

**LABS 9 & 10: LAGOMORPHA, CETACEA, TUBULIDENTATA, SIRENIA,  
PROBOSCIDEA, HYRACOIDEA, PERISSODACTYLA, ARTIODACTYLA**

Sources: Martin et al., chapters 20, 22, 24, 25, 26, 27; this handout

General Information and Taxonomic Notes:

We have skins and skulls of many specimens, skulls only for a few. As always, know Connecticut species to genus, others to family.

Once again, the classification used in this handout is for convenience only and does not necessarily reflect monophyletic groups. Relationships among the orders and among families within an order are in flux.

We have no specimens of the aardvark (Tubulidentata), therefore they are mentioned in the title for completeness only. Be sure to read about them in the textbook, however.

We are de-emphasizing familial diversity of cetaceans. This could be a course in itself. We will consider here only the two suborders, Odontoceti and Mysticeti (see taxonomic notes below). Finally, we lack specimens of the perissodactyl family Rhinocerotidae (if you saw one you'd know it immediately) and the artiodactyl families Tragulidae (the chevrotain, or mouse deer) and Giraffidae.

The Lagomorpha is indisputably the sister group of Rodentia, so we are studying them somewhat out of order. Remember, the easiest way to distinguish lagomorph skulls from rodents is the presence in lagomorphs of the second *upper* incisor immediately *behind* the grooved first upper incisor—almost as if it is supporting it. The fenestrated maxilla is also an obvious character.

**Order LAGOMORPHA**

Diagnosis: small to medium size; quadrupedal and digitigrade; tail either not evident externally or short and well-furred; soles of feet covered with hair; facial portion of maxilla fenestrated; incisive foramina large, confluent posteriorly, and elongate, terminating between cheek teeth; bony palate short, extending in midline only as far as P4 or M1; palatine ridges numerous; bulla formed only from ectotympanic; dental formula 2/1, 0/0, 3/2, 2-3/3 = 26-28; incisors ever-growing, with enamel extending to posterior surface; first upper incisor with longitudinal groove on anterior face; second upper incisor located directly behind first, small, peglike, and without cutting edge; lower incisors of variable length, terminating below P3 in leporids, below P4 in ochotonids; diastema between incisors and cheek teeth; cheek teeth hypsodont and rootless

Range: World-wide, with principal exception of southern South America, Australian region, New Zealand, Indonesia, Madagascar. Introduced into many of these areas by humans.

Families: Ochotonidae  
Leporidae

**Family Ochotonidae** (pikas, mouse hares, conies)

Diagnosis: ears short; tail not externally visible; limbs short, hind limbs only slightly longer than forelimbs; five manal digits, four pedal digits; skull flat in profile, much constricted between orbits; no supraorbital process on frontal; maxilla with a single, large fenestra; zygomatic arch slender, not vertically expanded

Habits: subfossorial; active in all seasons, but hibernation has been reported; diurnal; scampering, with great agility; typically inhabit rock slides; very vocal; chiefly herbivorous; have a distinctive habit of curing and storing food for winter use; litter size 2-5, up to two litters per year

Range: Holarctic; discontinuous in mountains of western North America, eastern Europe, and all of Asia north of Himalaya mountains

Specimen: *Ochotona*

Know: **Ochotonidae**

### **Family Leporidae (rabbits, hares)**

Diagnosis: ears longer than wide; hind limbs longer than forelimbs; pentadactyl, with strong reduction of first digit on both fore- and hind feet; skull more or less arched in profile and only moderately constricted between orbits; supraorbital process of frontal always with a posterior arm and often an anterior arm as well; maxilla with numerous fenestrae; zygomatic arch vertically expanded, often concave laterally; dental formula 2/1, 0/0, 3/2, 3/3 = 28; cutting edge of first upper incisor straight; enamel of re-entrant angles of upper cheek teeth usually crenated; last lower molar double (divided by transverse enamel plate)

Habits: nocturnal or crepuscular; do not hibernate or aestivate; locomotion varies from a scurrying or scampering gait to a series of long bounding jumps or leaps; some vocal, most drum with hind feet; almost strictly herbivorous, some coprophageous; do not store food; territorial behavior in some; females polyestrous

