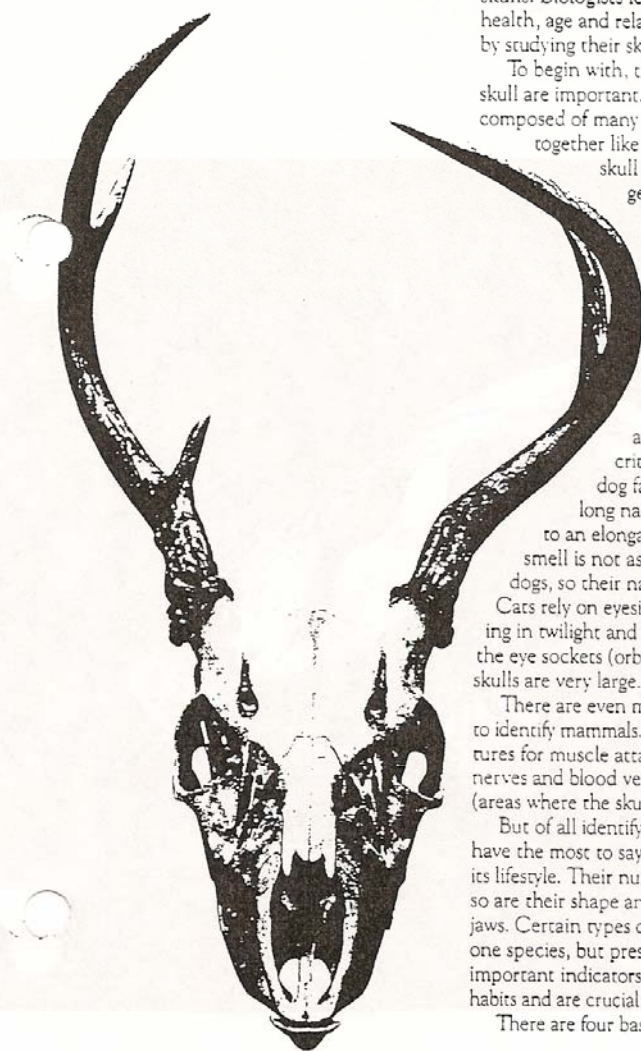


SKULL SESSIONS

The features of a skull reveal a lot about an animal's needs and habits.

written by Mary Kay Clark ©1997
photographed by Melissa McGaw



Of the bleached bones that she brought back to her desert studio, the artist Georgia O'Keeffe said, "They are as beautiful as anything I know."

The beauty that O'Keeffe saw in bones is perfectly illustrated in the elegant curves of the whitetail's antlers and the complex architecture of his skull. But there are other reasons to take a closer look at mammal skulls. Biologists learn much about the health, age and relationships of mammals by studying their skulls.

To begin with, the size and shape of the skull are important. All mammal skulls are composed of many separate bones that fit together like pieces in a puzzle. The skull bones, as well as other general features of the mammalian skull, are relatively constant among the mammals, but the size and shape of the bones vary according to the animal's particular lifestyle.

For example, because a keen sense of smell is critical to members of the dog family (canids), they have long nasal bones that contribute to an elongated skull. Among cats, smell is not as important as it is for dogs, so their nasal bones are reduced.

Cats rely on eyesight and hearing for hunting in twilight and darkness; consequently the eye sockets (orbits) and earbones in cat skulls are very large.

There are even more specific skull features to identify mammals. Biologists look for structures for muscle attachment, openings for nerves and blood vessels, and suture patterns (areas where the skull bones grow together).

But of all identifying features, the teeth have the most to say about a mammal and its lifestyle. Their number is important, but so are their shape and their location in the jaws. Certain types of teeth may be absent in one species, but present in another. All are important indicators of the animal's eating habits and are crucial for identifying the species.

There are four basic types of teeth: incisors,

canines, premolars and molars. Incisors are the front teeth. They have sharp edges for cutting and generally are simple in structure, but are modified in many mammals for grooming, cropping, cutting and other functions.

Canines are the conical, pointed teeth located between the incisors and the first premolars—they grip and tear food and are the "stabbing teeth" in some carnivores. The tusks found in many mammals are usually modified canines. Some mammals lack canines (particularly herbivores—rodents, horses and deer) and have a gap between the incisors and premolars.

Premolars, or bicusps, have two conical points and follow the canines. They are also used for gripping and tearing.

