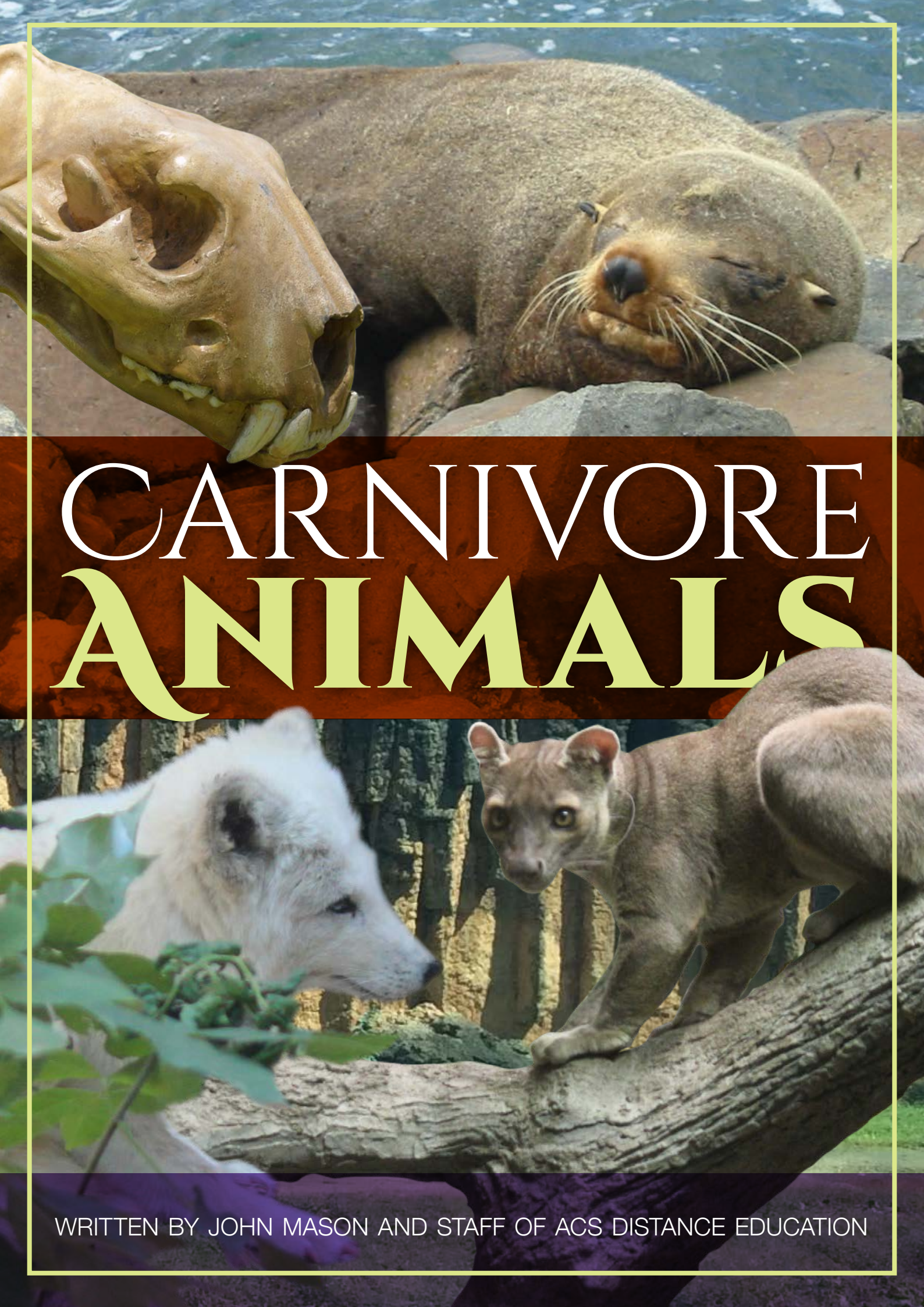

CARNIVORE ANIMALS

WRITTEN BY JOHN MASON AND STAFF OF ACS DISTANCE EDUCATION

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CREDITS

Written By:
Staff of ACS Distance Education

Photos:
John Mason and Stephen Mason

Layout & Illustration:
Stephen Mason

Editorial Assistants/Contributors:
Kara Wight B.Sc. (Bioscience and Zoology), HND (Animal Care).
Dr Robert Brown B.Sc., PhD.
Sarah Partridge B.S.Chs.(Zoology).
John Mason Dip.Hort.Sc.
Peta Jinnath Abdul B.Sc., Grad.Dip. Ed., M.Creative Writing.