Range: same as for order

Genera: *Lepus*, *Sylvilagus*, *Oryctolagus*, *Pentalagus*, *Nesolagus*, *Romerolagus*, *Poelagus*, *Bunolagus*, *Pronolagus*, *Caprolagus*

Specimens: *Lepus americanus* (snowshoe hare)  
*Sylvilagus transitionalis* (New England cottontail)  
*S. floridanus* (eastern cottontail)

Know: **Leporidae**  
***Lepus***  
***Sylvilagus***

## **Order CETACEA**

Diagnosis: Exclusively aquatic; body fusiform; anterior limbs (flippers) paddle-shaped (joints distal to shoulder immobile); no external digits or claws; no external hind limbs; tail flattened laterally and bearing

horizontal flukes at the tip; only internal vestiges of the ear pinna present; body essentially hairless; thick subcutaneous blubber; bones of skull strongly telescoped ;external nares (blowhole) on the vertex (except Physeteridae); rostrum greatly elongated; Mysticeti: baleen present, teeth absent; symmetrical skull; Odontoceti: no baleen, teeth always present, homodont, single-rooted, unicuspid; skull asymmetrical

Taxonomic notes: Several recent morphological and molecular studies have confirmed the long-held notion that whales evolved from terrestrial artiodactyls. However, the precise group of artiodactyls remains contentious. Most paleontologists believe that cetaceans evolved from a now extinct group. One recent molecular study suggests that hippos might be the living sister group of Cetacea.

Recent molecular data (Milinkovitch et al. [1993] *Nature* 361:346-348) suggests that the Odontoceti is a paraphyletic group. In other words, baleen whales (Mysticeti) evolved from within the toothed whales. Baleen whales are most closely related to the odontocete sperm whales (Physeteridae). Therefore, the traditional classification below is not a cladistic one, but is an evolutionary taxonomic one in that it emphasizes morphological differences, but not monophyly.

Another interesting recent finding is that of a fossil whale related to the living beluga and narwhal (Monodontidae). This whale seems to have had a blunt snout, a single, downward-directed tusk and dorsally-directed eyes. It probably looked and fed very much like a walrus, digging up clams with its tusk and then using a powerful suction mechanism to suck them into the mouth (de Muizon [1993] *Nature* 365:745-748).

Families: suborder **ODONTOCETI:** Platanistidae  
**Delphinidae** (*Delphinus?*)  
Monodontidae  
Physeteridae  
Ziphiidae  
suborder **MYSTICETI:** Eschrichtidae  
**Balaenopteridae** (*Balaenoptera acutorostrata*)  
Balaenidae

Specimen: *Delphinus* (mounted skeleton)  
*Balaenoptera* (huge hanging skull) (Minke Whale)

Know: **Delphinidae**  
**Balaenopteridae**

## Order SIRENIA

Diagnosis: massive, fusiform, thick-skinned, nearly hairless, and aquatic; no hind limbs, forelimbs paddle-like; external nares high on rostrum; anterior portion of palatines and corresponding surface of mandible covered with rough, horny plates; either single pair of tusk-like incisors or no anterior teeth; cheek teeth either small, peg-like, and a max. of 6 pairs, or large and numerous (possibly up to 20 pairs, but not all present at once); nasal bones either absent or small and not joined medially; pelvis vestigial, no sacrum; mouth small, lips bearing stiff vibrissae; tongue small and fixed; tail a horizontally flattened fluke

Habits: herbivorous, feeding primarily on marine algae; generally solitary and nocturnal; come to surface to breathe every 1 to 10 min. ; have one young per year, gestation period reported to be about 5

months in the manatee and 11 to 12 mo in the dugong; have prehensile snout/upper lips that move using muscular-hydrostatic deformation (like a tongue); use these movements to gather plants for ingestion

Range: pan-tropical in coastal waters except for eastern Pacific; also in fresh waters of Amazon and Orinoco basins of South America and in West Africa; formerly in Bering Sea (*Hydrodamalis*, the Steller's sea cow, exterminated by sailors within a few years of discovery in late 1700s)

Families: **Dugongidae** (*Dugong*, *Hydrodamalis*) (dugong and sea cow)  
**Trichechidae** (*Trichechus*) (manatee)

Specimen: *Trichechus* (manatee)??

