapping movements require a rigid bony framework. To mount the strong jaw muscles there are heavy zygomatic arches along

the sides of the skull, and crests or ridges down the centerline (sagittal crest) and across the rear (nuchal crest) of the braincase (Figure 3).

On the bottom of the skull are a pair of rounded, bony capsules containing the ear bones. The structure of these "tympanic bullae" (Figure 6) serves to further divide the Fissipeda into dog-related (infraorder Canoidea) and cat-related (infraorder Feloidea) lineages.

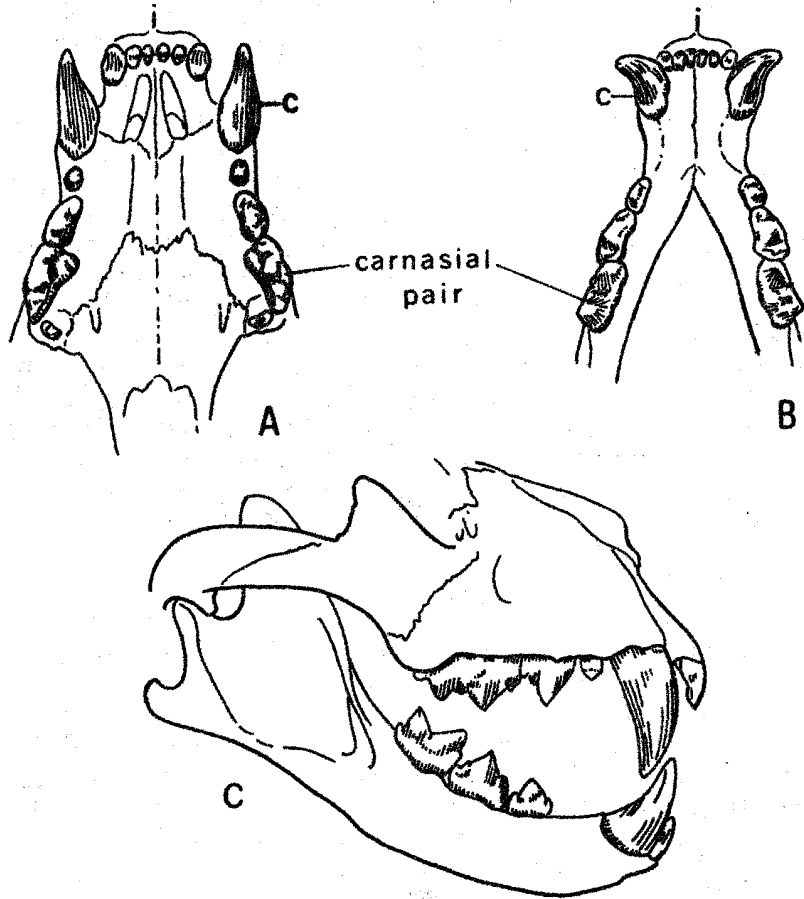


Figure 1. Occlusal views of A) Upper jaw, and B) Lower jaw, and side view of C) Both jaws.

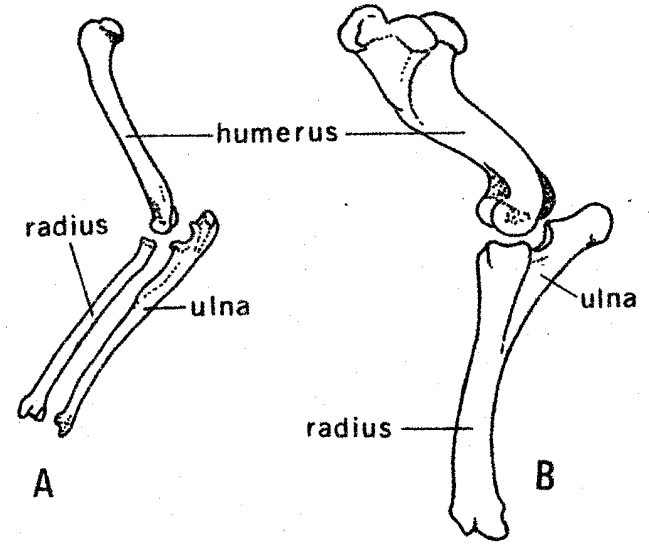


Figure 2. Outer view of left forelimbs of A) *Felis domesticus*, and B) *Equus caballus*.

