SAMPLE

Scope and Nature of Carnivore Zoology

Aim

To discuss the characteristics, classification and significance of carnivorous animals to man, ecosystems and environments.

INTRODUCTION

Carnivores are animals with four limbs (tetrapods), like reptiles, amphibians and birds. Carnivores are also mammals. That means they produce live young, produce milk and grow hair, like primates, ungulates and rodents).

Members of the Order Carnivora are typically carnivorous – carnivore means “meat eater”. There are however exceptions to this, with many being omnivorous and some that are even completely vegetarian.

In this course, we study mammals in the Order Carnivora which consists of at least 286 species.

Distinguishing Characteristics of Carnivores

- Most have teeth modified for eating meat (with some variations).
- Skulls are varied but generally with a relatively large brain case
- Brains relatively large, and intelligent
- Most have well developed senses
- Stomachs are always simple
- Thick coat of hair -varied in colour
- Most are medium sized animals - smallest a weasel around 80 grams, and largest are elephant seals to around 3,600 kg.
- Males commonly larger than females
- Relatively long lived animals (most to 10 years or more)
- Many are top predators in their ecosystems

TAXONOMY

When meaningfully discussing any subject, it is important that it is clearly defined. As you study carnivores you may sometimes encounter conflicting information concerning nomenclature, or their common and scientific names and therefore identity.

As you study carnivores you may sometimes encounter conflicting information concerning nomenclature. Books or authorities may use different nomenclature; however, this does not mean that they are inaccurate. It is important to recognise that the Linneaus ranking system is still the most accurate and widely used way of identifying different types of animals. Above all, it provides an extremely useful tool for understanding, studying, managing and protecting the diversity of animal life on earth.

Principles of Taxonomy

In the 18th century a scientist called Carl Linnaeus began a revolution in the way we name living organisms, dividing everything into three Kingdoms; animals, plants and minerals.

The Linneaus system also organised living organisms into a series of different levels of classification, which he called ranks, that resulted in a tree like structure with the Kingdom at the base then diverging through the different ranks:

- The Kingdom of animals was divided into Classes such a fish, mammals or birds.
- Classes were divided into Orders
- Orders into Families
- Families into Genera
- Genera into Species

Therefore, each species had a binomial name consisting of its Generic name with a capital and specific name. i.e. domestic cat Felis (happy) catus (cat). Note: Scientific names are preferably italicised, but may be underlined. Each species could also

Linneaus system of classifying was based on observations of organism's similarity in morphology, such as hair, scales, or feathers, or wings, legs and feet or fins, or bone structure, and somewhat on habitat. Linneaus system of classification did not assume evolutionary theory or genetics, as these sciences were still not founded. However, the ranks were highly suggestive of a progressive development of species from a common ancestor but this idea was heretical to Christian religions at the time.

However, new scientific knowledge placed further demands on taxonomy to reconcile the nature of species. This knowledge was partly developed through palaeontology showing that organisms in the fossil record showed development in complexity as the age of fossils became more recent. This observation combined with the observation that organisms produce far more progeny than needed to maintain populations, and that these progenies were selected by natural mortality to eventually reproduce consolidated into evolutionary theory as finally published by Charles Darwin's 1859 book "The Origin of Species".

Gregor Mendel (1822-1884) a Christian monk, established the principles of heredity or inherited traits. The science of modern genetics throughout the 1950's (confirmed the validity of Mendel's findings) lead to a broad consensus in which natural selection was the basic mechanism of evolution.

As time progressed and evolutionary theory became accepted, the notion that animals belonged to same species was evidence if organisms could breed and produce fertile offspring.

With the development of modern genetics to determine phylogeny and the manufacturing of powerful electron microscopes to reveal micro-structures, we can now classify species with greater certainty. The most powerful of these findings are regions of ribonucleic acid in mitochondrion, the energy factories of cells. Therefore, the difference in these between species tells us how related the species are and even when they diverged from a common ancestor.

The assessment of individual genes gives even more power to ascertaining evolutionary theory and currently scientific research and molecular biology teams are working globally to sequence the whole DNA of thousands of species to further the *Phylogenetic Tree of Life*.