Molars are the back teeth, and they vary in surface shape depending on the lifestyle of the mammal. Mammals that grind food have flat molars, while those that cut food have serrated ones. These are generally the most elaborate teeth in the dentition, and they are extremely variable in pattern.

Why do mammals have so many different kinds of teeth? Because the diets of mammals are diverse, and different types of teeth are needed to process the various foods that mammals eat. Biologists reduce the number, type and location of a mammal's teeth to a "dental formula." For instance, here's what the dental formula of an opossum, the only North American land mammal with 50 teeth, looks like.

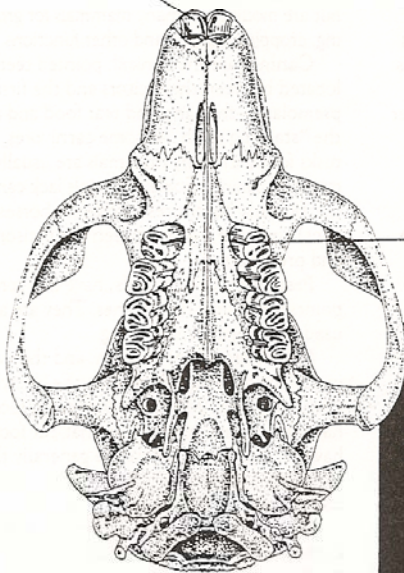
$$I \frac{10}{8} \quad C \frac{2}{2} \quad P \frac{6}{6} \quad M \frac{8}{8} = \frac{26}{24} \\ \text{or } 50 \text{ total teeth}$$

The letters refer to the different kinds of teeth: incisors (I), canines (C), etc. The numbers refer to the total number of teeth of each kind in both the upper and lower jaws. For example, the formula above shows that the opossum has six premolars (P) on each of its upper and lower jaws (12 altogether) and eight molars (M) on each jaw (16 altogether).

Mammals can be divided into three groups based on their feeding habits—herbivores (plant eaters), carnivores (meat eaters) and omnivores (plant and meat eaters). In the following pages try to discover what makes them herbivores, carnivores or omnivores. The answer you'll find, lies in their teeth.

Herbivores, such as the white-tailed deer and the beaver, must chew their food well before swallowing, since plant material is difficult to digest chemically. Generally, herbivores' cheek teeth (premolars and molars) are broad and flat to grind plant material to a pulp. Most herbivores don't have canines because they don't need to grab moving prey. In deer, beaver and other herbivores, the back of the lower jawbone (mandible) is wide and deep, providing a large area to anchor the strong chewing muscles.

Prominent incisors



Molars for grinding

The beaver, like other members of the rodent family, has very long, chisel-like front teeth in the upper and lower jaw for gnawing. The teeth are deeply rooted in a dense, robust skull that provides a strong foundation for the teeth. The skull must be rugged to withstand the physical stress of cutting and chipping hardwoods like oaks. The large, sharp incisors continually grow; otherwise they would quickly wear down from constant use. The incisors are sharpened by grinding the uppers against the lowers. Since beavers eat hard food such as twigs, chip the bark from trees, and chew through smaller trees to create short pieces for their dams and lodges, they also need large areas for muscle attachment. The molars are designed for grinding.

$$I \frac{2}{2} \quad C \frac{0}{0} \quad P \frac{2}{2} \quad M \frac{6}{6} = \frac{10}{10}$$

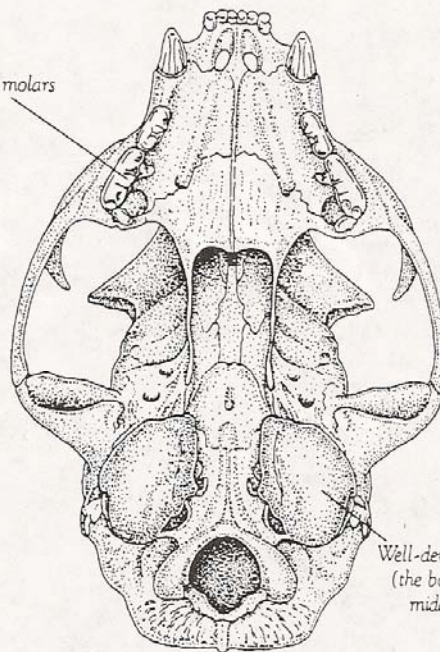
or 20 total teeth



Carnivores, such as bobcats and otters, have thick, heavy jaws with large surface areas and other features (such as a crest on the top of the head) for muscle attachment. Muscles are needed for the powerful, gripping bite that meat eaters need for grabbing and holding prey. In general, the teeth are pointed and sharp for catching and killing prey and for slicing and shearing meat. Cheek teeth are not as complex as in herbivores; less chewing is required because meat is easier to digest than plants. In true carnivores the cheek teeth are modified into sharp, shearing teeth called carnassials.