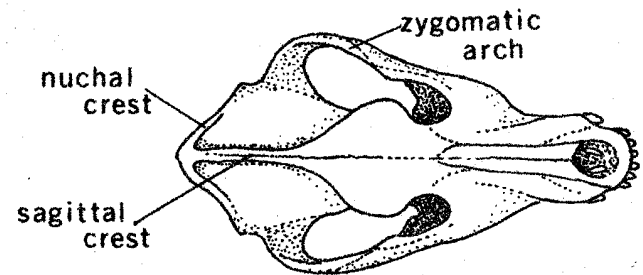


Figure 3. Top view of skull of *Canis familiaris*.

INFRAORDER CANOIDEA

FAMILY CANIDAE (Dogs, foxes, wolves, and kin)

Since their origin in the late Eocene, the canids have maintained a conservative central stock (the subfamily Caninae) represented in Florida by several species in the Oligocene, Miocene, and Pliocene and by the wolves, foxes, and coyote of the Pleistocene and Recent. From the central Caninae arise a few specialized side branches. Among these are:

The Borophaginae; "hyenoid dogs" noted for the heavy hyena-like construction of their carnassial teeth, represented in Florida by Aelurodon and Tomarctus of the Miocene and by the various species of Osteoborus of the Pliocene.

The Amphicyoninae and Amphicyonodontinae, lineages that became bear-like in size and habit, but neither of which is an ursid ancestor, including Amphicyon and Absonodaphoenus of the Florida Miocene epoch.

The generalized canine characters are chiefly adaptations for pursuing prey. Dogs are digitigrade (walk on their toes) and their claws are blunt and nonretractile. Functional toes are reduced to four on each foot plus a "dew-claw" (absent from the rear feet of most domestic dogs). Leg bones are long and slim, and never fused together. The eyes are set well anteriorly and directed forward. The snout is elongate.

The canid dental formula is usually $\frac{3}{3} \frac{1}{1} \frac{4}{4} \frac{2}{3}$

(Figure 4). The incisor teeth, of which i^3 is the largest, are three-cusped when unworn. The canine teeth are strong and pointed. Excluding P^4 (the upper carnassial) each premolar is low and narrow with a raised central cusp. M_1 is the lower carnassial and the longest tooth in the dentition. Molar number may vary from $\frac{1}{2}$ to $\frac{3}{3}$.

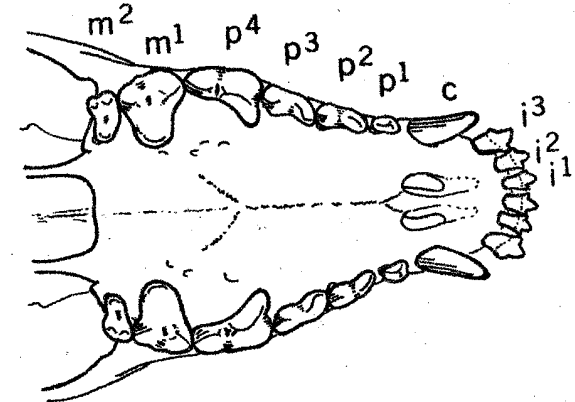
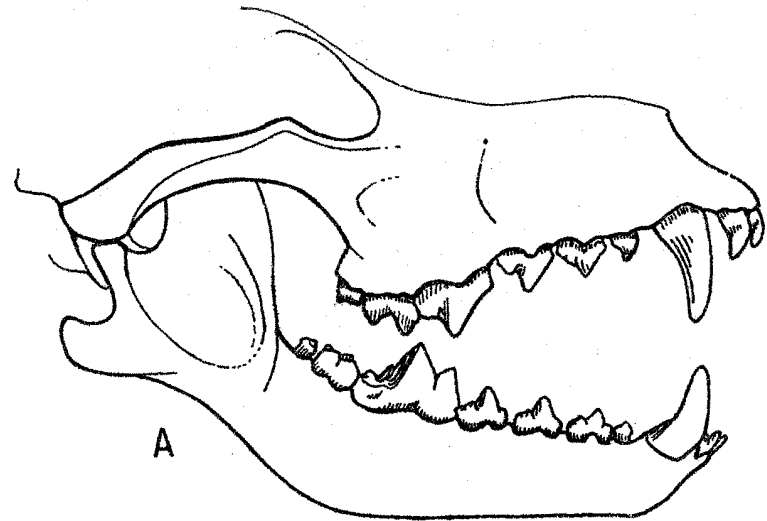


Figure 4. A) Side view of upper and lower jaws, and B) Palatal view of upper jaw of Canis lupus.

