Encyclopedia of Extinct Birds and Animals

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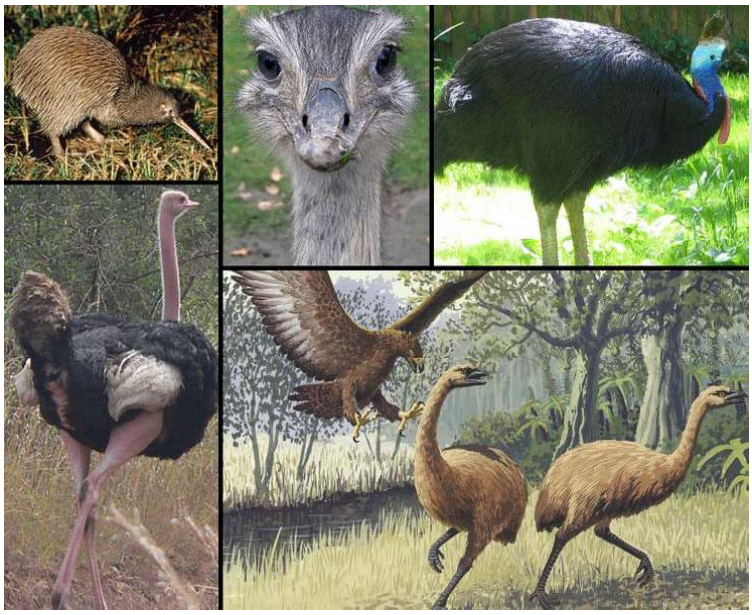
Ratite

Ratites Fossil range: paleocene–Present Mid-Paleocene–Present

Various ratite birds
Scientific classification
Kingdom: Animalia
Phylum: Chordata
Class: Aves
Subclass: Neornithes
Superorder: Palaeognathae
Order: **Struthioniformes*** (Latham, 1790)
Families
Struthionidae ostrich
Rheidae rhea
Casuariidae emu, cassowary

†Aepyornithidae elephant bird
†Dinornithidae moa
Apterygidae kiwi

Synonyms

Gallinae (Linnaeus, 1735)
Brachypterae (Mohr, 1752)
Grallae (Linnaeus, 1760)
Nudipedes (Schäffer, 1774)
Fissipedes bidactyles (Schäffer, 1774)
Retipedes (Scopoli, 1777)
Struthiones (Latham, 1790)
Campestres (Illiger, 1811)
Cursores (Illiger, 1811)
Proceri (Illiger, 1811)
Megistanes (Vieillot, 1816)
Brevipennes (Cuvier, 1817)
Pressirostres (Cuvier, 1817)
Inertes (Temminck, 1820)
Ratitae (Ranzani, 1823)
Rasores (Vigors, (1826)
Cursitrices (MacGillivray, (1840)
Grallatores (Keyserling & Bl., 1840)
Proceres (Sunder.,1872)
Struthiornithiformes

A **ratite** is any of a diverse group of large, flightless birds of Gondwanan origin, most of them now extinct. Unlike other flightless birds, the ratites have no keel on their sternum—hence the name from the Latin *ratis* (for raft). Without this to anchor their wing muscles, they could not fly even if they were to develop suitable wings.

Most parts of the former Gondwana have ratites, or did have until the fairly recent past. Their closest living relatives are the tinamous of South America.

Some taxonomical systems consider the various families of ratites to be orders, but the system used here uses the order "Struthioniformes" to refer to all ratites.

Species

Living forms

The African Ostrich is the largest living ratite. A large member of this species can be nearly 3 metres (9.8 ft) tall, weigh as much as 159 kilograms (350 lb) and can outrun a horse.

Of the living species, the Australian emu is next in height, reaching up to 2 metres (6.6 ft) tall and about 60 kilograms (130 lb). Like the ostrich, it is a fast-running, powerful bird of the open plains and woodlands.

Also native to Australia and the islands to the north are the three species of cassowary. Shorter than an emu, but heavier and solidly built, cassowaries prefer thickly vegetated tropical forest. They can be very dangerous when surprised or cornered because of their razor sharp talons. In New Guinea, cassowary eggs are brought back to villages and the chicks raised for eating as a much-prized delicacy, despite (or perhaps because of) the risk they pose to life and limb.

South America has two species of rhea, mid-sized, fast-running birds of the Pampas. The larger American rhea grows to about 1.5 metres (4.9 ft) tall and usually weighs 20 to 25 kilograms (44–55 lb). (South America also has 47 species of the small and ground-dwelling but not flightless tinamou family, which is closely related to the ratite group.)

The smallest ratites are the five species of kiwi from New Zealand. Kiwi are chicken-sized, shy and nocturnal. They nest in deep burrows and use a highly developed sense of smell to find small insects and grubs in the soil. Kiwi are notable for laying eggs that are very large in relation to their body size. A kiwi egg may equal 15 to 20 percent of the body mass of a female kiwi. The smallest species of kiwi is the Little Spotted Kiwi, at 1.2 kilograms (2.6 lb) and 40 centimetres (16 in).

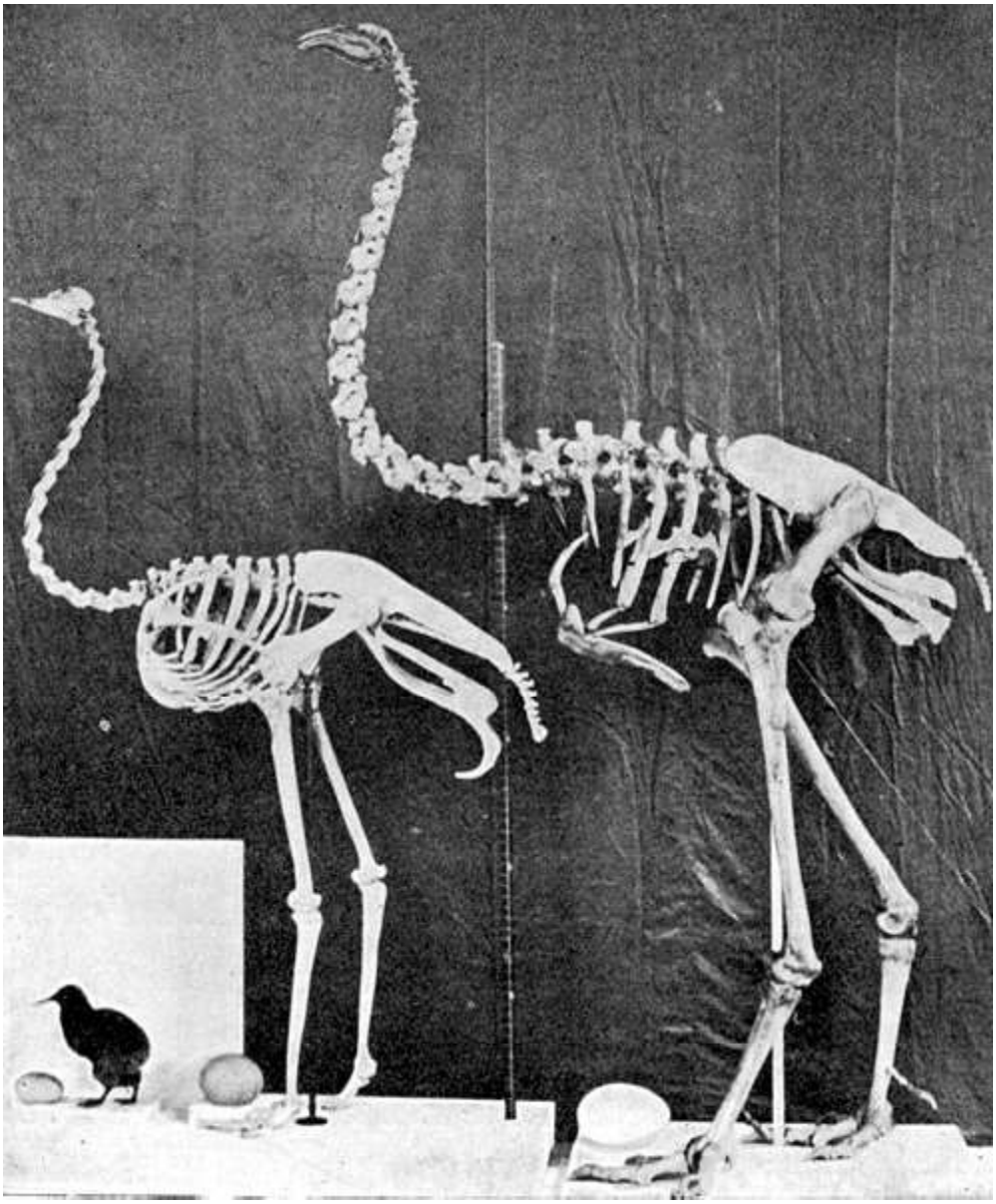
Extinct forms

At least 11 species of moa lived in New Zealand before the arrival of humans, ranging from turkey-sized to the Giant Moa *Dinornis giganteus* with a height of 3.3 metres (11 ft) and weighing about 250 kilograms (550 lb). They went extinct by A.D. 1500 due to hunting by Māori settlers, who arrived by A.D. 1300.

Aepyornis, the "elephant bird" of Madagascar, was the largest bird ever known. Although shorter than the tallest moa, a large *Aepyornis* could weigh over 450 kilograms (990 lb) and stand up to 3 metres (9.8 ft) tall.

Eggshell fragments similar to those of *Aepyornis* were found on the Canary Islands. The fragments date to the middle or late Miocene and no satisfying theory has been proposed as to how they got there due to uncertainties about whether these islands were ever connected to the mainland.

Evolution and systematics



Comparison of a kiwi, ostrich and *Dinornis*, each with its egg

There are two taxonomic approaches to ratite classification: the one applied here combines the groups as families in the order **Struthioniformes**, while the other supposes that the lineages evolved mostly independently and thus elevates the families to order rank (e.g. **Rheiformes**, **Casuariformes** etc.).

Some studies based on morphology, immunology and DNA sequencing had indicated that ratites are monophyletic. The traditional account of ratite evolution has the group emerging in flightless form in Gondwana in the Cretaceous, then evolving in their separate directions as the continents drifted apart.

However, recent analysis of genetic variation between the ratites conflicts with this. DNA analysis appears to show that the ratites diverged from one another too recently to share a common Gondwanian ancestor. Also, the Middle Eocene fossil "proto-ostrich" *Palaeotis* from Central Europe may imply that the "out-of-Gondwana" hypothesis is wrong. Furthermore, recent analysis of twenty nuclear genes has drawn into question the monophyly of the group, suggesting that the flighted tinamous cluster within the ratite lineage. The authors say the data "unequivocally places tinamous within ratites".

A comparative study of the full mitochondrial DNA sequences of living ratites plus two moas places moas in the basal position, followed by rheas, followed by ostriches, followed by kiwis, with emus and cassowaries being closest relatives. Another study has reversed the relative positions of moas and rheas and indicated that elephant birds are not close relatives of ostriches or other ratites, while a study of nuclear genes shows ostriches branching first, followed by rheas and tinamous, then kiwis splitting from emus and cassowaries. These studies share branching dates which suggest that, while ancestral moas may have been present in New Zealand since it split off from Gondwana, the ancestors of kiwis appear to have got there from Australia more recently, perhaps via a land bridge or by island-hopping.

All analyses show that rheas and extant Australo-Pacific ratites are monophyletic. DNA data shows the ostriches branching first. This would match the sequence of Gondwana's plate tectonic breakup. Other, but not all, aspects of ratite paleobiogeography were found to be consistent with the vicariance (plate tectonic split-up of Gondwana) hypothesis.

Recent phylogenomic studies suggest that tinamous may in fact belong to this group. If so, this would make 'ratites' paraphyletic rather than monophyletic. Since tinamous are weak fliers, this raises interesting questions about the evolution of flightlessness in this group. While the ratites were traditionally thought of as an ancestrally flightless, monophyletic group, the branching of the tinamous within the ratite lineage suggests that ratites evolved flightlessness at least three times. Re-evolution of flight in the tinamous would be an alternative explanation, but such a development is without precedent in avian history, while loss of flight is commonplace.

Physical characteristics

Ratites in general have many physical characteristics in common, which are often not shared by the family Tinamidae, or tinamous. First, the breast muscles are underdeveloped. They do not have keeled sterna. Their wishbones (furculae) are almost absent. They have a simplified wing skeletons and musculature. Their legs are stronger and do not have air chambers, except the femurs. Their tail and flight feathers have retrogressed or have become decorative plumes. They have no feather vanes, which means they do not need to oil their feathers, hence they have no preen glands. They have no separation of pterylae and apteria and finally, they have palaeognathous palates.

Ostriches have the greatest dimorphism, rheas show some dichromatism during the breeding season. Emus, cassowaries and kiwis show some dimorphism, predominately in size.

While the ratites share a lot of similarities, they also have major differences. Ostriches have only two toes, with one being much larger than the other. Cassowaries have developed long inner toenails, used defensively. Ostriches and rheas have prominent wings; although they don't use them to fly, they do use them in courtship and predator distraction.

Behavior

Feeding and diet

Ratite chicks tend to be more omnivorous or insectivorous; similarities in adults end with feeding, as they all vary in diet and length of digestive tract, which is indicative of diet. Ostriches, with the longest tracts at 14 metres (46 ft), are primarily vegetarian. Rheas' tracts are next longest at between 8–9 metres (26–30 ft) and they also have caeca. They are also mainly herbivores, concentrating on broad-leafed plants. However, they will eat insects if the opportunity arises. Emus have tracts of 7 metres (23 ft) length and have a more omnivorous diet, including insects and other small animals. Cassowaries have nearly the shortest tracts at 4 metres (13 ft). Finally, kiwis have the shortest tracts and eat earthworms, insects and other similar creatures.

