

**LAB 8: CARNIVORA**

Sources: Martin et al., chapter 19 (pp. 109-120;) this handout.

General Information and Taxonomic Notes:

We have skins and skulls of most specimens; skulls only for a few. As in the past, know Connecticut species to genus, all others to family.

Many workers place pinnipeds in a separate order, Pinnipedia. Others divide the order Carnivora into two suborders, the Pinnipedia and the Fissipedia. Either way, paraphyletic groups result. However, pinnipeds are morphologically distinct from other carnivorans and are superficially similar to one another, therefore it is convenient to diagnose them separately. Thus, in this handout separate diagnoses are presented for pinniped and non-pinniped groups of families. This does not constitute a formal taxonomy, i.e. it does not imply that these are formal (monophyletic) groups. Carnivorans as a group are divided into two separate lineages (suborders), Feliformia and Caniformia. The latter contains the pinniped families within it. At the present time, sea lions (Otariidae) and walruses (Odobenidae) are thought to be sister groups, but Phocidae (true seals) are either most closely related to them, or are most closely related to Mustelidae/Procyonidae (otters, raccoons, etc.).

Note that the family Herpestidae (mongooses) is often included *within* the Viverridae. Although we treat them as separate families, we do not, as yet, have separate diagnoses. Therefore, the herpestid diagnosis is included within the viverrid diagnosis here.

Note that the relationships of the greater and lesser pandas have been controversial for many years with controversy centering on whether they are bear or raccoon relatives. Traditionally they were placed together in a separate family Ailuropodidae. Recent work, however, suggests that the giant panda is more closely related to ursids (bears). The lesser panda has been variously placed with procyonids (raccoons and their relatives) and ursids. Superficial similarity certainly suggests that the lesser panda is a raccoon relative, but some evidence supports lesser pandas as ursids. Some classifications continue to separate the giant panda into its own family, Ailuropodidae and most recently, lesser pandas have been placed in their own family (Ailuridae) because of the ambiguity in their relationships! For convenience, we will treat both giant pandas (*Ailuropoda*) and lesser pandas (*Ailurus*) as ursids, as suggested by some recent studies.

Malagasy (Madagascar) carnivorans have been problematic. The fossas have usually been placed within the Viverridae or the Herpestidae, but most recently are given familial status (Eupleridae). Likewise, the African palm civet, Nandinia, has recently been taken out of the Viverridae/Herpestidae and placed in its own family, the Nandiniidae. We will not use this most recent taxonomy here.

**PINNIPED CARNIVORANS—GENERAL DIAGNOSIS**

Diagnosis: aquatic; external ears reduced or absent; teeth nearly homodont; one or two pairs of lower incisors in adult; canines conical; no carnassial pair; total number of postcanine teeth varies from 12 to 24; condyle of lower jaw transverse; cranial part of skull greater in proportion to facial part than in most non-pinnipeds; first digit of manus and first and fifth digits of pes usually longer than other digits; pes and manus fully webbed; nails tend to disappear; always five well-developed digits on each limb; thick subcutaneous fat always present

## NON-PINNIPED CARNIVORANS—GENERAL DIAGNOSIS

Diagnosis: mostly terrestrial (some aquatic); usually three pairs of lower incisors with outermost pair largest; two well-developed conical canines in each jaw; P<sup>4</sup>/M<sub>1</sub> forms carnassial pair, especially well-developed in felids, poorly developed in ursids; molars vary in number and, except for M<sub>1</sub>, have broad, crushing surfaces; condyle of lower jaw transverse, sometimes nearly locked into socket; tympanic bullae large and ossified.

### ORDER CARNIVORA

#### Suborder FELIFORMIA

#### Family Felidae (cats)

Diagnosis: incisors small, chisel-like, arranged in a transverse line; canines elongate, pointed; postcanine space common, premolars sharp; carnassials large and well-dev.; dental formula typically 3/3, 1/1, 3/2, 1/1 = 30; first upper premolar reduced, often absent; paroccipital process flattened against bulla; auditory bulla much inflated and divided; digitigrade; five toes on forefeet, four on hind; claws retractile, sharp, and strongly curved; face short and broad; tail short to long; legs short to long; ears more or less triangular

Habits: carnivorous; solitary or found in family groups; stalk their prey; more or less arboreal; senses of smell and hearing are acute; polyestrous; one to six young

Range: Cosmopolitan, except Antarctica, Australia, Madagascar, and most oceanic islands