FAMILY URSIDAE (Bears)

The bears arose from canid stock in the Miocene epoch of Europe and appear slightly later in North America. The first Florida record of a true bear is

Indarctos of the middle Pliocene. Pleistocene bears of Florida include at least three genera: Arctodus; extinct short-faced bears, Tremarctos; spectacled bears now living in South America, and Ursus the ancestors of the living black and grizzly bears.

The ursids generally are more omnivorous than the majority of the carnivores. The carnassial pair as well as the molars behind them become flat grinding "bread-loaves" (see Figure 5). The bears also differ in walking on the sole (plantigrade) rather than the toes (digitigrade). Each foot has five toes with long, nonretractile claws for digging.

The ursid dental formula is $\frac{3}{3} \frac{1}{1} \frac{4}{4} \frac{2}{3}$. The

incisor teeth are small and three-cusped. Large, powerful canine teeth have immense roots but comparatively lower cusps than the dogs. The first, second, and third premolar teeth are reduced or missing entirely, and the fourth premolar and first and second molars are relatively flattened grinders. The second upper molar is the longest tooth in either jaw.

FAMILY MUSTELIDAE (Skunks, badgers, weasels, otters)

The mustelids depart from the canid lineage in the Oligocene epoch. Three genera are known from the Miocene deposits at Thomas Farm, Florida.

Several subfamilies are recognized, based largely upon the diet, including:

Mustelinae. This includes the primitive, strictly flesh-eating forms such as weasels, mink, wolverines, and martens. Megalictis, an early Miocene weasel reached modern bear size; but the majority of mustelines are small.

Taxidiinae and Melinae. Neither the Melinae from Eurasia or even the Taxidiinae from the western United States, has been recorded from Florida. The badgers are much more omnivorous than the weasels.

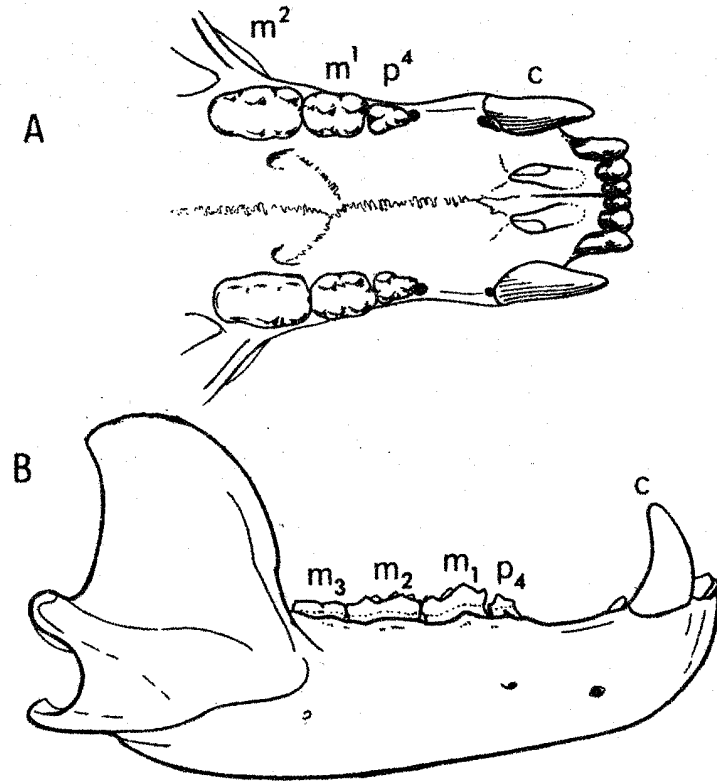


Figure 5. A) Palatal view of upper jaw, and B) Side view of lower jaw of Ursus americanus.

Mephitinae. The skunks are one step more omnivorous than the weasels.

Lutrinae. The otters are aquatically-adapted, fish-eating mustelids.

Leptarctinae. This extinct subfamily includes certain North American Miocene and Pliocene mustelids with omnivorous raccoon-like habits.

Mustelid adaptations vary with the subfamily. In general they are long-bodied, short-legged flesh eaters, having five toes with nonretractile claws on each foot. Like the bears, the bony palate extends rearward past the last molar. The bulla is flattened with a long tubular ear opening. The facial region is short and broad, compared with the long cranial region.