Published by:
ACS Distance Education

P.O. Box 2092, Nerang MDC,
Queensland, Australia, 4211
admin@acs.edu.au
www.acsbookshop.com

P O Box 4171, Stourbridge, DY8 2WZ,
United Kingdom
admin@acsedu.co.uk
www.acsebooks.com

ISBN: 978-0-9954356-4-3

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CHAPTER 1 INTRODUCTION TO CARNIVORE TAXONOMY

In general, carnivores are animals that eat other animals; though there are plenty of exceptions to that fact. The Order Carnivora consists of at least 286 living species. The Order Carnivora evolved about 60 million years ago, from an ancestor that was a 1kg arboreal mammal that likely ate insects and smaller mammals.

Fox - belongs to the Canidae family

TAXONOMY AND CONSERVATION

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; this does not mean that they are inaccurate. It is important to recognise 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.

Advanced conservation plans consider the continuance of genetic variation

within a species as the primary goal. Conservation measures require understanding of the genetic status of a species i.e. how genetically distinct a population is as an evolutionary distinct unit (EDU). That includes genetically distinct populations (GDPs), often not morphologically distinguishable, and behaviourally distinct populations (BDPs) such as those that have learned to access food sources behaviourally. An example of a BDP is vultures dropping bones from height to extract marrow. GDPs, if visually distinguishable would once have been referred to as sub-species or varieties.

Principles of taxonomy

In the 18th century, scientist 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. The result was 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**

Each species had a binomial name consisting of its Generic (genera) name with a capital and specific (species) name i.e. the domestic cat is Felis (Generic name) catus (specific name – Cat). Note: Scientific names are preferably italicised, but may be underlined.

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. The Linneaus system of classifying was based on observations of organism's similarities in morphology, such as hair, scales, feathers, wings, legs, feet, fins, bone structure, and somewhat on habitat.

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 increasing 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, consolidated into evolutionary theory as published by Charles Darwin's 1859 book On the Origin of Species.

Around the same time, Gregor Mendel (1822-1884) a Christian monk, established the principles of heredity. His work was not discovered until the early 20th Century and created the science of modern genetics. This eventually resulted (between the 1930-50's) in a broad consensus in which natural selection was the basic mechanism of evolution.

As time progressed, this evolutionary theory became accepted as a rule. If organisms interbred between each other, they would be in the same species. There are exceptions called hybrids that are uncommon in nature but frequently used in industry - particularly to produce domestic plant varieties.

With the development of modern genetics to determine phylogeny, and electron microscopes to reveal micro-structure, we can now classify species with greater certainty. The most powerful of these are regions of ribonucleic acid in mitochondrion, the energy factories of cells, that mostly mutate at random. Therefore, the interspecies differences seen in ribonucleic acids, tells us if there is any relation between the species and even when they diverged from a common ancestor.

The assessment of individual genes gives even more power to ascertaining evolutionary theory. Currently scientific teams are working globally to sequence DNA of thousands of species to further the Tree of Life.

Taxonomy at the species level has previously been a disordered field of science, with many species receiving multiple names, type specimens being lost, ambiguous and inept descriptions of species. Among scientific communities or individuals, there has been competition to ‘name’ a species. At the species level and in higher ranks there have been numerous re-naming and re-ranking.

Modern Science Has Changed Taxonomy

We understand evolution of animal species more than ever. From the use of genetics to determine phylogeny, increasing detailed knowledge of morphology and knowledge of the fossil record and geology. 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. Scientists currently consider the higher-level ranks, above Order, consist of Domains Bacteria and Archaea (no distinct nucleus, bacteria etc.), and the Eukaryota (distinct nucleus). Eukaryota 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 the International Code for Zoological Nomenclature and 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, our perception of the 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:

1. the Arctoidea (or Canoidea), with the families Canidae, Ursidae, Procyonidae, and Mustelidae
2. Aeluroidea (or Feloidea), with the families Viverridae, Hyaenidae, and Felidae. The Pinnipedia with families Odobenidae, Phocidae, and Otariidae

The Carnivore families are the:

- *Canidae* (dogs, jackals, fox, wolves)
- *Ursidae* (bears, panda)
- *Procyonidae* (raccoons)
- *Ailuridae* (red panda or lesser 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.