#### Genera

<b>Felinae</b>	<b>Pantherinae</b>
<i>Acinonyx</i>	<i>Neofelis</i>
<i>Caracal</i>	<i>Panthera</i>
<i>Catopuma</i>	
<i>Felis</i>	
<i>Leopardus</i>	
<i>Leptailurus</i>	
<i>Lynx</i>	
<i>Pardofelis</i>	
<i>Prionailurus</i>	
<i>Profelis</i>	
<i>Puma</i>	

Specimens: *Puma concolor* (mountain lion - no longer found in CT)  
*Lynx rufus* (bobcat)  
*Panthera* (big cats)

Know: **Felidae** (all)  
**Lynx**

#### Family Hyaenidae (hyaenas and aardwolf)

Diagnosis: third incisor larger than others; canines powerful to long and slender; carnassials well-dev., except *Proteles*; premolars small and widely spaced (*Proteles*) or strong and conical with

well-dev. crowns; molars strong and large or small (*Proteles*); dental formula 3/3, 1/1, 4/3, 1/1 = 34 (hyaenas) or 3/3, 1/1, 3/2-1, 1/1-21 = 28-32 (*Proteles*); paroccipital process in contact with bullae; hind limbs shorter than forelimbs; digitigrade; four toes or five on forefoot; claws blunt and non-retractile; tail of medium length and bushy; ears large and rounded

Range: Africa, southwestern Asia to India

Habits: hyaenas noted for bone-crushing habits; scavengers and predators of large animals, except *Proteles* which eats ants and other insects; usually solitary; depend largely on sense of smell, little on sight and hearing; *Crocuta* noted for "laugh;" polyestrous; one to six young

Genera: *Hyaena*, *Crocuta*, *Proteles*

Specimen: *Crocuta* (spotted hyaena)

Know: **Hyaenidae**

### **Family Viverridae** (civets, genets, linsangs, fossas)

Diagnosis: middle lower incisor raised above level of other two; canines small, elongate; premolars small, first minute or absent; upper carnassial usually without an anterior lobe and the lower with a well-dev. talonid; molars large, first molar considerably larger than second; dental formula usually 3/3, 1/1, 3-4/3-4, 2/2 = 36-40; paroccipital process in close contact with bulla; auditory bulla externally constricted and divided by septum; legs short in relation to length of body; digitigrade to semi-plantigrade; five toes on each foot, generally; pollex and hallux functionless, located well above the other toes; claws half-retractile; tail usually long and bushy; ears small and rounded; auditory meatus directed laterally and non-tubular

Habits: most carnivorous, but some frugivorous; solitary, in small packs, or in larger groups; senses of sight, smell, and hearing well-dev.; usually bear two litters annually, each with two to four young

Range: southern Eurasia, Africa, Indonesia

Genera: *Viverra*, *Civettictis*, *Viverricula*, *Genetta*, *Osbornictis*, *Poiana*, *Prionodon*, *Nandinia*, *Arctogalidia*, *Paradoxurus*, *Paguma*, *Macrogalidia*, *Arctictis*, *Hemigalus*, *Chrotogale*, *Cynogale*, *Fossa*, *Eupleres*, *Cryptoprocta*

Specimens: *Genetta* (genet)  
*Arctictis* (binturong) (skull only)  
*Paradoxurus* (palm civet)  
Unkn. Viverrid skull

Know: **Viverridae** (all)

### **Family Herpestidae** (mongooses)

Diagnosis, habits and range: see Viverridae, above

Genera: *Herpestes*, *Mungos*, *Crossarchus*, *Liberiictis*, *Helogale*, *Dologale*, *Bdeogale*, *Rhynchogale*, *Ichneumia*, *Atilax*, *Cynictis*, *Paracynictis*, *Suricata*, *Galidia*, *Galidictis*, *Mungotictis*, *Salanoia*

Specimen: *Herpestes javanicus* (Indian mongoose) (skull only)  
*Mungos* (banded mongoose) (skin only)

Know: **Herpestidae**

#### Suborder CANIFORMIA

#### Family Canidae (dogs, wolves, coyotes, jackals, foxes)

Diagnosis: carnassials well-dev., remaining molars with crushing surfaces; P<sup>4</sup> without parastyle; dental formula usually 3/3, 1/1, 4/4, 2/3 = 42, with variation only in the number of molars (*Otocyon* with up to 4/5 molars); facial part of skull elongate; paroccipital process long and prominent; legs long and semirigid, adapted for cursorial gait; digitigrade; five toes on forefoot, four on hind foot; claws non-retractile, blunt, and nearly straight; tail relatively long, distinctly bushy; ears pointed and erect, sometimes large