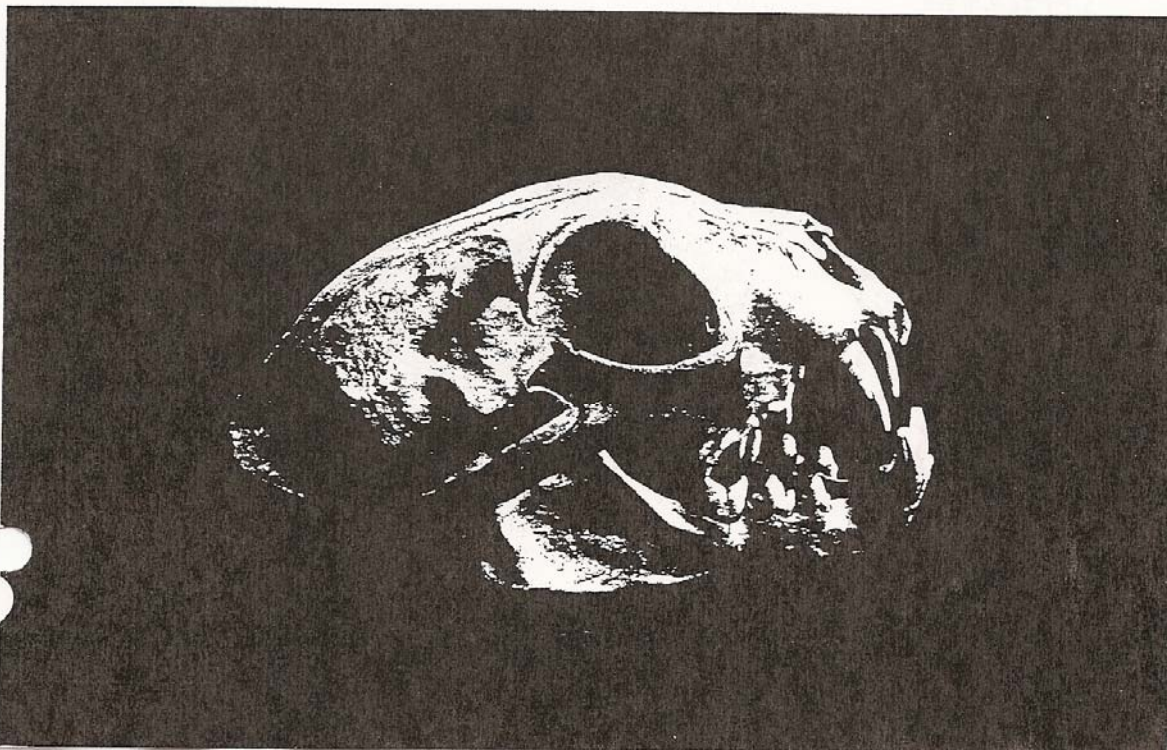
Elongated molars

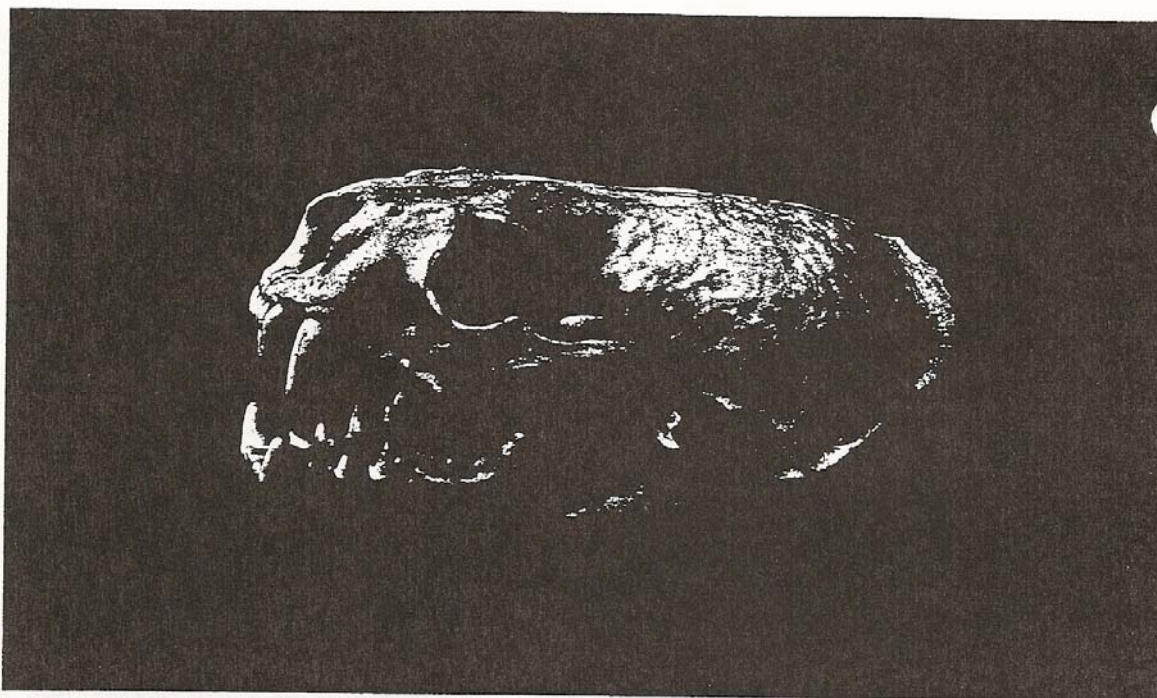


Well-developed auditory bulla
(the bones that protect the
middle and inner ear)

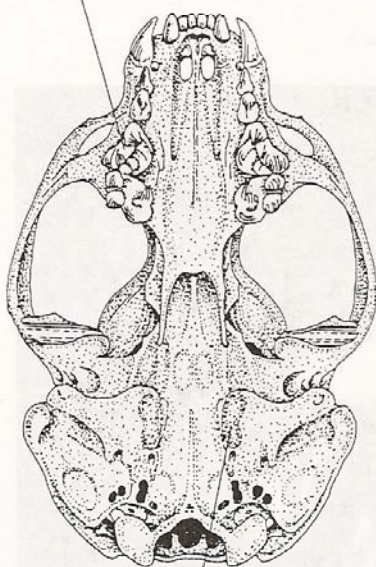
Bobcats, like all members of the cat family (felids), are true carnivores. Felids have a short-faced appearance, resulting from reduced nasal cavities and a shortened jaw. Bobcats rely on their sight and hearing when hunting. The bones that protect the middle and inner ear are well-developed and prominent orbits (eye sockets) are present because cats often hunt in twilight and in darkness. The first molars and premolars are specialized teeth, called carnassials, that are designed for gripping and tearing. The skulls of members of the cat family all have a high, rounded appearance.

$$I \frac{6}{6} \quad C \frac{2}{2} \quad P \frac{4}{4} \quad M \frac{7}{2} = \frac{14}{14} \text{ or 28 total teeth}$$