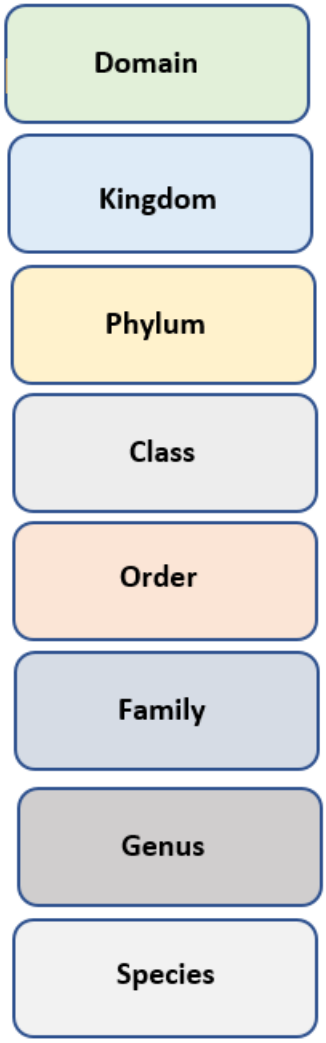
Taxonomy at the species level has previously been a "messy" field of science, often through scientific rivalry to name a species: some species have received multiple names, type specimens have been lost, ambiguous and inept descriptions of species have arisen. At the species level and in higher ranks there have been numerous re-naming and re-rankings.

Modern Science Has Changed Taxonomy

With the use of genetics to determine phylogeny, increasing detailed knowledge of morphology and knowledge of the fossil record and geology; our understanding of the evolution of animal species is much more informed than in Linnaeus' time. At extremes, some argue strongly for a "rank free" system of classification but the clear majority still broadly support and use the use of Linnaeus' system. Nevertheless, scientists currently generally consider that the higher-level ranks (above Order) consist of Domains:

Bacteria and **Archaea** (no distinct nucleus), and the **Eucaryota** (distinct nucleus).

Eucaryota are divided into the Kingdoms of animals, plants, protozoa and fungi.



The International Commission for Zoological Nomenclature acts as a global authority for managing the naming of animals internationally. They produce and manage any changes to an International Code for Zoological Nomenclature. This provides a central reference that all animal taxonomists can refer to. Because of the low cost of genetic analysis, the description of a new species now must include a phylogenetic genetic analysis.

As we learn more about animals and understand the genetic, chemical and anatomical similarities (and differences) in ever increasing detail, our perception of relationships between different organisms continues to grow. The current avalanche of knowledge has resulted in vibrant and sometimes heated debate among scientific schools of thought, especially in terms of higher classification (ranks), and generally more certainty and ironically sometimes uncertainty at the species level.

CLASSIFICATION OF CARNIVORES

The grandorder Ferae includes one single order: Carnivora; the Carnivores. This group includes dogs, wolves, bears, racoons, cats, weasels, hyenas, seals, sea lions and walruses.

Two living superfamilies of carnivores are usually recognised:

- the **Arctoidea (or Canoidea)**, with the families Canidae, Ursidae, Procyonidae, Ailuridae and Mustelidae; and the
- the **Aeluroidea (or Feloidea),** with the families Viverridae, Hyaenidae, and Felidae. The Pinnipedia with families Odobenidae, Phocidae, and Otariidae are often regarded as a full separate order.

The 12 carnivore families are the:

- Canidae (dogs, jackals, fox, wolves)
- Ursidae (bears, panda)
- Procyonidae (raccoons and allies)
- Ailuridae (red panda)
- Mustelidae (otters, weasels, badgers, mink)
- Mephitidae (skunks-previously part of Mustelidae)
- Viverridae (civets, genets)
- Herpestidae (mongooses-often considered part of Viverridae)
- Hyaenidae (hyenas, aardwolf)
- Felidae (cats, lion, tiger)
- Odobenidae (walrus)
- Phocidae (true, earless, or hair seals)
- Otariidae (eared seals, sea lions)

Carnivores have strong jaws and powerful muscles in the head and neck and a heavy skull. These characteristics enable them to use the incisor teeth more effectively.

Carnivores are Fissiped or Pinniped, characteristics that refer to their feet. Most carnivores have toes that are separated. These animals are known as Fissipeds, and they include cats and wolves. There are some species, those that are aquatic, that have toes that are joined, a feature that helps with swimming. These "fin footed" types are called Pinnipeds. Seals and sea lions are examples of pinnipeds.

Case study - Polar Bear (*Ursus maritimus*)

The polar bear has become an iconic species for conservation issues concerning the effects of global warming. The Arctic region is the habitat of the polar bear and is suffering some of the greatest warming resulting in diminishing ice coverage and earlier melting of ice as polar bears need a platform of sea ice to hunt their prey of seals. One aspect of the conservation importance of species is their evolutionary distinctiveness, that is how genetically distinct are they are. The evolutionary history of a species and evolutionary processes that guided evolution, such as the conditions under which they evolved and adapted, are also helpful for predicting the capacity of a species to survive under different climatic conditions and how they will cope with predicted environmental changes.

The issue of polar bear conservation has lead to intense genetic studies to ascertain their taxonomy. Until these studies, it was thought that polar bears diverged from brown bears relatively recently about 50-150 thousand years ago.