Know: **Trichechidae**

### Order PROBOSCIDEA

Diagnosis: largest terrestrial animals; nose extended into long muscular, flexible proboscis with nostrils at end; legs pillar-like with long upper segments; numerous air cells in walls of cranium and nasal-maxillary region of skull; five toes on each foot, most bearing small hoofs; dental formula: 1/1, 0/0, 3/3, 3/3, but usually only one or two cheek teeth functional at any one time; incisors ever-growing, forming tusks; cheek teeth hypsodont, lengthened anteroposteriorly and having transverse lophs of enamel, dentine, and cement; jugal participates in glenoid fossa.

There are five fossil families, but only one extant

**Family Elephantidae** (African and Asiatic elephants)

Diagnosis: same as for order

Habits: herbivores; usually one young per litter; gestation period between 18 and 24 mo.; live in herds of up to 400 individuals; very "intelligent"

Range: Africa, south of the Sahara, and Oriental region

Genera: *Loxodonta* (African elephant)  
*Elephas* (Asian or Indian elephant)

Specimen: *Elephas* (mandible only)

Know: **Elephantidae**

### Order HYRACOIDEA (Hyraxes)

Diagnosis: Were initially grouped with rodents based on physical similarity, but are more closely related to elephants and manatees; short, compact bodies (total length 32-60 cm; mass 1-5 kg), with brown or gray pelage; possess prominent middorsal gland; has specialized elastic pads on soles of feet, with secretory glands that maintain moisture for suction-like adhesion; toes with short, hoof-like nails

(except digit 2, which has grooming claw); dental formula 1/2, 0/0, 4/4, 3/3=34; upper incisors long, pointed, triangular in cross-section (ever-growing, and lacking enamel on posterior)

**Family Procaviidae** (hyraxes)

Diagnosis: same as for order

Habits: Rock hyraxes (*Procavia*, *Heterohyrax*) inhabit rocky habitats (northeast & southern Africa); arboreal tree hyraxes (*Dendrohyrax* spp.) inhabit forested areas of Africa (up to 3600 m elevation); all herbivorous (rock hyrax consumes mostly grasses and has hypsodont dentition; tree hyraxes consume less abrasive vegetation and have more brachyodont dentition); do not ruminate but possess unique digestive system with one large cecum and a pair of ceca on ascending colon; live in colonies of 25-35 individuals; rock hyraxes form social hierarchies with cooperative breeding

Range: Central & South Africa, and parts of Middle East

Genera: *Procavia* (rock hyrax)  
*Heterohyrax* (*H. brucei*; yellow-spotted rock hyrax)  
*Dendrohyrax* (tree hyraxes)

Specimen: *Procavia* skull

Know: **Procaviidae**

**Order PERISSODACTYLA** (odd-toed ungulates)

Diagnosis: hoofed, with middle digit (III) larger than others; usually three digits on pes, but only the middle one may be functional; skull elongate through enlargement of facial bones; dentition usually complete with 44 teeth; cheek teeth broad and lophodont

Three modern families and six fossil families; order much more diverse in the Tertiary

**Family Equidae** (horses)

Diagnosis: lateral digits reduced, third functional and terminating in a hoof; nasal bones long and narrow, projecting freely; hornless; orbits small and enclosed; postorbital process broad; tympanic bullae feebly developed; incisors broad, canines small and variable; cheek teeth hypsodont; dental formula 3/3, 0-1/0-1/, 3-4/3, 3/3; limbs long and slender; one living genus

Habits: feed on grasses and forbs in open plains; gregarious; both nocturnal and diurnal, but mainly crepuscular; one or occasionally two young per year; may live 20-25 yrs; gestation period about 11 mo.

Range: Africa, Arabia, western and central Asia; in historic times became widespread throughout Eurasia, and of course has been widely introduced by humans

Specimen: *Equus* (horses and zebras)

Know: **Equidae**  
*Equus*

## **Family Tapiridae (tapirs)**

Diagnosis: heavy bodied with short, stout legs and short tail; skin thick; hair sparse, eyes small; no horns; upper lip and nostrils elongated into short muscular proboscis; pes with three functional digits; nasal bones short, projecting freely; nasal opening enlarged and recessed; orbit and temporal fossae confluent; well-dev. paraoccipital processes; teeth brachy-lophodont without cement; canines well-dev. and conical; dental formula 3/3, 1/1, 4/4, 3/3