Otaria flavescens Patagonian Sea Lion

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 - *Ursus maritimus* (Polar Bear)

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. The impact of diminishing ice coverage and melting of ice is the reduction of the platform of sea ice from which polar bears hunt their prey of seals. One aspect of conservation important for this species is their evolutionary distinctiveness, that is how genetically distinct are they are.

The issue of polar bear conservation has led to intense genetic studies to ascertain their taxonomy. Until those genetic studies it was thought that polar bears diverged from brown bears relatively recently about 50-150 thousand years ago. Studies have now shown that brown and black bears diverged about 4-5 million years ago, and the sister species brown and polar bears almost simultaneously, then hybridized at 600,000 years ago, and then again diverged with the last major hybridisation and divergence 160,00 years ago.

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

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.

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 trees (charts) 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.

Ursus maritimus (Polar Bear)

CHAPTER 2 CARNIVORE BIOLOGY AND BEHAVIOUR

ANATOMY AND FEEDING

Terrestrial carnivores range in length from the least weasel 13-25cm to the polar bear at 3.1m and in mass 1000kg. Males carnivores are commonly larger than females. Aquatic carnivores have a smaller size range but greater maximum size, due to their aquatic habitat demanding greater thermoregulation through larger body size with layers of protecting fat and being able to supporting high body mass. The smallest seals are about 150cm in length and 68kg in weight, with the largest the southern elephant seal (*Mirounga leonine*) weighing up to 5000kg and 6.9m in length. The size of carnivores that predate individually on other individual animals is adapted to their prey size, but not so much with pack hunting carnivores. Most tend to be medium size animals - if too small they wouldn't be big enough to overpower and kill prey.

Canis lupus signatus (Iberian Wolf)

Carnivores are anatomically adapted to their various habitats to provide for locomotion, feeding, and thermoregulation and for sexual competition. Adaptations for locomotion provide for migration and predation and so depend on the carnivore's habitat, ranging from aquatic, through terrestrial to arboreal. These include elongated legs for grassy plains in the maned wolf (*Chrysocyon brachyurus*), for hunting on high grassy plains, or with cheetahs for speed. All terrestrial predators are covered with shiny hair and fur of colours ranging from black to white, and in many shades of red/ brown that may also include manes. Giant pandas (Ailuropoda melanoleuca) which diverged from other bears 23 million years ago, have evolved a 6th thumb from their wrist bone for grasping bamboo, and their molars are smoother and larger than those of other bears to crush bamboo but their canine teeth remain large for defence.

After the Cretaceous-Tertiary mass extinction, including the dinosaurs, there was a rapid diversification of ancestral mammals during the early Palaeocene period (65-55 million years ago). The rapid evolution and diversification of the Carnivores finally resulted in a wide range of terrestrial and aquatic species. Terrestrial carnivores have four legs, however, in seals the legs have become adapted to flippers from locomotion. All carnivores have claws made of keratin that may be non-retractable (dogs), semi non-retractable (cheetahs) or retractable (cats); retraction refers to withdrawal into a sheath not into a pocket.

This diversification included feeding habits driven by carnivore size and potential prey. Of terrestrial carnivores, some completely carnivorous (tigers, polar bears, cheetahs, dog packs), others are omnivorous (foxes, skunks, badgers, bears), filter feeder of krill (some seals), or even herbivorous (giant pandas). All aquatic carnivores live entirely on animal prey including krill (monk seals, Lobodon carcinophaga), shellfish and benthic organisms (walrus, *Odobenus rosmarus*), and the shark ratfish, flatfish, crab, squid, octopus (southern elephant seal). Carnivores that only eat meat are termed obligate carnivores or hypercarnivores, species include many cats. Mesocarnovores such as racoons, coyotes and foxes normally have a diet consisting of about 50% meat and are omnivorous in their dietary habits. Carnivores that have diet that include less than 30% meat are termed hypocarnivores, an example is the giant panda. Adaption's to their skulls and teeth reflect carnivore's diets. Some species such as the filter feeding crabeater seal have specialised krill-filtering cusp teeth, and walrus have greatly extended canines in the form of tusks.

Fox skull