Reproduction

Ratites are different from the flying birds in that they needed to adapt or evolve certain features to protect their young. First and foremost is the thickness of the shells of their eggs. Their young are hatched more developed than most and they can run or walk soon thereafter. Also, most ratites have communal nests, where they share the incubating duties with others. Ostriches are the only ratites where the female incubates; they share the duties, with the males incubating at night. Kiwis stand out as the exception with a monogamous relationship.

Ratites and humans

Ratites and humans have had a long relationship starting with the use of the egg for water containers, jewelry, or other art medium. Male ostrich feathers were popular for hats during the 18th century, which led to hunting and sharp declines in populations. Ostrich farming grew out of this need and humans harvested feathers, hides, eggs and meat from the ostrich. Emu farming also became popular for similar reasons and for their emu oil. Rhea feathers are popular for dusters and eggs and meat are used for chicken and pet feed in South America. Ratite hides are popular for leather products like shoes.

United States regulation

The USDA's Food Safety and Inspection Service (FSIS) began a voluntary, fee-for-service ratite inspection program in 1995 to help the fledgling industry improve the marketability of the meat. A provision in the FY2001 USDA appropriations act (P.L. 106-387) amended the Poultry Products Inspection Act to make federal inspection of ratite meat mandatory as of April 2001 (21 U.S.C. 451 et seq.).

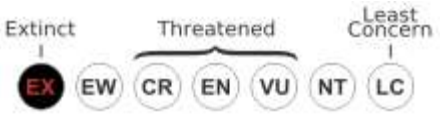
Chapter- 2

Great Auk

Great Auk

Specimen in the Staatliches Museum für Tierkunde Dresden

Conservation status



Extinct (IUCN 3.1)

Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Aves
Order:	Charadriiformes
Family:	Alcidae
Genus:	***Pinguinus*** Bonnaterre, 1791
Species:	***P. impennis***

Binomial name

Pinguinus impennis
(Linnaeus, 1758)

Approximate range (in blue) with known breeding sites indicated by yellow marks

Synonyms

- *Alca impennis* Linnaeus, 1758
- *Plautus impennis* Brünnich, 1772
- *Alca borealis* Forster, 1817

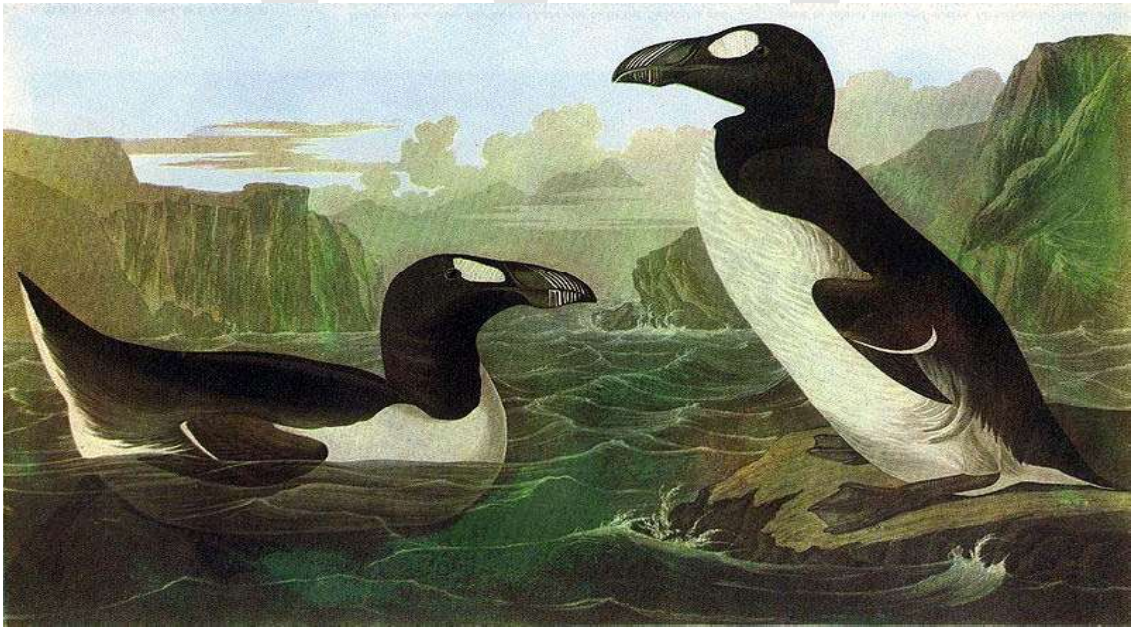
The **Great Auk**, *Pinguinus impennis*, formerly of the genus *Alca*, was a large, flightless alcid that became extinct in the mid-19th century. It was the only modern species in the genus ***Pinguinus***, a group of birds that formerly included one other species of flightless giant auk from the Atlantic Ocean region. It bred on rocky, isolated islands with easy access to both the ocean and a plentiful food supply, a rarity in nature that provided only a few breeding sites for the auks. When not breeding, the auks spent their time foraging in the waters of the North Atlantic, ranging as far south as New England and northern Spain through Canada, Greenland, Iceland, Norway, Ireland and Great Britain.

The Great Auk was 75 to 85 centimetres (30 to 33 in) tall and weighed around 5 kilograms (11 lb), making it the largest member of the alcid family. It had a black back and a white belly. The black beak was heavy and hooked with grooves etched into its surface. During the breeding season, the Great Auk had a white patch over each eye. After the breeding season, the auk lost this patch, instead developing a white band

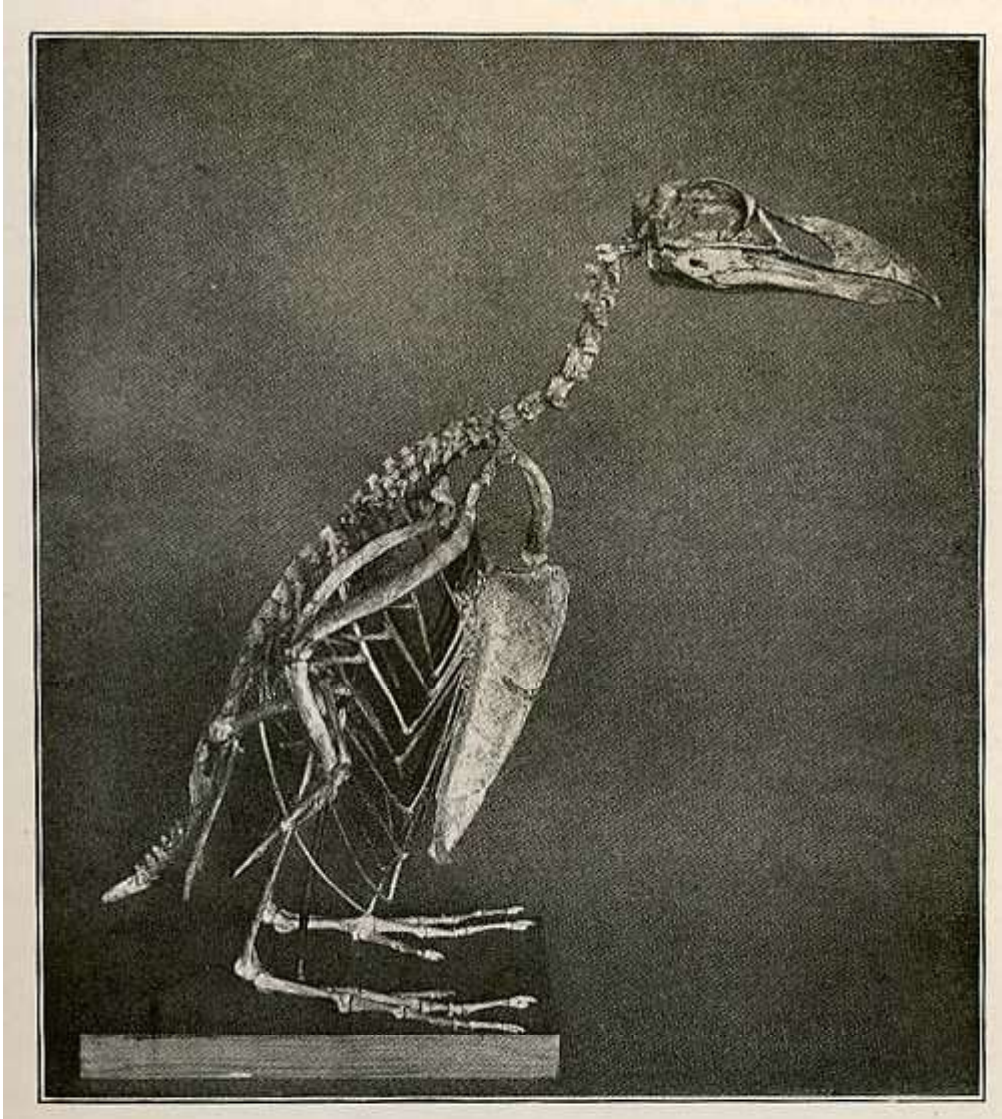
stretching between the eyes. The wings were 15 centimetres (5.9 in) long, rendering the bird flightless. Instead, the auk was a powerful swimmer, a trait that it used in hunting. Its favorite prey were fish, including Atlantic Menhaden and Capelin and crustaceans. Although agile in the water, it was clumsy on land. Its main predators were Orcas, White-tailed Eagles, Polar Bears and humans. Great Auk pairs mated for life. They nested in extremely dense and social colonies, laying one egg on bare rock. The egg was white with variable brown streaking. Both parents incubated for about six weeks before their young hatched. The young auks left the nest site after two or three weeks and the parents continued to care for them.

Humans had hunted the Great Auk for more than 100,000 years. It was an important part of many Native American cultures which coexisted with the bird, both as a food source and as a symbolic item. Many Maritime Archaic people were buried with Great Auk bones and one was buried with a cloak made of over 200 auk skins. Early European explorers to the Americas used the auk as a convenient food source or as fishing bait, reducing its numbers. The bird's down was in high demand in Europe, a factor which largely eliminated the European populations by the mid-16th century. Scientists soon began to realize that the Great Auk was disappearing and it became the beneficiary of many early environmental laws, but this proved not to be enough. Its growing rarity increased interest from European museums and private collectors in obtaining skins and eggs of the bird. This trend eliminated the last of the Great Auks on 3 July 1844 on Eldey, Iceland. However, a record of a bird in 1852 is considered by some to be the last sighting of this species. The Great Auk is mentioned in a number of novels and the scientific journal of the American Ornithologists' Union is named *The Auk* in honor of this bird.

Taxonomy



Great Auks by John James Audubon



SKELETON OF GREAT AUK.

Mounted skeleton

The Great Auk was one of the 4400 animal species originally described by Carolus Linnaeus in his 18th century work, *Systema Naturae*, in which it was named *Alca impennis*. The species was not placed in its own genus, *Pinguinus*, until 1791. The generic name is derived from the Spanish and Portuguese name for the species, while the specific name *impennis* is from Latin and refers to the lack of flight feathers or pennae.

Analysis of mtDNA sequences have confirmed morphological and biogeographical studies in regarding the Razorbill as the Great Auk's closest living relative. The Great Auk was also closely related to the Little Auk (Dovekie), which underwent a radically different evolution compared to *Pinguinus*. Due to its outward similarity to the Razorbill (apart from flightlessness and size), the Great Auk was often placed in the genus *Alca*,

following Linnaeus. The name *Alca* is a Latin derivative of the Scandinavian word for Razorbills and their relatives.

The fossil record (especially *Pinguinus alfrednewtoni*) and molecular evidence demonstrate that the three genera, while closely related, diverged soon after their common ancestor, a bird probably similar to a stout Xantus's Murrelet, had spread to the coasts of the Atlantic. By that time the murres, or Atlantic guillemots, had apparently already split off from the other Atlantic alcids. Razorbill-like birds were common in the Atlantic during the Pliocene, but the evolution of the Little Auk is sparsely documented. The molecular data are compatible with either view, but the weight of evidence suggests placing the Great Auk in a distinct genus. The Great Auk was not closely related to the other extinct genera of flightless alcids, *Mancalla*, *Praemancalla* and *Alcodes*.

Pinguinus alfrednewtoni was a larger though also flightless member of the genus *Pinguinus* that lived during the Early Pliocene. Known from bones found in the Yorktown Formation of the Lee Creek Mine in North Carolina, it is believed to have split along with the Great Auk from a common ancestor. *Pinguinus alfrednewtoni* lived in the western Atlantic while the Great Auk lived in the eastern Atlantic, but after the former died out after the Pliocene, the Great Auk replaced it.

The Basque name for the Great Auk is *arponaz* while the early French name was *apponatz*, both meaning "spearbill". The Norse called the Great Auk *geirfugl*, which means "spearbird". This has led to an alternative common name for the bird, "garefowl". Spanish and Portuguese sailors called the bird *pingüinos*. The Inuit name for the Great Auk was *isarukitsck*, which meant "little wing". The Welsh people referred to this species as "pingwen" (actually spelled "pengwyn" - lit. white head). When European explorers discovered what are today known as penguins in the Southern Hemisphere, they noticed their similar appearance to the Great Auk and named them after this bird, despite the fact that they are not related.