More cheekteeth than bobcat
and more variety in size and
shape of cheekteeth



Auditory bulla not
well-developed

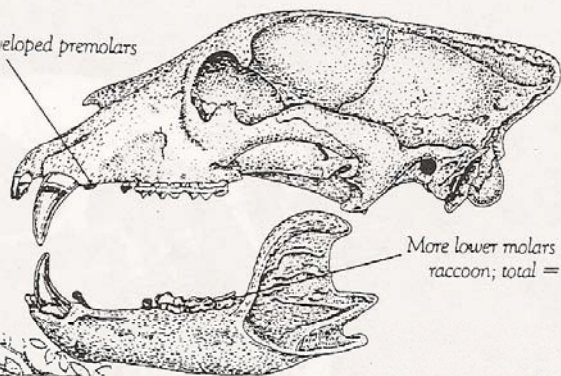
The otter, a member of the mustelid family (weasels and allies), is also a true carnivore with well-developed carnassials. The long and flattened shape of the skull is much different from the bobcat's high, round skull, and the otter's skull is much denser. This amphibious mammal catches frogs, crayfish, crabs and fish and consumes them immediately, crushing bones and hard exoskeletons with sharp teeth and strong jaws. The flattened shape of the skull contributes to the streamlined shape of the otter, a body plan that makes it an efficient swimmer.

$$I \frac{6}{6} \quad C \frac{2}{2} \quad P \frac{8}{6} \quad M \frac{2}{4} = \frac{18}{18} \text{ or } 36 \text{ total teeth}$$