Habits: nocturnal inhabitants of tropical forests and swamps; are shy and solitary; excellent swimmers and are usually associated with permanent water; they are herbivores which browse and graze; litter size is one, occasionally two; gestation period varies from 390-405 days; live for up to 20 yrs in captivity

Range: tropical parts of Western Hemisphere from southern Mexico to Argentina, and southeast Asia; family much more widespread in fossil record

Specimen: *Tapirus* (South American, Baird's, and Malay or saddle-backed tapirs)

Know: **Tapiridae**

## **Order ARTIODACTYLA (even-toed ungulates)**

Diagnosis: teeth bunodont to selenodont, brachydont to hypsodont; premolars generally simpler than molars; horns or antlers may be present; parietals usually reduced, frontals usually enlarged; third trochanter of femur absent; foot paraxonic, main axis between third and fourth digits; second and fifth digits usually reduced, lost in advanced forms; ungual phalanges usually flattened on inner and ventral surfaces, equally developed on third and fourth toes; two or four toes on each foot except Tayassuidae in which inner digit is suppressed on pes; astragalus with rolling surface above, pulley surface below

Range: Native: cosmopolitan, except Australia, oceanic islands, and Antarctica; Introduced: world-wide, except Antarctica

<u>Families:</u> Suborder Suiformes	<b>Suidae</b> <b>Tayassuidae</b> <b>Hippopotamidae</b>
Suborder Tylopoda	<b>Camelidae</b>
Suborder Ruminantia	Tragulidae <b>Cervidae</b> Giraffidae <b>Antilocapridae</b> <b>Bovidae</b>

**Family Suidae (pigs, hogs, boars)**

Diagnosis: teeth variable in number, molars bunodont; canines usually with sharp lateral edges, large upper canines tend to turn outward and upward, forming tusks; postorbital bar absent or incomplete; sagittal crest may be present; mastoid not visible in lateral view of skull; feet four-toed, metapodials separate

Habits: usually gregarious, nocturnal or diurnal; grub or root for food; food consists of vegetable and animal matter; breed throughout year, 2 to 14 young per pregnancy

Range: native to Eurasia and Africa, introduced into Australia and New World

Genera: *Potamochoerus*, *Sus*, *Phacochoerus*, *Hylochoerus*, *Babyrousa* (meaning "pig deer")

Specimen: ***Sus***

Know: **Suidae**  
***Sus***

### **Family Tayassuidae (peccaries)**

Diagnosis: dental formula 2/3, 1/1, 3/3, 3/3 = 38; upper canine tusks relatively small, directed downward, with sharp cutting edge; molars bunodont, forming continuous series gradually increasing in size from first to last; four toes on front feet, three toes on hind feet; no postorbital bar; sagittal crest present; mastoid not visible in lateral view

Habits: gregarious, omnivorous; usually bear twins

Range: southwestern U. S. south to central Argentina

Genera: *Tayassu*, *Pecari*, *Catagonus* (only 3 species in family)

Specimens: *Tayassu pecari* (white-lipped peccary)  
*Pecari tajacu* (collared peccary or javelina)  
*Catagonus wagneri* (chacoan peccary – DISCOVERED BY UCONN SCIENTISTS!)

Know: **Tayassuidae**

### **Family Hippopotamidae (hippopotamus)**

Diagnosis: dental formula 2-3/1-3, 1/1, 4/4, 3,3 = 38-40; incisors and canines tusk-like, continually growing; inner pair of lower incisors are largest, project upward and outward; teeth bunodont; postorbital bar incomplete; sagittal crest present; mastoid not visible in lateral view; four toes on each foot

Habits: amphibious; diurnally never ventures far from water; rests in deep water with only eyes and nostrils above surface or basks in sun on sand spits; at night ventures onto land to feed; vocal; gregarious (except *Choeropsis*); breed year round