Description

Breeding (standing) and nonbreeding (swimming) plumage. By John Gerrard Keulemans

Standing about 75 to 85 centimetres (30 to 33 in) tall and weighing around 5 kilograms (11 lb), the flightless Great Auk was the largest of both its family and the order Charadriiformes. The auks which lived further north averaged larger in size than the more southerly members of the species. Males and females were similar in plumage, although there is evidence for differences in size, particularly in the bill and femur length. The back was primarily a glossy black, while the stomach was white. The neck and legs were short and the head and wings small. The auk appeared chubby due to a thick layer of fat necessary for warmth. During the breeding season, the Great Auk developed a wide white eye patch over the eye, which had a hazel or chestnut iris. After the breeding season the auk molted and lost this eye patch, which was replaced with a wide white band and a gray line of feathers which stretched from the eye to the ear. During the summer, the auk's chin and throat were blackish-brown, while the inside of the mouth was yellow. During the winter, this alcid molted and the throat became white. The bill was large at 11 centimetres (4.3 in) long and curved downwards at the top; the bill also had deep white grooves in both the upper and lower mandibles, up to seven on the upper mandible

and twelve on the lower mandible in summer, though there were fewer in winter. The wings were only 15 centimetres (5.9 in) in length and the longest wing feathers were only 10 centimetres (3.9 in) long. Its feet and short claws were black while the webbed skin between the toes was brownish black. The legs were far back on the bird's body, which gave it powerful swimming and diving abilities.

Hatchlings were gray and downy. Juvenile birds had less prominent grooves in their beaks and had mottled white and black necks, while the eye spot found in adults was not present; instead, a gray line ran through the eyes (which still had the white eye ring) to just below the ears.

The auk's calls included low croaking and a hoarse scream. A captive auk was observed making a gurgling noise when anxious. It is not known what its other vocalizations were like, but it is believed that they were similar to those of the Razorbill, only louder and deeper.

Distribution and habitat

Stac an Armin, St. Kilda, Scotland, where the Great Auk used to breed

The Great Auk was found in the cold North Atlantic coastal waters along the coasts of Canada, the northeastern United States, Norway, Greenland, Iceland, Ireland, Great Britain, France and northern Spain. The Great Auk left the North Atlantic waters for land

only in order to breed, even roosting at sea when not breeding. The rookeries of the Great Auk were found from Baffin Bay down to the Gulf of St. Lawrence, across the far northern Atlantic, including Iceland and in Norway and the British Isles in Europe. The Great Auk's nesting colonies required rocky islands with sloping shorelines to provide the birds access to the seashore. This was an extremely limiting factor and it is believed that the Great Auk may never have had more than 20 breeding colonies. Additionally, the nesting sites needed to be close to rich feeding areas and be far enough from the mainland to discourage visitation by humans and Polar Bears. Only seven breeding colonies are known: Papa Westray in the Orkney Islands, St. Kilda Island off Scotland, the Faeroe Islands between Iceland and Ireland, Grimsey Island and Eldey Island near Iceland, Funk Island near Newfoundland and the Bird Rocks (Rochers-aux-Oiseaux) in the Gulf of St. Lawrence. Records suggest that this species may have bred on Cape Cod, Massachusetts. By the late 18th and early 19th centuries, the breeding range of the Great Auk was restricted to Funk Island, Grimsey Island, Eldey Island, the Gulf of St. Lawrence and St. Kilda Island. Funk Island was the largest known breeding colony.

The Great Auk migrated north and south away from the breeding colonies after the chicks fledged and tended to go southward during late fall and winter. It was common in the Grand Banks. Its bones have been found as far south as Florida, where it may have occurred during four isolated time periods: around 1000 BC, 1000 AD, the 15th century and the 17th century. It also frequented France, Spain and even Italy in the Mediterranean Sea. The Great Auk typically did not go further south than Massachusetts Bay in the winter. Additionally, it has been suggested that some of the bones discovered in Florida may be the result of aboriginal trading.

Ecology and behavior

Great Auks walked slowly and sometimes used their wings to help them traverse rough terrain. When they did run, it was awkwardly and with short steps in a straight line. They had few natural predators, mainly large marine mammals, such as the Orca and White-tailed Eagles. Polar bears preyed on nesting colonies of the auk. This species had no innate fear of human beings and their flightlessness and awkwardness on land compounded their vulnerability. They were hunted for food, feathers and as specimens for museums and private collections. Great Auks reacted to noises, but were rarely scared by the sight of something. The auks used their bills aggressively both in the dense nesting sites and when threatened or captured by humans. These birds are believed to have had a life span of about 20 to 25 years. During the winter, the Great Auk migrated south either in pairs or in small groups and never with the entire nesting colony.

The Great Auk was generally an excellent swimmer, using its wings to propel itself underwater. While swimming, the head was held up but the neck was drawn in. This species was capable of banking, veering and turning underwater. The Great Auk was known to dive to depths of 76 metres (249 ft) and it has been claimed that the species was able to dive to depths of 1 kilometre (3,300 ft). It could also hold its breath for 15 minutes, longer than a seal. The Great Auk was capable of swimming rapidly to gather

speed, then shooting out of the water and landing on a rocky ledge above the ocean's surface.

Diet

Great Auk eating a fish, by John Gould

This alcid typically fed in shoaling waters which were shallower than those frequented by other alcids, although after the breeding season they had been sighted up to 500 kilometres (310 mi) from land. They are believed to have fed cooperatively in flocks. Their main food was fish, usually 12 to 20 centimetres (4.7 to 7.9 in) in length and weighing 40 to 50 grams (1.4 to 1.8 oz), but occasionally their prey was up to half the bird's own length. The bird could on average dive up to 75 metres (246 ft) for its prey with the maximum dive depth being estimated at 130 metres (430 ft); however, to conserve energy, most dives were shallower. Its ability to dive so deep reduced competition with other alcid species. Based on remains associated with Great Auk bones found on Funk Island and on ecological and morphological considerations, it seems that Atlantic Menhaden and Capelin were their favored prey. Other fish suggested as potential prey include lumpsuckers, Shorthorn Sculpins, cod, crustaceans and sand lance. The young of the Great Auk are believed to have eaten plankton and, possibly, fish and crustaceans regurgitated by adult auks.

Reproduction

Egg, illustration by Adolphe Millot

Great Auks began pairing in early and mid May. They are believed to have mated for life, although some theorize that auks could have mated outside of their pair, a trait seen in the Razorbill. Once paired, they nested at the base of cliffs in colonies, where they likely copulated. Mated pairs had a social display in which they bobbed their heads, showing off their white eye patch, bill markings and yellow mouth. These colonies were extremely crowded and dense, with some estimates stating that there was a nesting auk for every 1 square metre (11 sq ft) of land. These colonies were very social. When the colonies included other species of alcid, the Great Auks were dominant due to their size.

Great Auk egg at Ipswich Museum

The Great Auk laid only one egg each year between late May and early June, though they could lay a replacement egg if the first one was lost. In years when there was a shortage of food, the auk did not breed. The species laid a single egg on bare ground up to 100 metres (330 ft) from shore. The egg was pear-shaped and averaged 12.4 centimetres (4.9 in) in length and 7.6 centimetres (3.0 in) across at the widest point. The egg was yellowish white to light ochre with a varying pattern of black, brown or greyish spots and lines which often congregated on the large end. It is believed that the variation in the egg's streaks enabled the parents to recognize their egg in the colony. The pair took turns incubating the egg in an upright position for the 39 to 44 days before the egg hatched, typically in June, although eggs could be present at the colonies as late as August.

The parents also took turns feeding their chick. At birth, the chick was covered with grey down. The young bird took only two or three weeks to mature enough to abandon the nest and land for the water, typically around the middle of July. The parents cared for their young after they fledged and adults were seen swimming with their young on their back. Great Auks sexually matured when they were four to seven years old.

Relationship with humans

The Great Auk is known to have been preyed upon by Neanderthals more than 100,000 years ago, as evidenced by well-cleaned bones found by their campfires. Images of the Great Auk were also carved into the walls of the El Pinto Cave in Spain over 35,000 years ago, while cave paintings 20,000 years old have been found in France's Grotte Cosquer.

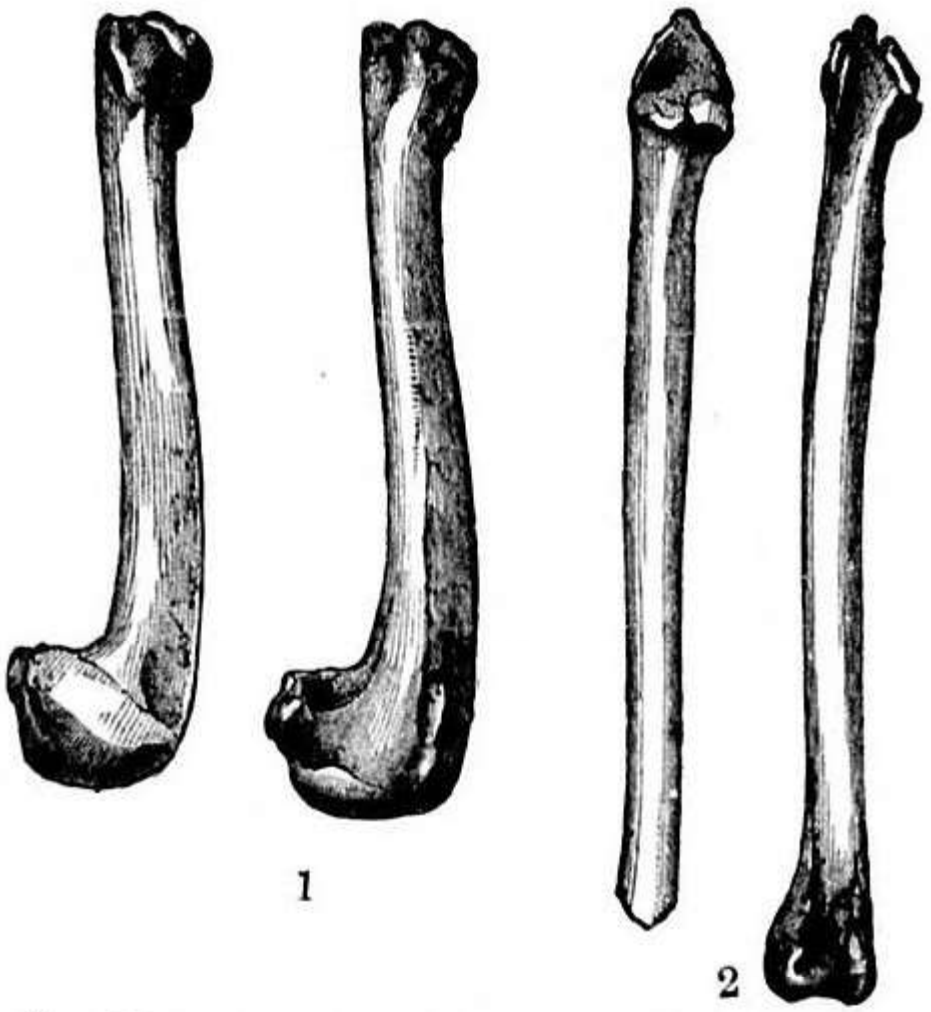
Native Americans who coexisted with the Great Auk valued it as a food source during the winter and as an important symbol. Images of the Great Auk have been found in bone necklaces. A person buried at the Maritime Archaic site at Port au Choix, Newfoundland, dating to about 2000 BC, was interred clothed in a suit made from more than 200 Great Auk skins, with the heads left attached as decoration. Nearly half of the bird bones found in graves at this site were of the Great Auk, suggesting that it had cultural significance for the Maritime Archaic people. The extinct Beothuks of Newfoundland made pudding out of the auk's eggs. The Dorset Eskimos also hunted the species, while the Saqqaq in Greenland overhunted the species, causing a range reduction locally.

Later, European sailors used the auks as a navigational beacon, as the presence of these birds signaled that the Grand Banks of Newfoundland were near.

Extinction

Stuffed Great Auk, Royal Belgian Institute of Natural Sciences (KBIN), Belgium

This species is estimated to have had a maximum population in the millions, although some scientists dispute this estimate. The Great Auk was hunted on a significant scale for food, eggs and its down feathers from at least the 8th century. Prior to that, hunting by local natives can be documented from Late Stone Age Scandinavia and eastern North America, as well as from early 5th century Labrador, where the bird seems to have occurred only as a straggler. Early explorers, including Jacques Cartier and numerous ships attempting to find gold on Baffin Island, were not provisioned with food for the journey home and therefore used this species as both a convenient food source and bait for fishing. Some of the later vessels anchored next to a colony and ran out planks to the land. The sailors then herded hundreds of these auks onto the ships, where they were then slaughtered. Some authors have questioned whether this hunting method actually occurred successfully. Great Auk eggs were also a valued food source, as the eggs were three times the size of a murre's and had a large yolk. These sailors also introduced rats onto the islands.



1. Two Humeri; and, 2, two Tibiæ of the Great Auk (*Alca impennis*), found in a kitchen midden at Keiss, Caithness-shire (half the natural size).