Some important behavioral traits are also highly hereditable. This is the case of infanticide with the carnivores.

Key points:

It is important to accurately ascertain the taxonomic status of species both for identification and for conservation.

Taxonomy is a rapidly developing science mainly due to increased genetic and fossil evidence.

Taxonomy is dependent on a hierarchical phylogenetic charts (trees) with their classical final unit being a species, and now as evolutionary significant units.

Taxonomic status also correlated to the previous adaptive history of species and species behavioural traits.

Evolution of Carnivores

The Order Carnivora evolved about 50 to 60 million years ago from a common ancestor that was a 1kg arboreal mammal that likely ate insects and smaller mammals.

The living families of carnivores are believed to have evolved along two lines

1. Dog like mammals descended from wolf like animals called Vulperines, producing eight of the modern families (Canidae, Ursidae, Procyonidae, Ailuridae, Mephitidae, Mustelidae, Otaridae, Phocidae and Odobenidae).
2. Cat like mammals descended from Viverraines which were civet like animals, giving rise to the remaining four families (Felidae, Hyanidae, Herpestidae and Viverridae).

Extinct Carnivores

Canines

Dire Wolf (Canis dirus) bexame extinct around 9,000BC.

Falkland Island wolf, or warrah (*Dusicyon australis*) has been considered extinct on the Falkland Islands since the 1870's.

Dusicyon avus is a wolf from Pategonia (South America) that became extinct in the 1500's.

Cats

Giant Cheetah (*Acinonyx pardinensis*) – same genus as the modern cheetah, but much larger.

Xenosmilus – relative of the Saber Toothes Tiger -a very large cat.

Giant Jaguar (Panthera onca) – from North and South America, became extinct around 9,000BC.

European Jaguar (Panthera gombaszeogensis) -very large cat to 210kg, was at it's peak in Europe and East Africa around 1.5 million years ago.

Cave Lion – an extinct and very large sub species of the modern lion.

Homotherium or Scimitar Cat -widespread in the northern hemisphere, could reach 400kg, extinct for 10,000 years.

Machairodus 5abir – Perhaps as large as a horse, to 500kg, with giant saber teeth.

American Lion (Panthera atrox) – from North and South America, becoming extinct 11,000 years ago.

Saber-Toothed Tiger (*Smilodon species*) – three species, the largest up to 500kg. The genus became extinct 10,000 years ago.

Bears

Arctotherium angustidens was the largest carnivore to have ever lived; estimated to have been between 1,000 and 18,000 kg. This became extinct around 11,000 years ago.

Parictis is the oldest known bear genus, with 8 known species dating to 38 million years ago.

Cave Bear (*Ursus spelaeus*) from Europe became extinct around 24,000 years ago.

Giant Short Faced Bear (*Arctodus simus*) was around 1,000 kg. This became extinct around 12,000 years ago.

Agriotherium africanum is not as large as many other ancient bears, but it has a much stronger bit force than other bears.

Florida Cave Bears (Tremarctos floridanus) are thought to have become extinct around 6,000BC.

Kolponomos are a genus of marine bears thought to have become extinct 20 million years ago.

Other Species

Japanese sea lion (*Zalophus japonicus*) is thought to be extinct since the 1970's.

Caribbean monk seal (*Neomonachus tropicalis*) is thought to be extinct since the 1950's.

Sea mink (*Neovison macrodon*) has been extinct since the 1890's.

Giant fossa (*Cryptoprocta spelea)* became extinct in the early 1500's.

SET TASK

Set Task 1

Visit a zoo and observe carnivores. Take photos.

If due to accessibility problems, you are unable to visit a zoo, you may complete this task by taking a virtual visit, and recording URL's of photos and videos which illustrate different species you would expect to see. If you must do this, you need to explain why you cannot visit a real zoo, and you should ensure you observe primates moving on video and not just still images.

Enjoy your trip.

Set Task 2

Undertake research, using any resources you have access to, including the notes in this lesson, to find out and fill in gaps and additional information on the table based on the one below.

1. Redraw the table as you need to – you will need more space to fit in the information you find.
2. Be sure to add details beyond just those in the course notes – write in your own words.
3. Spend no more than 1 hour undertaking this task.

Carnivore Family	Common Name	Distinguishing Characteristics *	Where They Originate
Canidae			
Procyonidae			
Ailuridae			
Ursidae			
Mustelidae			
Mephitidae			
Viverridae			
Herpestidae			
Hyaenidae			
Felidae			
Odobenidae			
Phocidae			
Otariidae			

**phenotypical traits – an obvious, observable trait which we can see (linked to genetics e.g. coat colour)*