The dental formula varies, most North American forms having $\frac{3}{3} \frac{1}{1} \frac{2-3}{2-3} \frac{3}{3} \frac{1}{2}$. The incisors may be large or small, but are usually simple. The canine teeth are comparatively slender and sharp-pointed. Most mustelids have a functional carnassial tooth pair. It is followed by a large upper molar with the inner lobe broader than the outer. In more carnivorous forms this tooth is narrow-waisted; in more omnivorous types it is nearly square (Figure 6a).

FAMILY PROCYONIDAE (Raccoons)

Arising from near the base of the canid family tree in the Oligocene epoch, the procyonids are essentially dogs adapted for tree living and an omnivorous diet. Body size is small to medium as carnivores go, and the legs are comparatively shorter than in the canids but longer than in the mustelids. Five toes with semi- or nonretractile claws are present on each foot. The skull is rounded with well-inflated braincase and bullae and a short snout. The incisor teeth are simple or two-cusped. The canine teeth are pointed but less recurved than in the dogs. Following two to three simple premolars, the fourth upper premolar (the carnassial of other carnivores) and the molar teeth are multicusped and "squared up." (Figure 6b) No carnassial pair is present except in the Central American genus Bassariscus.

The dental formula is $\frac{3}{3} \frac{1}{1} \frac{4}{4} \frac{2}{2}$ in all living procyonids,

but a third lower molar tooth is present in a few pre-Pleistocene genera.

Procyon, the true raccoon is common in the Florida Pleistocene, but no procyonids have been described from earlier sediments.

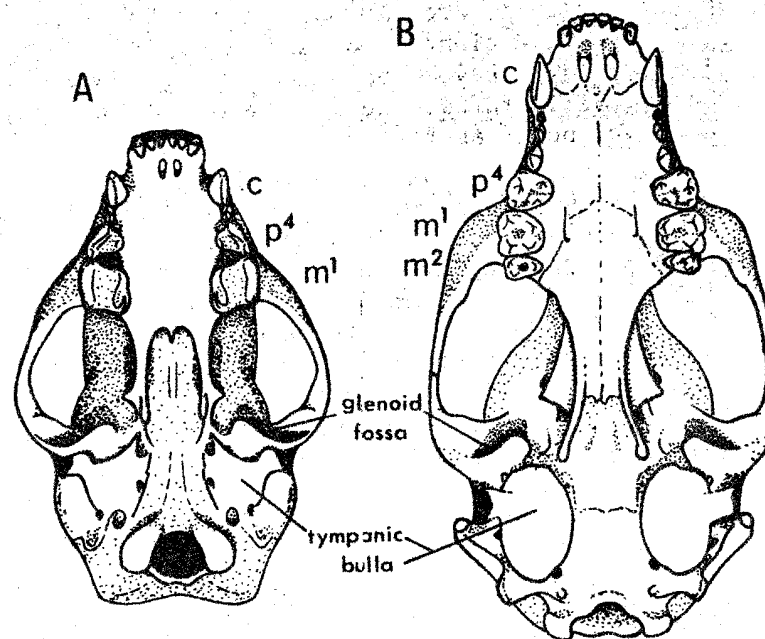


Figure 6. Palatal views of skulls of A) Conepatus leuconotus (hog-nosed skunk), and B) Procyon lotor (raccoon).

INFRAORDER FELOIDEA

FAMILY FELIDAE (Cats and sabertoothed cats)

Although felids appear in the Oligocene epoch of Europe and North America, opinions differ regarding cat lineages. Possibly the cat family tree has "old" and "new" branches, each of which has its own sabertoothed and true cats, or it may be that the true cats arose from sabertoothed lines. In support

of this latter idea are fossil "false" saber cats which are about right chronologically and physically, to be ancestral true cats.

Both true and sabertoothed cats are first known in Florida from the middle Pliocene epoch, and by the Pleistocene epoch are fairly common fossils. Among the most spectacular are Smilodon, the sabertoothed "tiger"; Felis atrox, a giant lion; and Felis onca augusta, a giant jaguar. Beyond this the living Florida cats, the bobcat, Felis rufus, and the mountain lion, Felis concolor, occur as fossils.

Cats are adapted to capturing prey in a sudden rush rather than by extended running (the African cheetah, Acinonyx, is an exception) and the skeleton is even more flexible than in the canids. Five front and four rear toes have sharp retractile claws that are used as offensive weapons. The three bony phalanges in each toe show modifications for retraction (Figure 7).