Bones of the Great Auk uncovered by archaeologists in an ancient kitchen midden in Caithness

The Little Ice Age may have reduced the population of the Great Auk by exposing more of their breeding islands to predation by Polar Bears, but massive exploitation for their down drastically reduced the population. By the mid-16th century, the nesting colonies along the European side of the Atlantic were nearly all eliminated by humans killing this bird for its down, which was used to make pillows. In 1553, the auk received its first official protection and in 1794 Great Britain banned the killing of this species for its feathers. In St. John's, individuals violating a 1775 law banning hunting the Great Auk for its feathers or eggs were publicly flogged, though hunting for use as fishing bait was still permitted. On the North American side, eider down was initially preferred, but once the eiders were nearly driven to extinction in the 1770s, down collectors switched to the

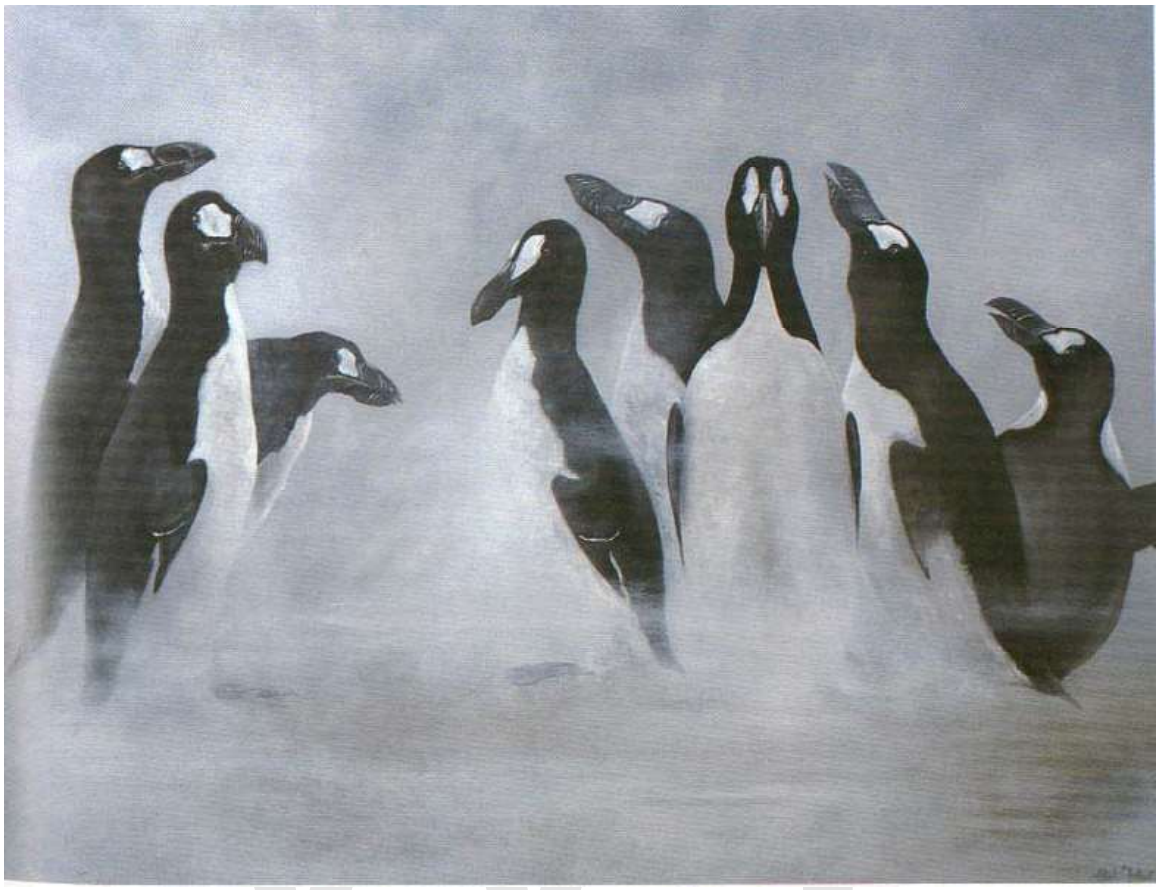
auk at the same time that hunting for food, fishing bait and oil decreased. Specimens of the Great Auk and its eggs became collectible and highly prized by rich Europeans and the loss of a large number of its eggs to collection contributed to the demise of the species. Eggers, individuals who visited the nesting sites of the Great Auk to collect their eggs, quickly realized that the birds did not all lay their eggs on the same day, so they could make return visits to the same breeding colony. Eggers only collected eggs without embryos growing inside of them and typically discarded the eggs with embryos.

It was on the islet of Stac an Armin, St Kilda, Scotland, in July 1840, that the last Great Auk seen in the British Isles was caught and killed. Three men from St Kilda caught a single "garefowl", noticing its little wings and the large white spot on its head. They tied it up and kept it alive for three days, until a large storm arose. Believing that the auk was a witch and the cause of the storm, they then killed it by beating it with a stick.

The last colony of Great Auks lived on Geirfuglasker (the "Great Auk Rock") off Iceland. This islet was a volcanic rock surrounded by cliffs which made it inaccessible to humans, but in 1830 the islet submerged after a volcanic eruption and the birds moved to the nearby island of Eldey, which was accessible from a single side. When the colony was initially discovered in 1835, nearly fifty birds were present. Museums, desiring the skins of the auk for preservation and display, quickly began collecting birds from the colony. The last pair, found incubating an egg, was killed there on 3 July 1844, with Jón Brandsson and Sigurður Ísleifsson strangling the adults and Ketill Ketilsson smashing the egg with his boot. However, a later claim of a live individual sighted in 1852 on the Grand Banks of Newfoundland has been accepted by the International Union for Conservation of Nature and Natural Resources (IUCN).

Today, around 75 eggs of the Great Auk remain in museum collections, along with 24 complete skeletons and 81 mounted skins. While thousands of isolated bones have been collected from 19th century Funk Island to Neolithic middens, only a small number of complete skeletons exist. Following the bird's extinction, the price of its eggs sometimes reached up to 11 times the amount earned by a skilled worker in a year.

Cultural depictions



'Last Stand' by Errol Fuller from his book 'The Great Auk'

The Great Auk is one of the more frequently referenced extinct birds in literature. It appears in many works of children's literature, including Charles Kingsley's *The Water-Babies, A Fairy Tale for a Land Baby* and Enid Blyton's *The Sea of Adventure*. Both works deal with the bird's extinction, with the first novel depicting an auk telling the tale of its species's extinction and the latter novel sending the protagonist on a failed search for what he believes is a lost colony of the species. The Great Auk is also present in a wide variety of other works of fiction. In his novel *Ulysses*, James Joyce mentions the bird while the novel's main character is drifting into sleep. He associates the Great Auk with the mythical roc bird as a method of formally returning the main character to a sleepy land of fantasy and memory. *Penguin Island*, a 1908 French satirical novel by the Nobel Prize winning author Anatole France, narrates the fictional history of a Great Auk population that is mistakenly baptized by a nearsighted missionary. A Great Auk is collected by fictional naturalist Stephen Maturin in the Patrick O'Brian historical novel *The Surgeon's Mate*. This work also details the harvesting of a colony of auks. The Great Auk is the subject of a novel, *The Last Great Auk* by Allen Eckert, which tells of the events leading to the extinction of the Great Auk as seen from the perspective of the last one alive. The bird also appears in Farley Mowat's *Sea of Slaughter*. It is also the subject

of a ballet, *Still Life at the Penguin Café* and a song, 'A Dream too Far', in the ecological musical Rockford's Rock Opera.

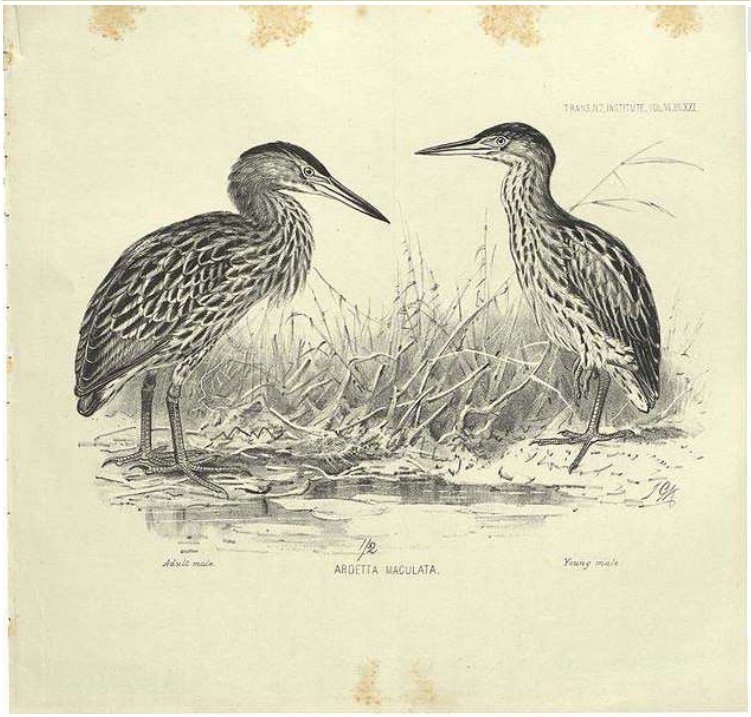
The Great Auk is the mascot of the Archmere Academy in Claymont, Delaware, Sir Sandford Fleming College in Ontario and the Adelaide University Choral Society (AUCS) in Australia. It is also the mascot of the Knowledge Masters educational competition. The scientific journal of the American Ornithologists' Union is named *The Auk* in honor of this bird. According to Homer Hickam's memoir, *Rocket Boys* and its movie production, *October Sky*, the early rockets he and his friends built were ironically named "Auk". Even a cigarette company, the British Great Auk Cigarettes, was named after this bird. Walton Ford, the American painter, has featured Great Auks in two paintings: 'The Witch of St. Kilda' and 'Funk Island'. The English painter and writer Errol Fuller produced 'Last Stand' for his monograph on the species. The Great Auk also appeared on one stamp in a set of five depicting extinct birds issued by Cuba in 1974.

Chapter- 3

New Zealand Little Bittern and Réunion Sacred Ibis

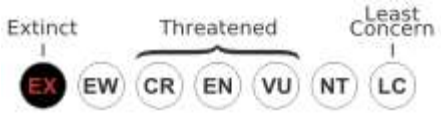
New Zealand Little Bittern

New Zealand Little Bittern



New Zealand Little Bittern (Adult male & Juv. male)

Conservation status



Extinct (IUCN 3.1)

Scientific classification

Kingdom: Animalia

Phylum:	Chordata
Class:	Aves
Order:	Pelecaniformes
Family:	Ardeidae
Genus:	*Ixobrychus*
Species:	***I. novaezelandiae***

Binomial name

Ixobrychus novaezelandiae
(A. C. Purdie, 1871)

Synonyms

Ardea pusilla Vieill, 1817
Ardetta punctata Gray, 1844
Ardetta pusilla Gould, 1848
Ardeola pusilla Bonap., 1855
Ardeola novaezelandiae A. C. Purdie, 1871
Ardetta maculata Buller, 1873
Ixobrychus minutus novaezelandiae Mathews & Iredale, 1913
Dupetor flavicollis P. L. Horn, 1980

The **New Zealand Little Bittern** (***Ixobrychus novaezelandiae***) is an extinct and enigmatic species of heron in the Ardeidae family. It was endemic to New Zealand and was last recorded alive in the 1890s.

Common names for this species include **New Zealand Bittern**, **Spotted Heron** and ***Kaoriki*** (Maori). The scientific species name also has numerous junior synonyms.

Taxonomy

The species has sometimes been regarded as a subspecies of Little Bittern (*Ixobrychus minutus*), or conspecific with the Australian Little Bittern, though it was first described by Alexander Callender Purdie in 1871 as *Ardeola Novae Zelandiae*. In 1980 New Zealand paleontologist Peter L. Horn found subfossil bones of a bittern from Lake Poukawa which he named *Dupetor flavicollis*. In 1991 Philip Millener identified Horn's material as remains of the New Zealand Little Bittern.

Description

Although a small bittern, the species was larger (length about 14.75 inches (38 cm)) than the Little Bittern (25–36 cm). Few specimens are known and of these there is even doubt about the sex of some, making published descriptions unreliable. Differences from Little Bittern include a larger buff patch on the upperwing, black upperparts streaked light brown, underparts streaked dark brown and rufous-buff.

Distribution and habitat

In recent times the bird is only known with certainty to have inhabited the South Island of New Zealand, with most records from Westland. Although subfossil remains have been found in the North Island, reports of living birds may have been of misidentified Australasian Bitterns. The first scientific specimen was reportedly obtained at Tauranga in the North Island by a Reverend Mr Stack in 1836, but is now untraceable. The holotype specimen in the Museum of New Zealand was taken from the head of Lake Wakatipu in Otago. Recorded habitat for the species includes the wooded margins of saline lagoons and creeks.

Behaviour

Walter Buller quotes a Mr Docherty, who was familiar with the bird in Westland:

"They are to be found on the salt-water lagoons on the seashore, always hugging the timbered side of the same. I have seen them in two positions, viz.:— standing on the bank of the lagoon, with their heads bent forward, studiously watching the water; at other times I have seen them standing straight up, almost perpendicular; I should say this is the proper position for the bird to be placed in when stuffed. When speaking of lagoons as the places where they are to be found, I may mention that I caught one about two miles in the bush, on the bank of a creek; but the creek led to a lagoon. They live on small fishes or the roots of reeds; I should say the latter, because at the very place where I caught one I observed the reeds turned up and the roots gone. They are very solitary and always found alone and they stand for hours in one place. I heard a person say that he had opened one and found a large egg in it. They breed on the ground in very obscure places; I never heard their cry."

Feeding

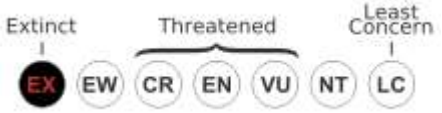
The bittern is recorded as eating mudfish and worms in captivity, when given in water.