Habits: essentially carnivorous, eat all types of animal life; some eat carrion; some solitary, some hunt in packs; rely largely on senses of hearing and smell, less on sight; generally highly vocal

Range: cosmopolitan, except most oceanic islands and Antarctica

Genera: *Canis*, *Alopex*, *Vulpes*, *Fennecus*, *Urocyon*, *Nyctereutes*, *Dusicyon*, *Cerdocyon*, *Atelocynus*, *Chrysocyon*, *Speothos*, *Cuon*, *Lycaon*, *Otocyon*, *Pseudalopex*, *Lycalopex*

Specimens: *Canis lupus* (wolf)  
*Canis latrans* (coyote)  
*Canis familiaris* (domestic dog)  
*Vulpes vulpes* (red fox)  
*Urocyon cinereoargenteus* (gray fox)

Know: **Canidae** (all)  
***Canis***  
***Vulpes***  
***Urocyon***

#### Family Ursidae (bears)

Diagnosis: canines elongate, conical, slightly hooked; first three premolars usually rudimentary or lost; molars with broad, flat, tubercular crowns (bunodont); carnassials weakly dev.; dental formula 3/3, 1/1, 4/4, 2/3 = 42; skull elongate; paroccipital process large, broad, independent of bulla; legs large and powerful; plantigrade; five toes on each foot; claws well-dev. but not retractile

Habits: omnivorous (*Ursus maritimus*, polar bear, strictly carnivorous); usually solitary; smell is dominant sense; sight and hearing usually poorly developed; relatively quiet, slow in movement, and of sluggish habits; often climb trees; monoestrous and have delayed implantation; some hibernate

Note: Diagnosis and Habits do not include *Ailuropoda* and *Ailurus*.

Range: most of North America, Europe, and Asia, incl. Malay peninsula, and Andes of South America

Genera: *Ursus*, *Tremarctos*, *Ailuropoda*, *Ailurus*

Specimens: *Ursus americanus* (black bear)  
*Ailurus* (lesser panda) (skull only)

Know: **Ursidae**  
*Ursus*

### **Family Otariidae** (sea lions, eared seals, fur seals)

Diagnosis: hind limbs capable of being placed underneath body for support and movement on land; small external ears; postorbital process present; four lower incisors; first two upper incisors notched transversely; usually 20 to 24 postcanine teeth in all; small but distinct tail

Habits: assemble in large herds during breeding season when males guard harems; are mostly pelagic; migrate seasonally; forelimbs used mainly in swimming

Range: coastlines of Pacific, South Atlantic, and Indian oceans

Genera: *Phocarcos*, *Otaria*, *Zalophus*, *Neophoca*, *Eumetopias*, *Callorhinus*, *Arctocephalus*

Specimen: *Otaria* (South American sea lion)  
*Zalophus* (California sea lion)

Know: **Otariidae**

### **Family Odobenidae** (walrus)

Diagnosis: hind limbs capable of being placed under body; no external ear; upper canines of both sexes forming tusks; no postorbital process; mastoid process enormous; lower incisors absent in adult; postcanine teeth usually 12

Taxonomic Note: Wozencraft (1989) (phylogeny and taxonomy shown in figures at end of this handout) includes Odobenidae within Otariidae (they are sister taxa according to him, so this is a purely taxonomic decision—are they different enough to have different family names?—you decide)

Habits: more or less gregarious and polygamous; seldom in open sea, but stay close to ice flows or shore; move seasonally with ice; feed chiefly on mollusks and other bottom-dwelling invertebrates; vocal; usually only one per litter; breed but once every 3 years

Range: Arctic regions of Atlantic and Pacific

Genus: *Odobenus*

Specimen: *Odobenus rosmarus* (walrus; historically present in New England)  
(see specimen in TLS foyer)

Know: **Odobenidae**

## Family Procyonidae (raccoons and their ilk [that's *ilk*, not *elk*])

Diagnosis: canines elongate and oblong in cross section; premolars pointed and small; carnassials weakly developed; molars broad, somewhat bunodont; dental formula usually 3/3, 1/1, 4/4, 2/2 = 40, but variable in number of premolars; paroccipital processes prominent; legs moderate in length, flexible; semi-plantigrade to plantigrade; five flexible toes on each foot; claws non-retractile or semi-retractile; tail long, prehensile in *Potos*; ears small to medium in size