The cat skull, short-snouted and broadened by wide spreading zygomatic arches, is nearly as broad as it is

long. The general dental formula is $\frac{3}{3} \frac{1}{1} \frac{2-3}{1-2} \frac{1}{1}$. The

incisors are closely appressed, particularly in the sabertoothed cats, and one- to three-cusped. True cats have upper and lower canine teeth of nearly equal length, but sabertoothed cats feature enormously elongated upper and reduced lower canines. Cat dentitions are notable for their reduction of all cheek teeth except the huge carnassial-chewing pair (P^4 and M_1). (Figure 8)

Two additional families of carnivores must be mentioned. The cat-like Hyenidae are typically Old World scavengers, but a single species is known from western North America and could possibly have reached Florida. The Viverridae (civets and their kin) are known exclusively from the Old World except for the mongoose which was recently introduced into the West Indies.

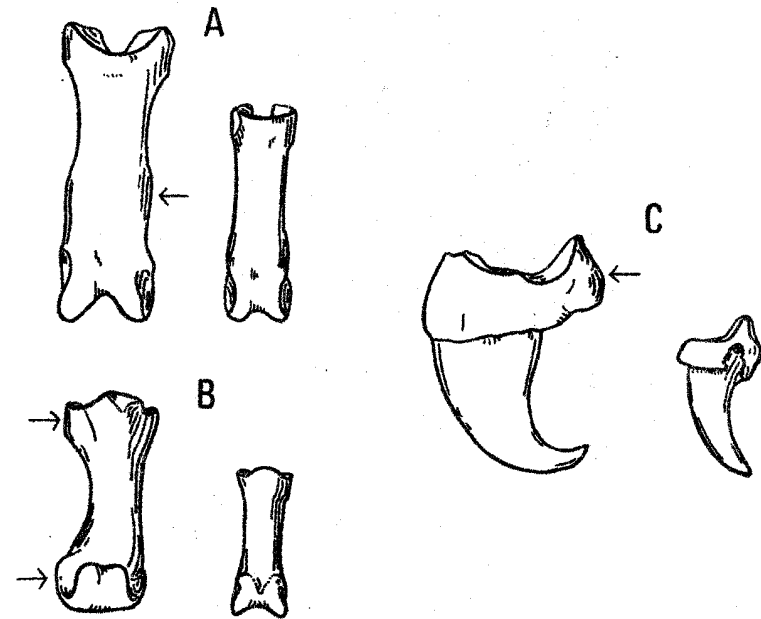


Figure 7. A) Upper, B) Middle, and C) Terminal phalanges of Felis concolor (on left) and Canis lupus (on right). A) and B) are top views, and C) is a side view. Arrows indicate modified portions of Felis phalanges.