Voice

Two calls were recorded by Buller, a "peculiar snapping cry" as an alarm call and a "cry not unlike that of a kingfisher, though not so loud".

Réunion Sacred Ibis

Réunion Sacred Ibis
Conservation status



Extinct (IUCN 3.1)

Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Aves
Order:	Pelecaniformes
Family:	Threskiornithidae
Subfamily:	Threskiornithinae
Genus:	*Threskiornis*
Species:	†***T. solitarius***

Binomial name

†***Threskiornis solitarius***
(de Sélys-Longchamps, 1848)

Synonyms

Borbonibis latipes
Raphus solitarius
Victoriornis imperialis

The **Réunion Sacred Ibis**, ***Threskiornis solitarius***, is an extinct bird species that was native to the island of Réunion. It is probably the same bird discovered by Portuguese sailors there in 1613. Until recently assumed by biologists to have been a relative of the Dodo (*Raphus cucullatus*), classified. It was thus classified as a member of the didine pigeons (subfamily Raphinae) and called the **"Réunion Solitaire"** (*Raphus solitarius*).

Description and ecoology

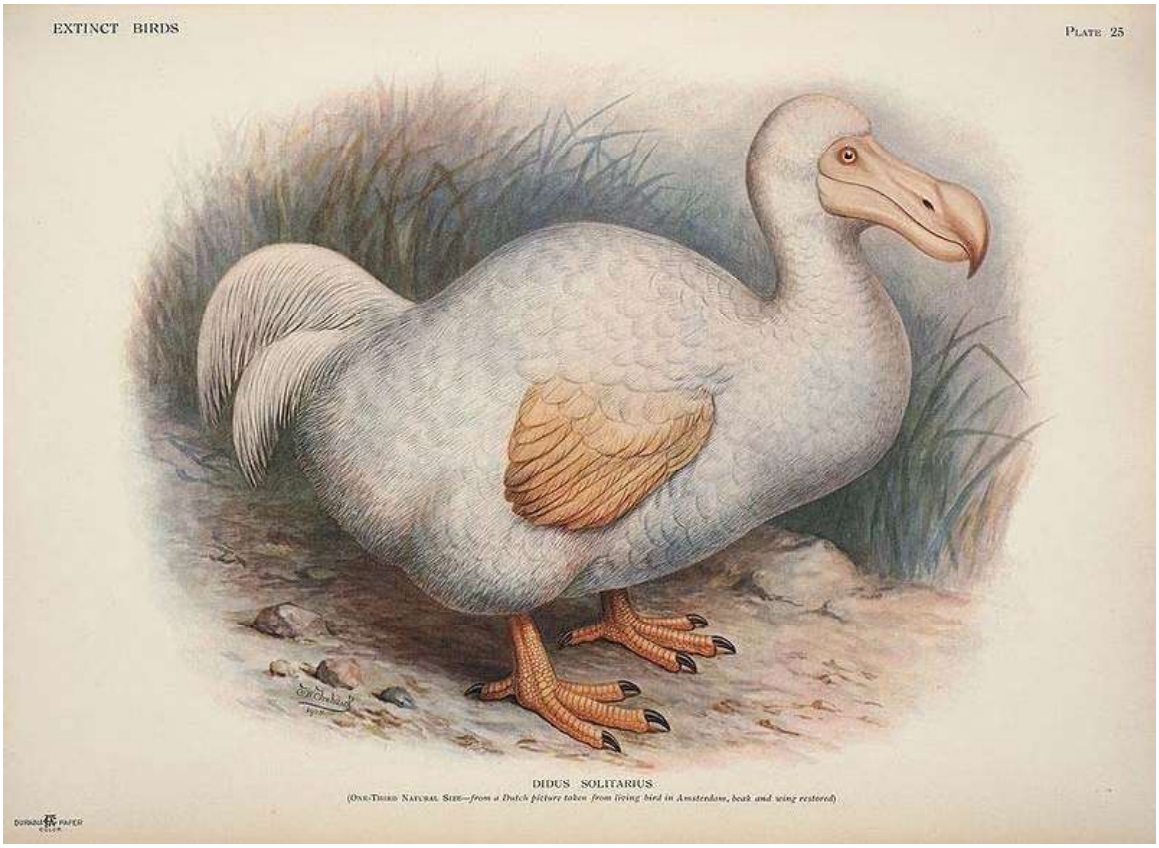
It had a white plumage, with black wingtips and tail and a dark, naked head. Bill and legs were long, the former slim and slightly downcurved. All in all, it looked much like a small Sacred Ibis with short wings.

The Réunion Sacred Ibis lived solitarily in deep forests near freshwater, where it fed on invertebrates like worms and crustaceans which it caught or dug out of the mud with its long beak. If threatened, it is described to have tried to get away on foot, but using its wings for assistance and to glide short distances, especially downhill. The old vernacular name **"Réunion Flightless Ibis"** is thus misleading. Travellers' reports as well as bone

measurements indicate that it was well on its way to flightlessness, but could still fly some distance on its own power after a running take-off.

The last account of the "Réunion Solitaire" was recorded in 1705, indicating that the species probably became extinct sometime early in that century.

Old descriptions and paintings



Painting of an albino dodo, mislabeled as "*Didus solitarius*"

The bird was at various times identified with 17th century descriptions and paintings of a white dodo-like bird, which did not match the descriptions of *solitaries* (reclusive non-gregarious large birds) seen by contemporary explorers on Réunion very well – apart from being mostly white. Due to this, some assumed two species (*Raphus solitarius* and *Victoriornis imperialis*) co-existed on Réunion (or "Bourbon", as it was called in former times) – one dodo-like, one resembling the Rodrigues Solitaire (*Pezophaps solitaria*). The latter was a dodo relative that generally was not a social bird but for breeding formed monogamous couples. These defended a territory around their large, easily recognized ground nest, deep in the woods; they were thus said to have a "solitary" lifestyle. Though the same French word was used for the birds of both Rodrigues and Réunion, the Réunion Solitaire was given this name because only single individuals were usually encountered all year round. Similar nesting behaviour as on Rodrigues (in the Réunion

bird, or in the dodo for that matter) was never reported, marking a conspicuous difference between the two species.

Some of the paintings are very fine and detailed; others are less refined but (as other, well-known birds that accompany the white dodo demonstrate) nonetheless appear generally realistic. In particular the latter show menagerie scenes, with various attractively patterned but ecologically dissimilar waterfowl and a white dodo as onlooker. Lithographs and woodcuts have also been made, but these are generally based on the paintings. The bird looks as an albino dodo from Mauritius that has grown fat in captivity would be expected to. In some paintings, the billtip is round. Dodos had a huge bill and were reported to bite savagely in defence; the round bill and general setting indicate that such a bird did indeed live in a European menagerie and had its rhamphotheca tip cropped for safety.

Subfossil remains

Borbonibis latipes was described from the first ibis bones found on Réunion, before a connection to the *solitaire* reports had been made. The epithet *solitarius* derives from the *Raphus solitarius* description of Baron Edmund de Sélys-Longchamps in 1848, but that the *solitare* reported from Réunion actually existed was not confirmed until the discovery of bones on Réunion in the late 20th century.

The discovery that it actually was an ibis perfectly fits what the early travellers said about its plumage and habits. The confusion can be explained by the fact that *solitaire* was used by the writers of the descriptions as a term indicating a non-gregarious lifestyle, which the ibis happened to share with the Rodrigues Solitaire, but was interpreted by the scientists as an indication of a taxonomic relationship.

Chapter- 4

Dodo

Dodo
Fossil range: Late Holocene

Dodo reconstruction reflecting new research at Oxford University Museum of Natural History

Conservation status

Extinct (IUCN 3.1)

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata

Class:	Aves
Order:	Columbiformes
Family:	Columbidae
Subfamily:	†Raphinae
Genus:	†***Raphus*** Brisson, 1760
Species:	†***R. cucullatus***

Binomial name

†***Raphus cucullatus***
(Linnaeus, 1758)

Former range (in red)

Synonyms

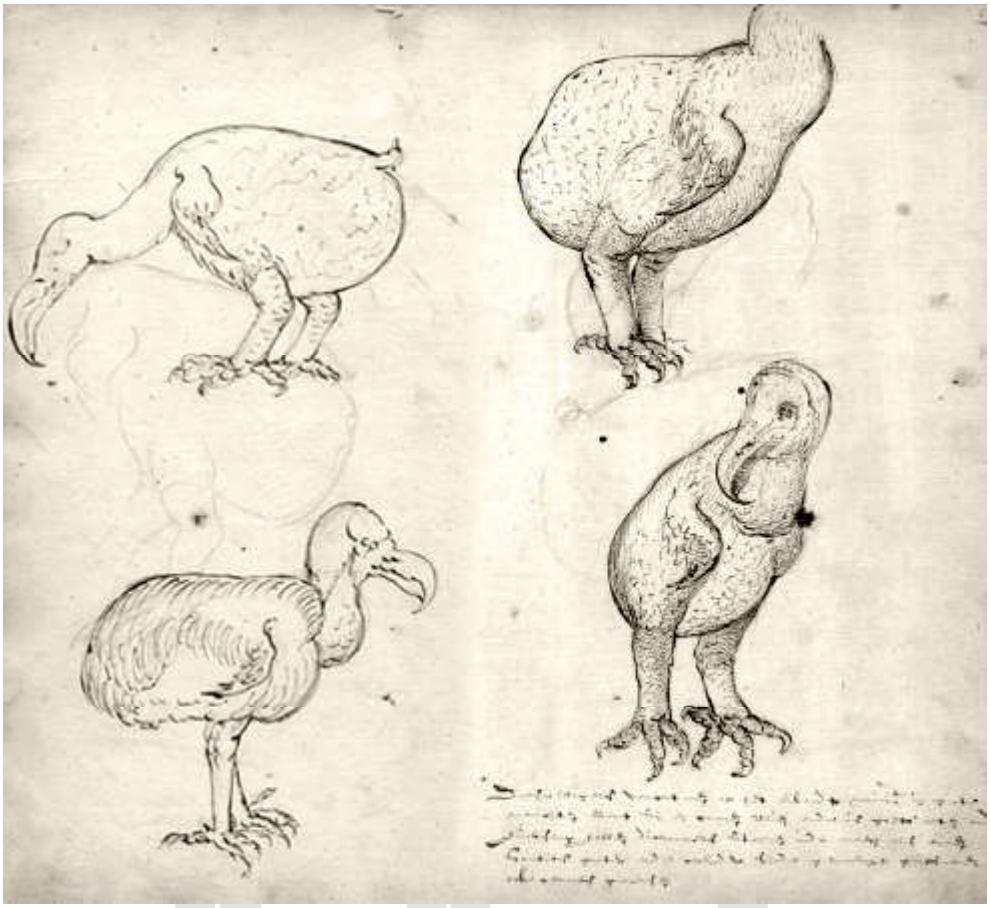
- *Struthio cucullatus* Linnaeus, 1758
- *Didus ineptus* Linnaeus 1766

The **dodo** (*Raphus cucullatus*) was a flightless bird endemic to the Indian Ocean island of Mauritius. Related to pigeons and doves, it stood about a meter (3.3 feet) tall, weighing about 20 kilograms (44 lb), living on fruit and nesting on the ground.

The dodo has been extinct since the mid-to-late 17th century. It is commonly used as the archetype of an extinct species because its extinction occurred during recorded human history and was directly attributable to human activity.

The phrase "dead as a dodo" means undoubtedly and unquestionably dead, whilst the phrase "to go the way of the dodo" means to become extinct or obsolete, to fall out of common usage or practice, or to become a thing of the past.

Discovery and etymology



Drawings of the dodo from the travel journal of the VOC ship *Gelderland* (1601–1603)

The first known descriptions of the bird were made by the Dutch. They called the Mauritius bird the *walghvogel* ("wallow bird" or "loathsome bird") in reference to its taste. Although many later writings say that the meat tasted bad, the early journals only say that the meat was tough but good, though not as good as the abundantly available pigeons. The name *walgvogel* was used for the first time in the journal of vice-admiral Wybrand van Warwijck, who visited the island in 1598 and named it Mauritius.

The etymology of the word *dodo* is unclear. Some ascribe it to the Dutch word *dodoor* for "sluggard", but it more likely is related to *dodaars* ("knot-arse"), referring to the knot of feathers on the hind end. The first recording of the word *dodaerse* is in captain Willem van Westsanen's journal in 1602. Thomas Herbert used the word *dodo* in 1627, but it is unclear whether he was the first; the Portuguese had visited the island in 1507, but, as far as is known, did not mention the bird. Nevertheless, according to the *Encarta Dictionary* and *Chambers Dictionary of Etymology*, "dodo" derives from Portuguese *doudo* (currently *doido*) meaning "fool" or "crazy". However, the present Portuguese name for the bird, *dodô*, is taken from the internationally used word dodo.

David Quammen considered the idea that *dodo* was an onomatopoeic approximation of the bird's own call, a two-note pigeony sound like "doo-doo".

In 1606 Cornelis Matelief de Jonge wrote an important description of the dodo, some other birds, plants and animals on the island.

Systematics and evolution

The Nicobar Pigeon (*Caloenas nicobarica*) is the closest living relative of the dodo and the Réunion Solitaire.