Habits: omnivorous; may travel alone, in family groups, or in bands; excellent tree climbers; generally not vocal (raccoons an exception); usually monoestrous; one to six young

Range: southeastern Asia and New World

Genera: *Bassariscus*, *Procyon*, *Nasua*, *Nasuella*, *Potos*, *Bassaricyon*

Specimens: ***Procyon lotor*** (raccoon)  
***Bassariscus*** (ringtail)  
***Nasua*** (coati)  
***Potos*** (kinkajou)

Know: **Procyonidae** (all)  
***Procyon***

## Family Mustelidae (weasels, badgers, skunks, otters)

Taxonomic Note: According to some studies, skunks and a few other “mustelids” are a distinct group and elevated to a separate family, Mephitidae. This family would include the following genera: *Conepatus*, *Mephitis*, *Mydaus*, and *Spilogale*. Because the evidence is equivocal, we use the traditional taxonomy, which includes them within the Mustelidae.

Diagnosis: canines elongate and sharp; premolars small; carnassials usually well-dev.; molars reduced in number; a constriction usually present between lateral and medial parts of M<sup>1</sup>; dental formula usually 3/3 (*Enhydra* 3/2), 1/1, 3/3 (*Lutra* 4/3), 1/2 = 34; facial region of skull shortened; paroccipital process prominent; postglenoid process curved over glenoid fossa, locking mandible in place; legs usually short in relation to length of body; plantigrade to digitigrade; five toes on each foot; claws never fully retractile; tail usually long; ears small and rounded; auditory meatus directed forward, tubular and long (compare with viverrids)

Habits: primarily flesh-eaters; fierce, quick; solitary; some good swimmers (*Enhydra*, *Lutra*); smell is best-developed, followed by hearing and sight; important economically as fur-bearers; monoestrous, often have delayed implantation

Range: cosmopolitan except Madagascar, Australia and most oceanic islands

Genera: Mustelinae: *Mustela*, *Vormela*, *Martes*, *Eira*, *Galictis*, *Lyncodon*, *Ictonyx*, *Poecilictis*, *Poecilogale*, *Gulo*; Mellivorinae: *Mellivora*; Melinae: *Meles*, *Arctonyx*, *Mydaus*, *Taxidea*, *Melogale*; Mephitinae: *Mephitis*, *Spilogale*, *Conepatus*; Lutrinae: *Lutra*, *Pteronura*, *Aonyx*, *Enhydra*

Specimens: ***Mustela erminea*** (ermine, stoat or short-tailed weasel)  
***M. frenata*** (long-tailed weasel)  
***M. vison*** (American mink)  
***Martes pennanti*** (fisher)

*Eira barbara* (tayra) – skull only  
*Mephitis mephitis* (striped skunk)  
*Spilogale* (spotted skunk)  
*Conepatus* (hog-nosed skunk)  
*Lutra canadensis* (river otter)  
*Enhydra* (sea otter) – skull only  
*Taxidea* (New World badger)

Know: **Mustelidae**  
***Mustela***  
***Martes***  
***Mephitis***  
***Lutra***

**Family Phocidae** (true, earless, or hair seals)

Diagnosis: hind limbs extend straight back and cannot be rotated forward under body; no external pinnae; postorbital process rudimentary or absent; two to four lower incisors; postcanine teeth usually 16 to 20 in all.

Habits: vary from solitary to highly gregarious; mostly monogamous; mainly use hind limbs and dorsoventral body flexion for swimming and move on land by undulations of body; chiefly eat fish, squid, octopus, shellfish, but specialized feeders take macroplankton (*Lobodon* and young leopard seals, *Hydrurga*); some are migratory; are vocal; usually one young per litter

Range: along most coastlines north of 30° north latitude and south of 50° south latitude

Genera: *Phoca*, *Halichoerus*, *Erignathus*, *Monachus*, *Lobodon*, *Ommatophoca*, *Hydrurga*, *Leptonychotes*, *Cystophora*, *Mirounga* (sometimes *Pagophilus* [harp seal] and *Histiophoca* are recognized as separate genera, but most include them within the genus *Phoca*)

Specimens: ***Phoca vitulina*** (harbor or common seal)  
***Halichoerus grypus*** (gray seal)  
***Mirounga*** (elephant seal)

Know: **Phocidae**  
***Phoca***  
***Halichoerus***