Recent

Partial Phylogeny of the CARNIVORA

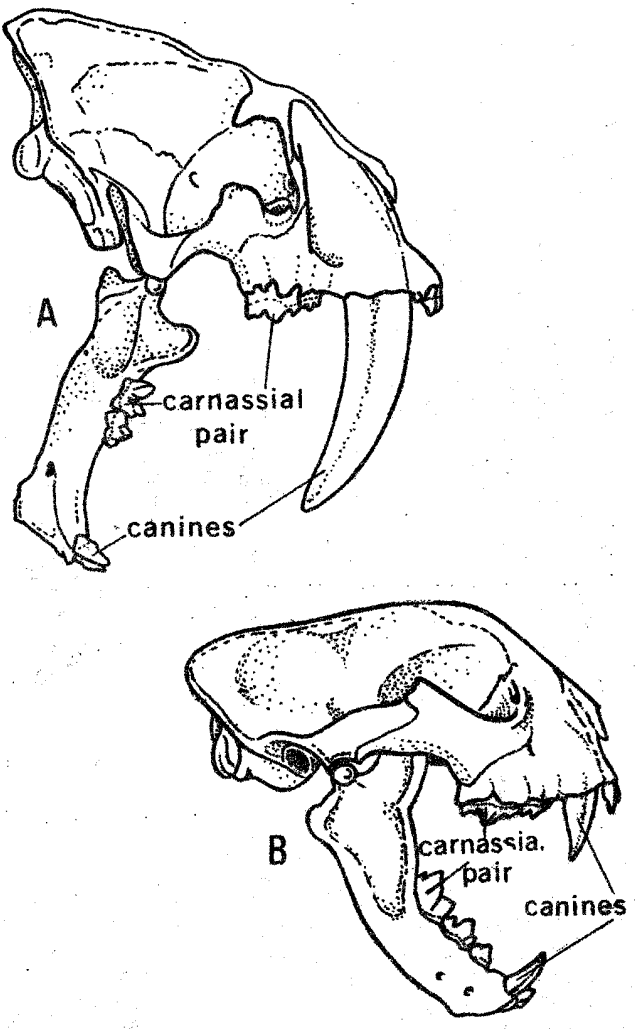
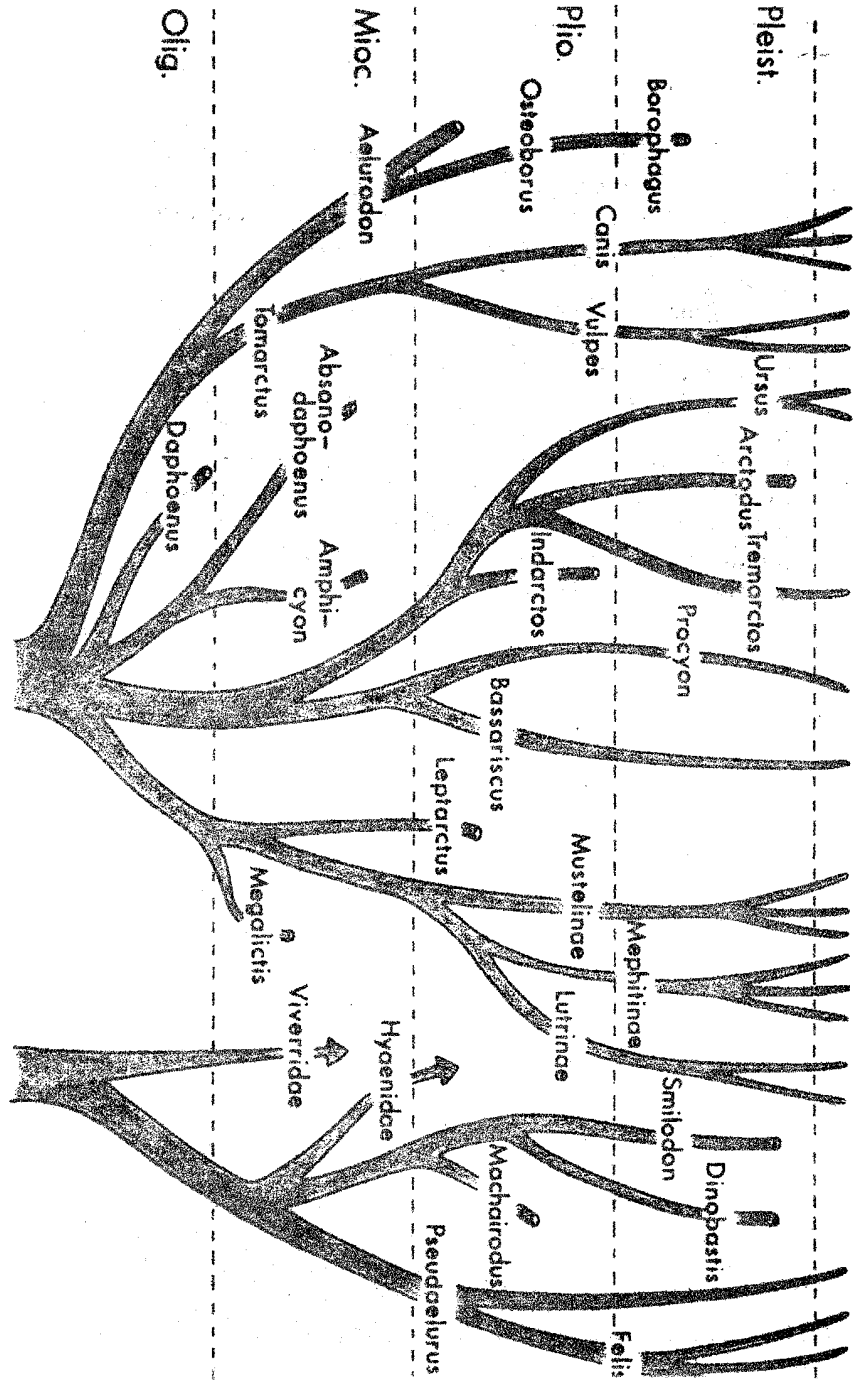


Figure 8. Side views of skulls of A) *Smilodon floridanus* (sabre cat) and B) *Pseudaelurus minor* (true cat).