The dodo was a close relative of modern pigeons and doves. mtDNA cytochrome *b* and 12S rRNA sequences analysis suggests that the dodo's ancestors diverged from those of

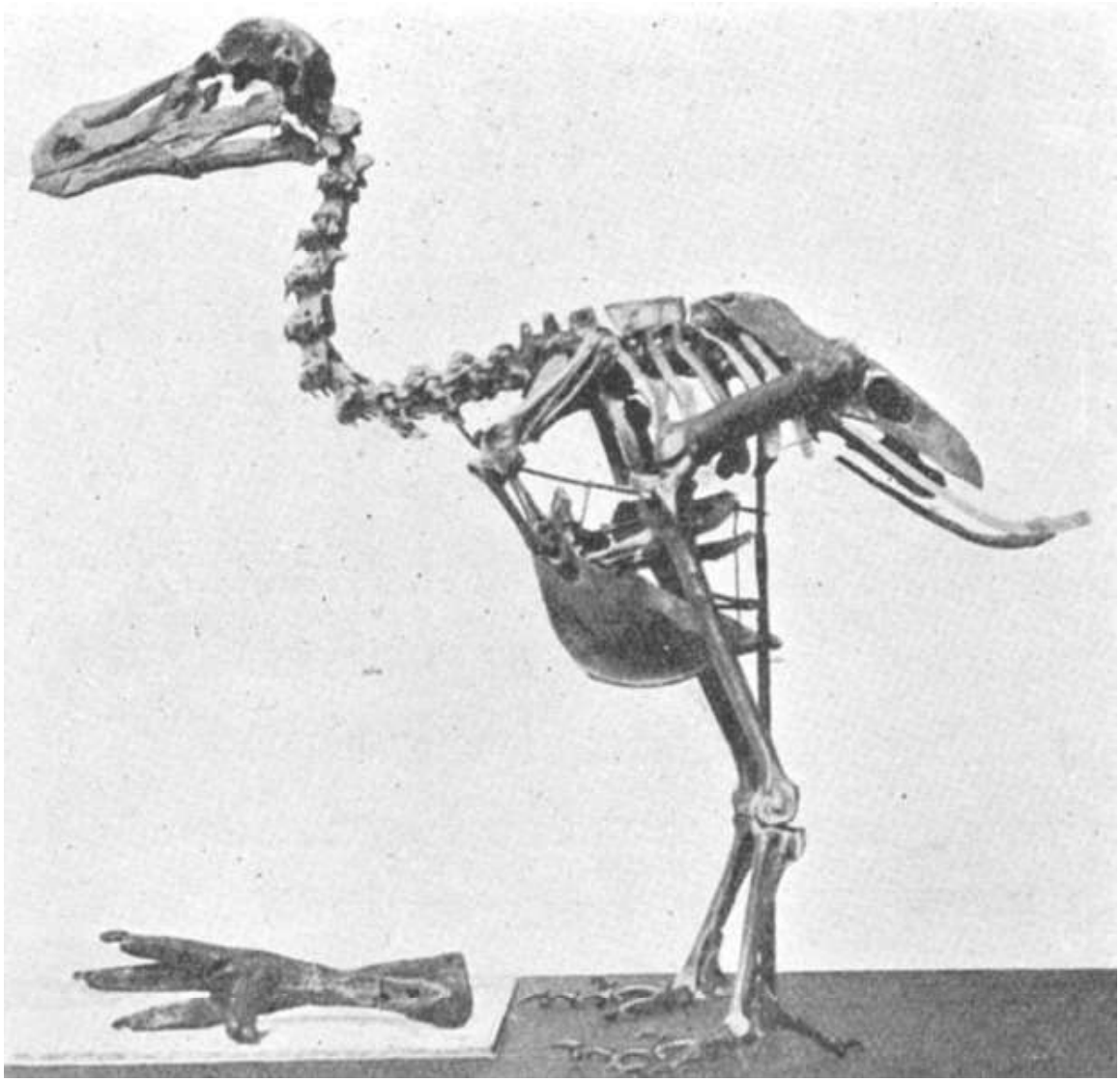
its closest known relative, the Rodrigues Solitaire (which is also extinct), around the Paleogene-Neogene boundary. As the Mascarenes are of volcanic origin and less than 10 million years old, both birds' ancestors remained most likely capable of flight for considerable time after their lineages' separation. The same study has been interpreted to show that the Southeast Asian Nicobar Pigeon is the closest living relative of the dodo and the Réunion Solitaire.

However, the proposed phylogeny is rather questionable regarding the relationships of other taxa and must therefore be considered hypothetical pending further research; considering biogeographical data, it is very likely to be erroneous. All that can be presently said with any certainty is that the ancestors of the didine birds were pigeons from Southeast Asia or the Wallacea, which agrees with the origin of most of the Mascarenes' birds. Whether the dodo and Rodrigues Solitaire were actually closest to the Nicobar Pigeon among the living birds, or whether they are closer to other groups of the same radiation such as *Ducula*, *Treron*, or *Goura* pigeons is not clear at the moment.

For a long time, the dodo and the Rodrigues Solitaire (collectively termed "didines") were placed in a family of their own, the Raphidae. This was because their relationships to other groups of birds (such as rails) had yet to be resolved. As of recently, it appears more warranted to include the didines as a *subfamily* Raphinae in the Columbidae.

The supposed "White Dodo" is now thought to be based on misinterpreted reports of the Réunion Sacred Ibis and paintings of apparently albinistic dodos; a higher frequency of albinos is known to occur occasionally in island species.

Morphology and flightlessness



Skeleton of a dodo put together from bones found in a marshy pool on Mauritius and the dried leg of a specimen which was brought alive to Europe about the year 1600, in Natural History Museum

In October 2005, part of the Mare aux Songes, the most important site of dodo remains, was excavated by an international team of researchers. Many remains were found, including bones from birds of various stages of maturity and several bones obviously belonging to the skeleton of one individual bird and preserved in natural position. These findings were made public in December 2005 in the Naturalis in Leiden. Before this, few associated dodo specimens were known, most of the material consisting of isolated and scattered bones. Dublin's Natural History Museum and the Oxford University Museum of Natural History, among others, have a specimen assembled from these disassociated remains. A dodo egg is on display at the East London museum in South Africa.

Plaster cast of a dried head and leg of a dodo

Manchester Museum's bones

Until recently, the most intact remains, currently on display at the Oxford University Museum of Natural History, were one individual's partly skeletal foot and head which contain the only known soft tissue remains of the species. Manchester Museum has a small collection of dodo bones on display.

The remains of the last known stuffed dodo had been kept in Oxford's Ashmolean Museum, but in the mid-18th century, the specimen – save the pieces remaining now – had entirely decayed and was ordered to be discarded by the museum's curator or director in or around 1755.

In June 2007, adventurers exploring a cave in Mauritius discovered the most complete and well-preserved dodo skeleton ever.

According to artists' renditions, the dodo had greyish plumage, a 23-centimeter (9-inch) bill with a hooked point, very small wings, stout yellow legs and a tuft of curly feathers high on its rear end. Dodos were very large birds, possibly weighing up to 23 kg (50 pounds), althuogh some estimations give a weight of about 10.6-17.5 kg. The sternum was insufficient to support flight; these ground-bound birds evolved to take advantage of an island ecosystem with no predators.

The traditional image of the dodo is of a fat, clumsy bird, hence the synonym *Didus ineptus*, but this view has been challenged in recent times. The general opinion of scientists today is that the old drawings showed overfed captive specimens. As Mauritius has marked dry and wet seasons, the dodo probably fattened itself on ripe fruits at the end of the wet season to live through the dry season when food was scarce; contemporary reports speak of the birds' "greedy" appetite. In captivity, with food readily available, the birds became overfed very easily.

Diet

The tambalacoque, also known as the "dodo tree", was hypothesized by Stanley Temple to have been eaten from by dodos and only by passing through the digestive tract of the dodo could the seeds germinate; he claimed that the tambalacocque was now nearly extinct due to the dodo's disappearance. He force-fed seventeen tambalacoque fruits to Wild Turkeys and three germinated. Temple did not try to germinate any seeds from control fruits not fed to turkeys so the effect of feeding fruits to turkeys was unclear. Temple also overlooked reports on tambalacoque seed germination by A. W. Hill in 1941 and H. C. King in 1946, who found the seeds germinated, albeit very rarely, without abrading.

Extinction

Dronte (17th century)

As with many animals that have evolved in isolation from significant predators, the dodo was entirely fearless of people and this, in combination with its flightlessness, made it easy prey for humans. However, journals are full of reports regarding the bad taste and tough meat of the dodo, while other local species such as the Red Rail were praised for their taste. When humans first arrived on Mauritius, they also brought with them other animals that had not existed on the island before, including dogs, pigs, cats, rats and Crab-eating Macaques, which plundered the dodo nests, while humans destroyed the forests where the birds made their homes; the impact these animals—especially the pigs and macaques—had on the dodo population is currently considered to have been more severe than that of hunting. The 2005 expedition's finds are apparently of animals killed by a flash flood; such mass mortalities would have further jeopardized a species already in danger of becoming extinct.

Dodo skeleton, Natural History Museum (England)

Although there are scattered reports of mass killings of dodos for provisioning of ships, archaeological investigations have hitherto found scant evidence of human predation on these birds. Some bones of at least two dodos were found in caves at Baie du Cap which were used as shelters by fugitive slaves and convicts in the 17th century, but due to their isolation in high, broken terrain, were not easily accessible to dodos naturally.

There is some controversy surrounding the extinction date of the dodo. Roberts & Solow state that "the extinction of the Dodo is commonly dated to the last confirmed sighting in 1662, reported by shipwrecked mariner Volkert Evertsz" (Evertszoon), but many other sources suggest the more conjectural date of 1681. Roberts & Solow point out that because the sighting prior to 1662 was in 1638, the dodo was likely already very rare by the 1660s and thus a disputed report from 1674 cannot be dismissed out-of-hand.

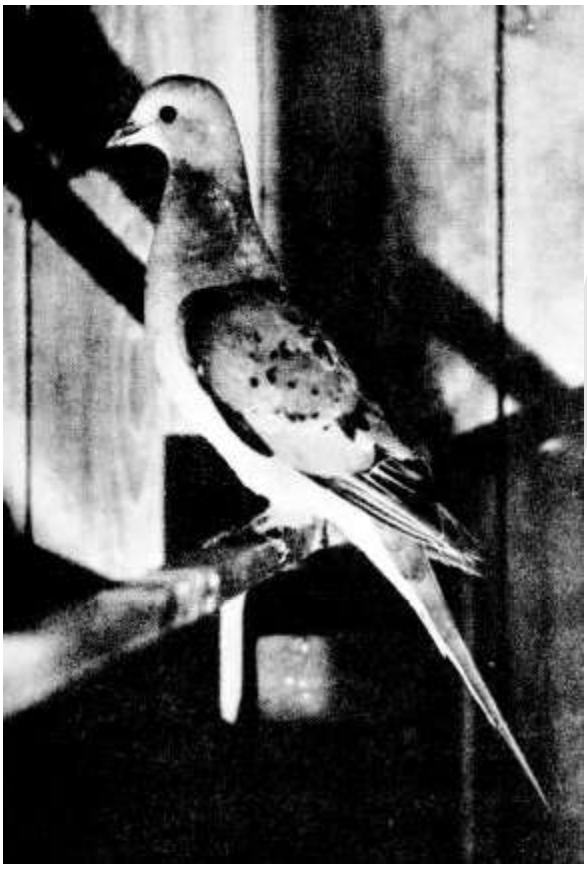
Statistical analysis of the hunting records of Isaac Johannes Lamotius give a new estimated extinction date of 1693, with a 95% confidence interval of 1688 to 1715. Considering more circumstantial evidence such as travelers' reports and the lack of good reports after 1689, it is likely that the dodo became extinct before 1700; the last dodo died a little more than a century after the species' discovery in 1581.

Few took particular notice of the extinct bird. By the early 19th century it seemed altogether too strange a creature and was believed by many to be a myth. With the discovery of the first batch of dodo bones in the Mauritian swamp, the Mare aux Songes and the reports written about them by George Clarke, government schoolmaster at Mahébourg, from 1865 on, interest in the bird was rekindled. In the same year in which Clarke started to publish his reports, the newly vindicated bird was featured as a character in Lewis Carroll's *Alice's Adventures in Wonderland*. With the popularity of the book, the dodo became a well-known and easily recognizable icon of extinction.

Chapter- 5

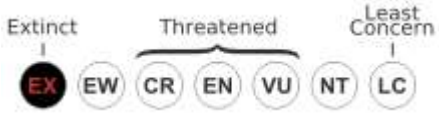
Passenger Pigeon

Passenger Pigeon



Live passenger pigeon in 1898

Conservation status



Extinct (IUCN 3.1)

Scientific classification

Kingdom: Animalia

Phylum: Chordata

Class:	Aves
Order:	Columbiformes
Family:	Columbidae
Genus:	***Ectopistes*** Swainson, 1827
Species:	***E. migratorius***

Binomial name

Ectopistes migratorius
(Linnaeus, 1766)

The **Passenger Pigeon** or **Wild Pigeon** (*Ectopistes migratorius*) is an extinct bird, which existed in North America. It lived in enormous migratory flocks – sometimes containing more than two billion birds – that could stretch one mile (1.6 km) wide and 300 miles (500 km) long across the sky, sometimes taking several hours to pass.

Some estimate that there were three billion to five billion passenger pigeons in the United States when Europeans arrived in North America. Others argue that the species had not been common in the Pre-Columbian period, but their numbers grew when devastation of the American Indian population by European diseases led to reduced competition for food.