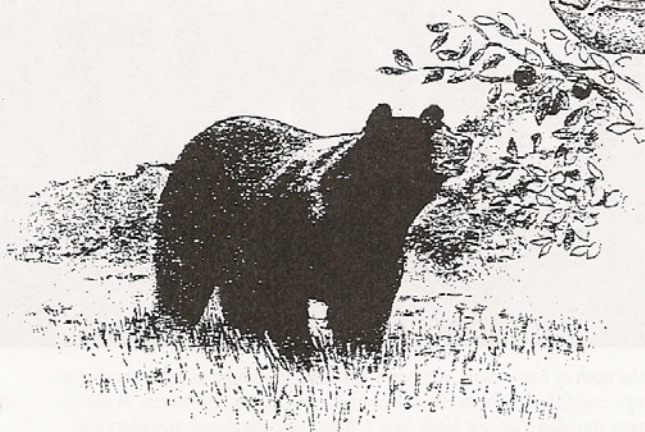


Omnivores eat both plant and animal food, and their dentition and other characteristics exhibit a combination of features of herbivores and carnivores. In order to handle such a varied diet, they usually have the full complement of teeth (incisors, canines, premolars and molars), but their jaws and teeth are generally less specialized than those of carnivores or herbivores.

Poorly developed premolars

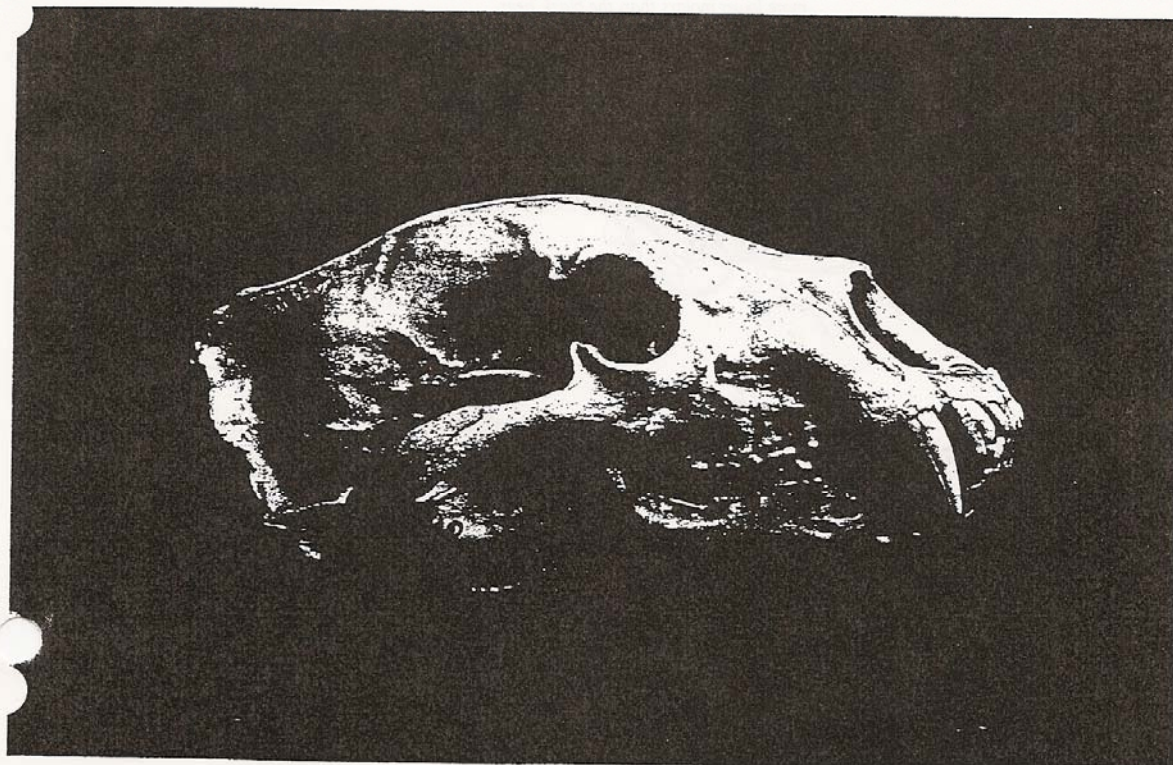


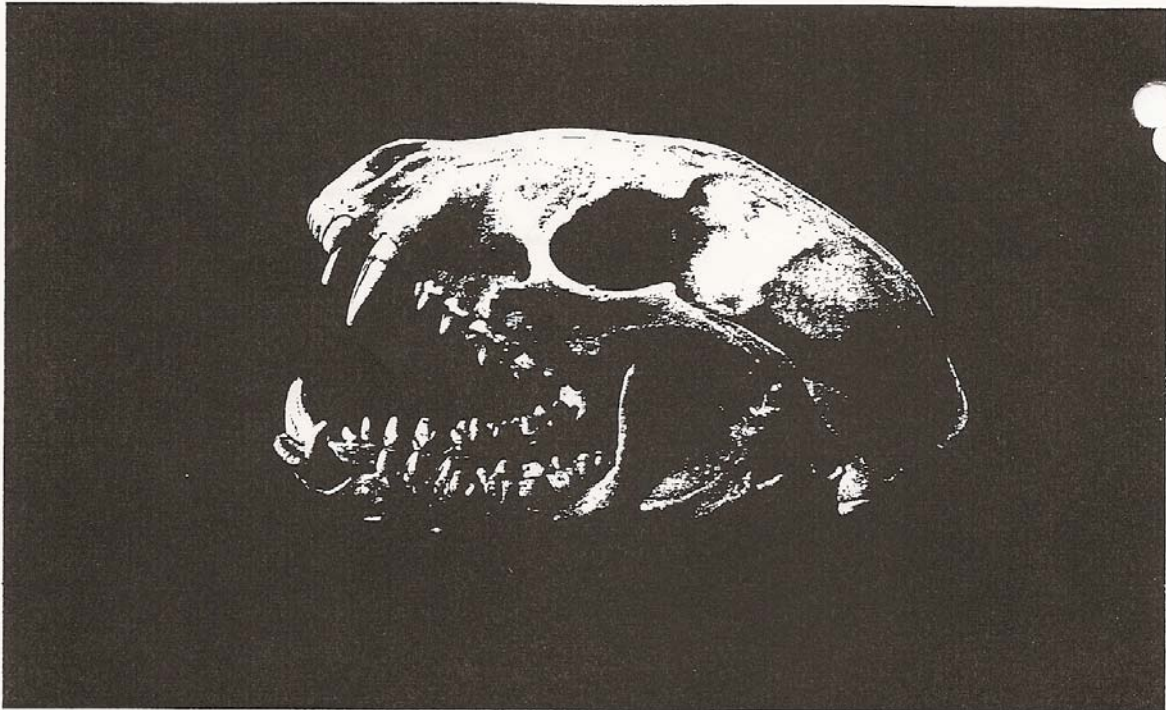
More lower molars than raccoon; total = 6



The bear family has evolved from being chiefly carnivorous to omnivorous. Black bears feed on almost any succulent vegetation and also on grubs, carrion, fish and other small animals. They have incisors that are unspecialized, and the canines are long, as they are in true carnivores. The premolars are not