Range: Africa south of Sahara

Genera: *Hippopotamus*, *Choeropsis*

Specimen: *Hippopotamus*

Know: **Hippopotamidae**

**Family Camelidae** (camels, guanaco, llama, alpaca, vicuna)

Diagnosis: premaxillae bearing full number of upper incisors in young, outer incisors of upper jaw persist in adult as isolated lanariform teeth; canines in both jaws, suberect, pointed; lower incisors procumbent, spatulate; molars selenodont, anterior premolars, when present, simple, separated from other cheek teeth; no horns; postorbital bar present; sagittal crest present; mandibular condyle more or less rounded; lateral toes absent; digitigrade; dental formula  $1/3, 1/1, 3/1-2, 3/3 = 32-34$  in *Camelus*,  $1/3, 1/1, 2/1, 3/3 = 30$  in *Lama*

Habits: most exist only in domestication; herbivorous grazers; gregarious; polyestrous, usually have one young

Range: Native: now restricted to Gobi Desert in central Asia and southwestern South America; domesticated forms range from north Africa through central Asia and throughout western South America

Genera: *Lama*, *Vicugna*, *Camelus*

Specimen: *Lama* (llama)

Know: **Camelidae**

**Family Cervidae** (deer)

Diagnosis: vacuity between lacrimal and nasal bones; postorbital bar present; sagittal crest absent; mandibular condyle long; dental formula  $0/3, 0-1/1, 3/3, 3/3 = 32-34$ ; molars selenodont and brachydont; lateral toes present, small; antlers present, normally shed yearly, present generally only in males

Habits: gregarious, sociable; some, like *Rangifer*, are seasonally migratory; usually good swimmers; herbivorous, generally browsers; use antlers in intraspecific combat in breeding season, and for defense; young usually one or two per litter

Range: cosmopolitan, except nearly all of Africa and Australasian region

Genera: *Moschus*, *Hydropotes*, *Muntiacus*, *Elaphodus*, *Dama*, *Axis*, *Cervus*, *Elaphurus*, *Odocoileus*, *Blastocerus*, *Ozotoceros*, *Hippocamelus*, *Mazama*, *Pudu*, *Alces*, *Rangifer*, *Capreolus*

Specimens: *Cervus* (N. A. wapiti, known as N. A. elk to some; European red deer)  
*Muntiacus* (muntjac)  
*Odocoileus virginianus* (white-tailed deer)  
*Alces alces* (moose; in Europe, *Alces* known as elk)

*Mazama* (brocket deer)

*Pudu* (pudu)

Know:        *Cervidae*  
                  *Odocoileus*

### **Family Antilocapridae** (pronghorn)

Diagnosis: cheek teeth selenodont, hypsodont; dental formula 0/3, 0/1, 3/3, 3/3 = 32; horns in both sexes having bony cores and sheaths of fused hair; sheaths shed annually after the breeding season; no sagittal crest; postorbital bar present; lacrimal bone separated from nasal by a vacuity; no lateral toes; horns have short branch arising above middle of horn-height that is directed forward

Habits:     gregarious in winter, but solitary or in small bands at other times; when disturbed erect hairs on their white rump as warning signal; are agile and rapid runners, cruise at 50 km/hr; keen vision; nervous; herbivorous, chiefly browsers

Range:     western North America

Specimen: *Antilocapra* (wall mount)

Know:     **Antilocapridae**

### **Family Bovidae** (cattle, bison, buffalo, goats, sheep, antelope)

Diagnosis: upper canines reduced or absent; molars usually hypsodont, selenodont; dental formula 0/3, 0/1, 3/2-3, 3/3 = 30-32; lacrimal bone almost meeting nasal; no lacrimal-nasal vacuity; no sagittal crest; postorbital bar present; lateral toes reduced to vestiges or absent; horns always present in males, often in females, composed of bony core covered with keratin, unbranched, nondeciduous

Habits:     primarily grassland grazers; polyestrous; young vary in number from one to five

Range:     cosmopolitan, except for Central and South America, and Australasia; worldwide in domestication

Genera:    45 living genera, usually divided into 5 subfamilies: Bovinae, Cephalophinae, Hippotraginae, Antilopinae, Caprinae

Specimens:   Bovinae:        *Bos* (oxen)  
                                  *Bison* (bison, buffalo)  
                                  Caprinae:        *Capra* (goat)  
    *Oreamnos* (mountain goat)  
    *Ovis* (sheep)  
    *Ovibos* (muskox)  
                                  Hippotraginae: *Alcelaphus* (hartebeest)  
    *Connochaetes* (wildebeest, gnu)

Know:        **Bovidae**  
                  *Bos*  
                  *Capra*

*Ovis*