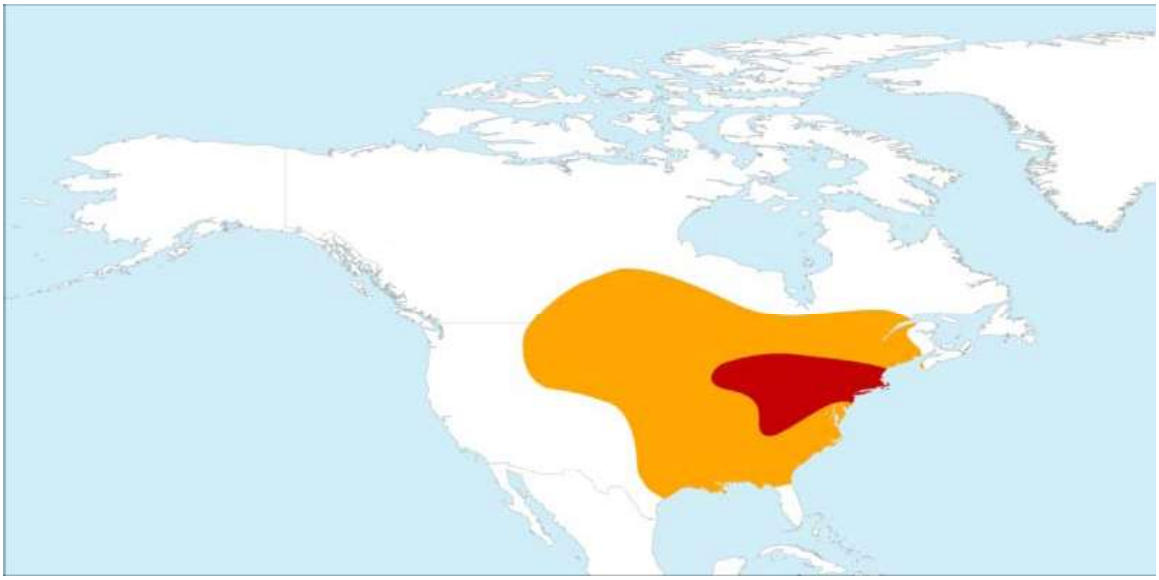
The species went from being one of the most abundant birds in the world during the 19th century to extinction early in the 20th century. At the time, passenger pigeons had one of the largest groups or flocks of any animal, second only to the Rocky Mountain locust.

Some reduction in numbers occurred because of habitat loss when the Europeans started settling further inland. The primary factor emerged when pigeon meat was commercialized as a cheap food for slaves and the poor in the 19th century, resulting in hunting on a massive scale. There was a slow decline in their numbers between about 1800 and 1870, followed by a catastrophic decline between 1870 and 1890. Martha, thought to be the world's last passenger pigeon, died on September 1, 1914, at the Cincinnati Zoo.

In the 18th century, the passenger pigeon in Europe was known to the French as *tourtre*; but, in New France, the North American bird was called *tourte*. Tourtière, a traditional meat-pie originating from Quebec and associated with French-Canadian culture, was so-named because *tourte* was historically a key ingredient. Today, the dish is typically made from pork and/or veal, or beef. In modern French, the bird is known as the *pigeon migrateur*.

In Algonquian languages, it was called *amimi* by the Lenape and *omiimii* by the Ojibwe. The term *passenger pigeon* in English derives from the French word *passager*, meaning *to pass by*.

Distribution



Distribution map of *Ectopistes migratorius*, with breeding zone in red and wintering zone in orange

During summer, passenger pigeons lived in forest habitats throughout North America east of the Rocky Mountains from eastern and central Canada to the northeast United States. In the winters, they migrated to the southern U.S. and occasionally to Mexico and Cuba.

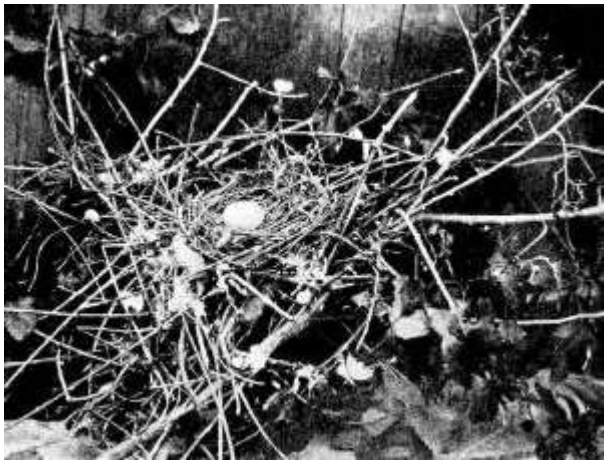
Taxonomy and systematics

The Passenger Pigeon is a member of the Columbidae family (pigeons and doves) that has been assigned to the genus ***Ectopistes***. Earlier descriptions of the species placed the population with the genus *Columba*, but it was transferred to the monotypic genus (no fossil ancestors known) due to the greater length of the tail and wings. The generic epithet translates as 'wandering about', the specific indicates that it is migratory; the Passenger Pigeon's movements were not only seasonal, as with other birds, they would amass in whatever location was most productive and suitable for breeding.

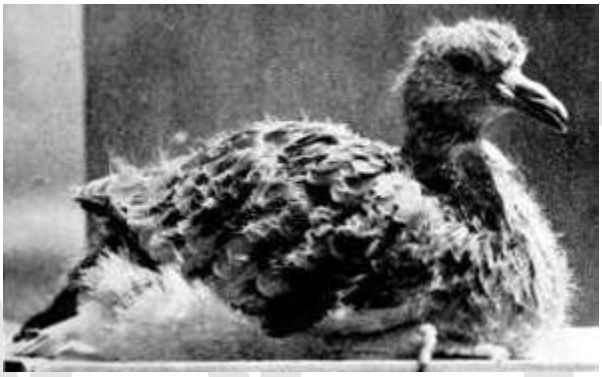
The Passenger Pigeon's closest living relative were thought to be the *Zenaida* doves (e.g. Mourning Dove *Z. macroura*),. Some have suggested using Mourning Doves for cloning the Passenger Pigeon in the future. However, in 2010 genetic data showed it was closer to the American pigeons *Patagioenas*. Rather than belonging (like *Zenaida*) to the American dove clade around *Leptotila*, the DNA sequence data show *Ectopistes* to be part of a radiation that includes the "typical" Old World pigeons (e.g. Domestic Pigeon *Columba livia*) and the Eurasian turtledoves (*Streptopelia*) and *Patagioenas*, as well as the cuckoo-doves and relatives of the Wallacea region and its surroundings. If anything, *Ectopistes* is closer to the former, but relationships within this Columbidae lineage are not fully resolved yet.

Behavior

Nesting passenger pigeon



Nest and egg of a passenger pigeon



Passenger pigeon chick

The passenger pigeon was a very social bird. It lived in colonies stretching over hundreds of square miles, practicing communal breeding with up to a hundred nests in a single tree. Pigeon migration, in flocks numbering billions, was a spectacle without parallel:

Early explorers and settlers frequently mentioned passenger pigeons in their writings. Samuel de Champlain in 1605 reported "countless numbers," Gabriel Sagard-Theodat wrote of "infinite multitudes," and Cotton Mather described a flight as being about a mile in width and taking several hours to pass overhead. Yet by the early 1900s no wild passenger pigeons could be found.
—*The Smithsonian Encyclopedia*

There was safety in large flocks which often numbered hundreds of thousands of birds. When a flock of this huge a size established itself in an area, the number of local animal predators (such as wolves, foxes, weasels and hawks) was so small compared to the total number of birds that little damage would be inflicted on the flock as a whole. This colonial way of life and communal breeding became very dangerous when humans began to hunt the pigeons. When the passenger pigeons were massed together, especially at a huge nesting site, it was easy for people to slaughter them in such great numbers that

there were not enough birds left to successfully reproduce the species. As the flocks dwindled in size with resulting breakdown of social facilitation, it was doomed to disappear.

Causes of extinction

Passenger Pigeon, *Ectopistes migratorius*, juvenile (left), male (center), female (right)

The extinction of the passenger pigeon has two major causes. The primary cause is held to be the commercial exploitation (unregulated hunting) of pigeon meat on a massive scale. But current examination also focuses on the pigeon's loss of habitat.

Hunting

Prior to colonization, Aboriginal Americans occasionally used pigeons for meat. In the early 19th century, commercial hunters began netting and shooting the birds to sell in the city markets as food, as live targets for trap shooting and even as agricultural fertilizer.

Once pigeon meat became popular, commercial hunting started on a prodigious scale. The bird painter John James Audubon described the preparations for slaughter at a known pigeon-roosting site:

"Few pigeons were then to be seen, but a great number of persons, with horses and wagons, guns and ammunition, had already established encampments on the borders. Two farmers from the vicinity of Russelsville, distant more than a hundred miles, had

driven upwards of three hundred hogs to be fattened on the pigeons which were to be slaughtered. Here and there, the people employed in plucking and salting what had already been procured, were seen sitting in the midst of large piles of these birds. The dung lay several inches deep, covering the whole extent of the roosting-place."

Pigeons were shipped by the boxcar-load to the Eastern cities. In New York City, in 1805, a pair of pigeons sold for two cents. Slaves and servants in 18th and 19th century America often saw no other meat. By the 1850s, it was noticed that the numbers of birds seemed to be decreasing, but still the slaughter continued, accelerating to an even greater level as more railroads and telegraphs were developed after the American Civil War.

One of the last large nestings of passenger pigeons was at Petoskey, Michigan, in 1878. Here 50,000 birds were killed each day and the hunt continued for nearly five months. When the adult birds that survived the slaughter attempted second nestings at new sites, they were located by the professional hunters and killed before they had a chance to raise any young. In 1896, the final flock of 250,000 were killed by the hunters knowing that it was the last flock of that size.

Stuffed passenger pigeon, Bird Gallery, Royal Ontario Museum, Toronto

Loss of habitat

Another significant reason for its extinction was deforestation. The birds traveled and reproduced in prodigious numbers, satiating predators before any substantial negative impact was made in the bird's population. As their numbers decreased along with their habitat, the birds could no longer rely on high population density for protection. Without this mechanism, many ecologists believe, the species could not survive.

Methods of killing

Front view of a live passenger pigeon

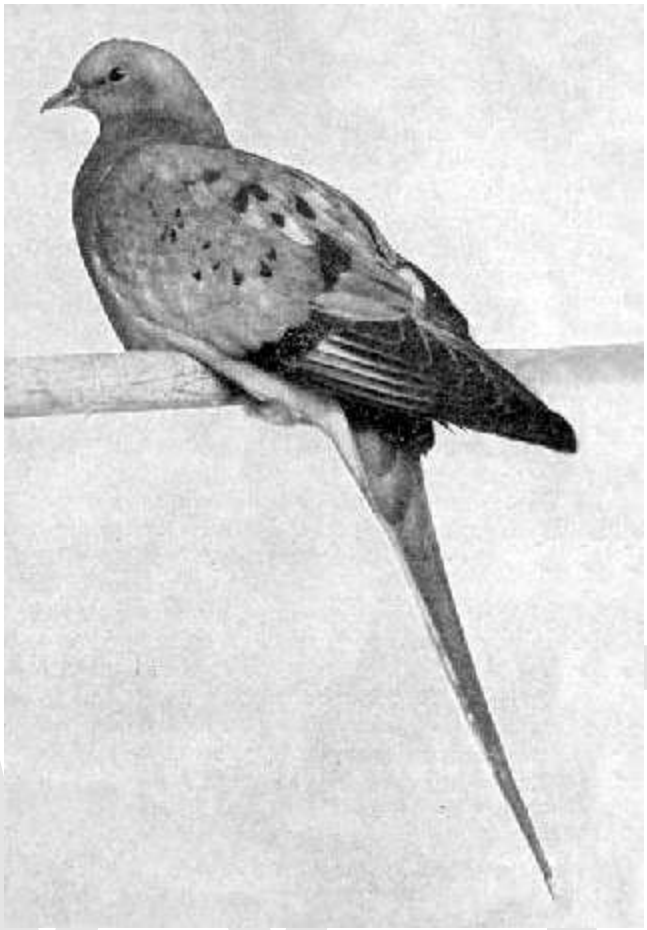
Alcohol-soaked grain intoxicated the birds and made them easier to kill. Smoky fires were set to nesting trees to drive them from their nests.

One method of killing was to blind a single bird by sewing its eyes shut using a needle and thread. This bird's feet would be attached to a circular stool at the end of a stick that could be raised five or six feet in the air, then dropped back to the ground. As the bird attempted to land, it would flutter its wings, thus attracting the attention of other birds flying overhead. When the flock landed near this decoy bird, nets would trap the birds and the hunters would crush their heads between their thumb and forefinger. This has been claimed as the origin of the term stool pigeon, though this etymology is disputed.

Attempts at preservation

Conservationists were ineffective in stopping the slaughter. A bill was passed in the Michigan legislature making it illegal to net pigeons within two miles (3 km) of a nesting area, but the law was weakly enforced. By the mid 1890s, the passenger pigeon had almost completely disappeared. In 1897, a bill was introduced in the Michigan legislature asking for a ten-year closed season on passenger pigeons. This was a futile gesture. This was a highly gregarious species—the flock could initiate courtship and reproduction only when they were gathered in large numbers; it was realized only too late that smaller groups of passenger pigeons could not breed successfully and the surviving numbers proved too few to re-establish the species. Attempts at breeding among the captive population also failed for the same reasons.