well-developed and the molars are designed for crushing plant matter. Bears have a massive skull with a long rostrum (nasal area) similar to that seen in the dog family.

$I \frac{6}{6} \quad C \frac{2}{2} \quad P \frac{8}{8} \quad M \frac{4}{6} = \frac{20}{22}$
or 42 total teeth

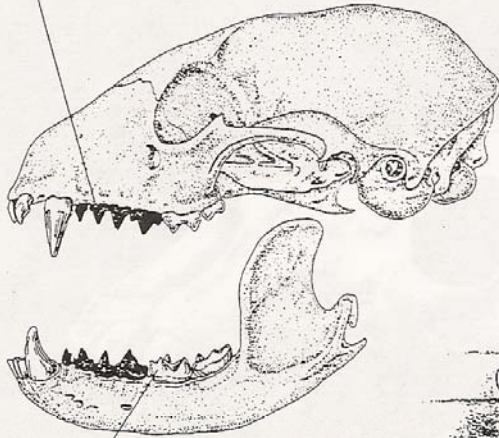




In contrast to the teeth of black bears, raccoon's teeth are generalized to accommodate a varied diet of frogs, crayfish, fish, birds, small mammals, fruits, nuts and insects. A raccoon's skull is more rounded than the black bear's. It has well-developed premolars and more lower molars than the black bear.

$$I \frac{6}{6} \quad C \frac{2}{2} \quad P \frac{8}{8} \quad M \frac{4}{4} = \frac{20}{20} \text{ or } 40 \text{ total teeth}$$

Well-developed pre-molars



Fewer lower molars than black bear; total = 4



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