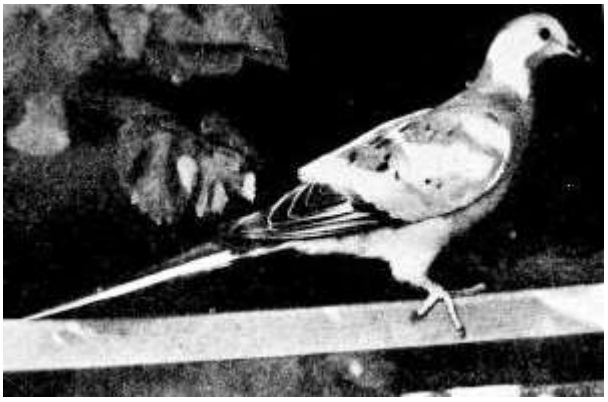
Attempts to revive the species by breeding the surviving captive birds were not successful. The passenger pigeon was a colonial and gregarious bird practicing communal roosting and communal breeding and needed large numbers for optimum breeding conditions. It was impossible to reestablish the species with just a few captive birds and the small captive flocks weakened and died. Since no accurate data were recorded, it is only possible to give estimates on the size and population of these nesting areas. Each site may have covered many thousands of acres and the birds were so congested in these areas that hundreds of nests could be counted in each tree. One large nesting area in Wisconsin was reported as covering 850 square miles (2,200 km^2) and the number of birds nesting there was estimated to be around 136,000,000. Their technique of survival had been based on mass tactics.



Young passenger pigeon

The extinction of the passenger pigeon aroused public interest in the conservation movement and resulted in new laws and practices which have prevented many other species from going extinct.

Last wild survivors



Live passenger pigeon

The last fully authenticated record of a wild bird was near Sargents, Pike County, Ohio, on March 22, 1900, although many unconfirmed sightings were reported in the first decade of the 20th century. From 1909 to 1912, a reward was offered for a living specimen — no specimens were found. However, unconfirmed sightings continued up to about 1930.

Reports of passenger pigeon sightings kept coming in from Arkansas and Louisiana, in groups of tens and twenties, until the first decade of the 20th century.

The naturalist Charles Dury, of Cincinnati, Ohio, wrote in September 1910:

One foggy day in October 1884, at 5 a.m. I looked out of my bedroom window and as I looked six wild pigeons flew down and perched on the dead branches of a tall poplar tree that stood about one hundred feet away. As I gazed at them in delight, feeling as though old friends had come back, they quickly darted away and disappeared in the fog, the last I ever saw of any of these birds in this vicinity.

Martha

Martha, the last passenger pigeon

In 1857, a bill was brought forth to the Ohio State Legislature seeking protection for the passenger pigeon. A Select Committee of the Senate filed a report stating "The passenger pigeon needs no protection. Wonderfully prolific, having the vast forests of the North as its breeding grounds, traveling hundreds of miles in search of food, it is here today and elsewhere tomorrow and no ordinary destruction can lessen them, or be missed from the myriads that are yearly produced."

Fifty-seven years later, on September 1, 1914, Martha, the last known passenger pigeon, died in the Cincinnati Zoo, Cincinnati, Ohio. Her body was frozen into a block of ice and sent to the Smithsonian Institution, where it was skinned and mounted. Currently, Martha (named after Martha Washington) is in the museum's archived collection and not on display. A memorial statue of Martha stands on the grounds of the Cincinnati Zoo.

Chapter- 6

New Caledonian Lorikeet and Norfolk Island Kākā

New Caledonian Lorikeet

New Caledonian Lorikeet

Conservation status

Critically Endangered (IUCN 3.1)

Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Aves
Order:	Psittaciformes
Family:	Psittacidae
Genus:	*Charmosyna*
Species:	***C. diadema***

Binomial name

Charmosyna diadema
(Verreaux & Des Murs, 1860)

Synonyms

Psitteuteles diadema Verreaux & Des Murs, 1860

The **New Caledonian Lorikeet** *Charmosyna diadema* is a possibly extinct lorikeet endemic to the Melanesian island of New Caledonia.

Description

The New Caledonian Lorikeet is 18-19 cm long (the size of a large hand), 7-8 cm of which is the slim and pointed tail. The wings are slender and pointed, measuring 91 mm in the only specimen. Its tarsus is 16 cm long.

Female birds are green overall, with deep violet blue crown and dark bluish thighs, a yellowish face and underside face and a red anal region. The tail is green above and yellowish olive below, with the four lateral feathers with red basal markings followed by a black band, tipped yellow on the underside. The beak is orange-red, the iris probably dark orange like the feet.

Males have not been recorded. Based on similar species, they likely have more red coloration, probably including the face, underside of the primaries and the rump sides; and are likely slightly larger. Immature birds should look like dull females.

Its noises are also unknown but—again based on similar species—are likely high-pitched screeches. These would be the most telling sign of the species, but only to observers familiar with other local parrots' vocalizations. While the birds would be unmistakable due to their small size, they are extremely hard to spot.

Distribution

The provenance of the extant specimen is unknown. One was shot at Mont Ignambi near Oubatche in 1913 (Sarasin & Roux, 1913), but not preserved. Unverified reports exist from west of Mont Panié and the Mont Ignambi area in the North Province and from the La Foa-Canala road and Yaté Lake in the South Province (Stokes, 1980; Forshaw &

Cooper 1989; Ekstrom *et al.*, 2002). Bregulla (1993) suggested it might be in the area around Mont Panié and Mont Humboldt—about 60 km SE of Canala—and the Massif du Kouakoué. Given the low accessibility of the highlands, flocks could, in theory, exist in any of the larger remaining patches of relatively undisturbed forest, e.g., between the intercoastal roads around the province border.

Ecology

This bird is hard to track because it is nomadic and is relatively inconspicuous. The species is believed to live in humid montane forests but (seasonally?) flies in and out of lowland *Melaleuca* forests. Most reports come from such lowland forests, but this probably reflects better accessibility. Mt. Ignambi is believed to be an ideal habitat for the species. The Yaté Lake report was from an area of low shrubland.

The bird apparently keeps to treetops. Related species eat nectar, pollen, blossoms and sometimes soft fruit, foraging in pairs or small (typically fewer than 10) flocks. *Erythrina* was specifically mentioned as food plants for this species. Reproduction data for 'green' *Charmosyna* lorikeets is only available for the Red-flanked (*C. placentis*) and the Red-fronted Lorikeet (*C. rubronotata*). Breeding season probably is July-December and possibly to February, or even all-year round. They excavate in arboreal termite nests or epiphytic ferns. Clutches consist of two (sometimes three?) white rounded eggs; extrapolating from scant data for relatives, *C. diadema* eggs probably measure about 19.6 x 18.7 mm.

Status

Described from two skins (both females) collected somewhere on New Caledonia before 1860 (Berlioz 1945). One has since disappeared. The other is in the MNHN (specimen 762A). Sarasin & Roux (1913) report a claim that the species existed near Oubatche; one bird was shot but could not be preserved. Layard & Layard (1882), while not observing birds themselves, report there were rare sightings up to 1880. Forshaw & Cooper (1989) cite Anthony Stokes, who in December 1976 collected reports on sightings: An older local identified it from a colored plate and claimed to have observed a single bird in shrubland near Lake Yaté "many years ago," possibly in the 1920s. A forestry official claimed to have twice seen two individuals fly overhead, once in 1953 or 1954 on the La Foa-Canala road and once on June 3, 1976, W of Mt Panié. However, none of these claims could be confirmed and all searches (e.g., 1938 by MacMillan) have been fruitless. Stokes also reported that collectors coming to New Caledonia to search for this bird offered rewards for live or dead specimens.

Opinion is divided on whether the New Caledonian Lorikeet still exists. King (1981) lists it as extinct since 1860, which is certainly not correct. Most authors hope someone will yet rediscover the New Caledonian Lorikeet. This hope isn't unrealistic, given that the subject would be a very small, inconspicuous bird in a large, wild area that is difficult for ornithological field work. The 1999 rediscovery of *Aegotheles savesi*, which was known only from a single male skin for 119 years, provides encouragement. A 6-month search

expedition to the Mt. Ignambi area in 1998 did not find the species and locals were not familiar with it. New surveys of highland rainforests are planned for 2006/2007.

Reasons for the species' rarity are unknown. There seems to have been a marked decline in the numbers of two of the other three parrots native to New Caledonia (the New Caledonian Red-crowned Parakeet and the Horned Parakeet. Deplanche's Lorikeet is still common), also for unknown reasons. New Caledonian bird populations decline wherever habitat is modified, which supports the hypotheses that human interference impacts the birds in a serious way. However, *C. diadema'*s post-1880 decline—if real—took place too early for habitat destruction to have been a decisive factor. Neither could capture for the cage bird trade have influenced the decline. Introduced cats or rats could have been responsible for the decline, or an introduced disease, or a combination of these factors and subtle habitat changes. For example, the large-scale destruction of lowland forest may have deprived the species of a food source they seasonally depended on. The introduction of cats and European rats in the mid-19th century fits the assumed pattern of decline; however, cats probably didn't spread over the whole island until recent times. Rats, especially black rats, which are arboreal, probably represent a serious threat, but the species did not succumb to the prehistoric arrival of the Polynesian rat.

For whatever reason, the New Caledonian Lorikeet is an extremely rare and elusive bird. The rarity could be caused in part by the elusiveness. Its relative, the Red-throated Lorikeet, feared extinct since the beginning of the 20th century, apparently survived in considerable numbers to the 1970s. However, it's more likely *C. diadema* is genuinely rare. Based on distance between sightings and remaining prime habitat, any remaining populations are probaby small and georgrapically fragmented.

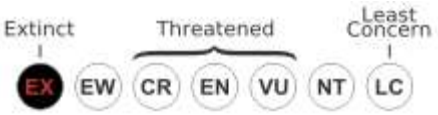
The New Caledonian Lorikeet, like most parrots, is listed in CITES Appendix II (since June 6, 1981) and European Union regulation 338/97 Appendix B (since June 1, 1997). It is listed as **Critically Endangered (D1)** by BirdLife International, which means that the effective population size is likely to be less than fifty individuals.

Norfolk Island Kākā

Norfolk Island Kākā

Painting by John Gould

Conservation status



Extinct (IUCN 3.1)

Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Aves
Order:	Psittaciformes
Family:	Strigopidae
Tribe:	Nestorini

Genus:	*Nestor*
Species:	***N. productus***

Binomial name

Nestor productus
(Gould, 1836)

Synonyms

Nestor norfolcensis
Plyctolophus productus
Centrurus productus

The **Norfolk Island Kākā** (*Nestor productus*) is an extinct species of large parrot, belonging to the parrot family Strigopidae. The birds were about 38 cm long, with mostly olive-brown upperparts, (reddish-)orange cheeks and throat, straw-coloured breast, thighs, rump and lower abdomen dark orange and a prominent beak. It inhabited the rocks and treetops of Norfolk Island and adjacent Phillip Island. It was a relative of the Kākā from New Zealand.

Norfolk Island Kākā

Biology

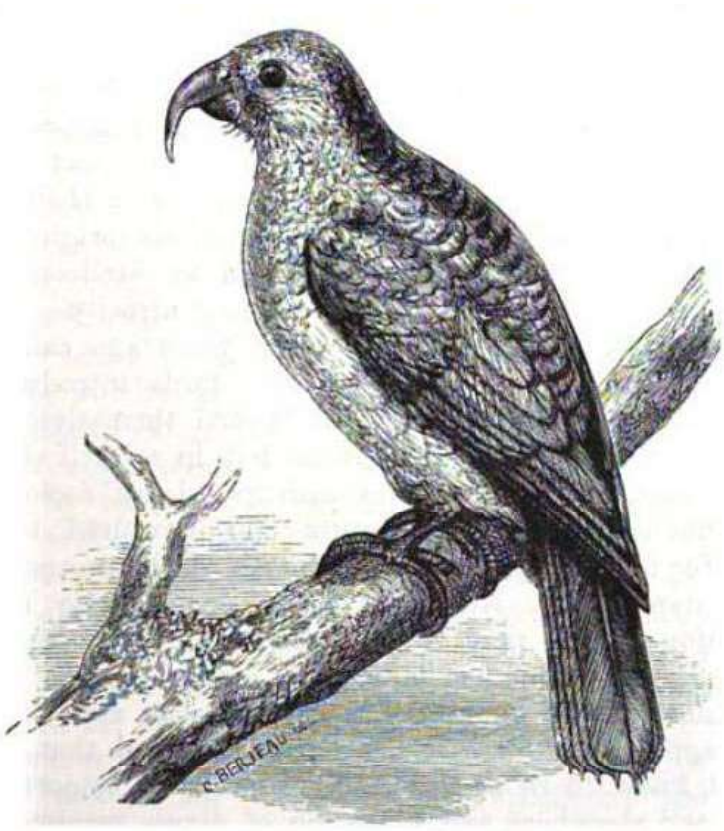
Little is known of the bird's biology. It was said to have lived both on the ground and in tall trees, feeding on flowering shrubs and trees. The call was described by Gould as "hoarse, quacking, inharmonious noise, sometimes resembling the barking of a dog".

Discovery

It was first described by the naturalist Johann Reinhold Forster and his son Georg following the discovery of Norfolk Island by James Cook on October 10, 1774. Unfortunately, the description was only published in 1844. Around 1790, John Hunter depicted a bird on a Kangaroo Apple (*Solanum aviculare*). The bird was formally described by John Gould in 1836, from a specimen at the Zoological Society of London. Originally, the individuals from Norfolk Island and Philip Island were considered two separate species, *Nestor norfolcensis* (described by August von Pelzeln in 1860) and *Nestor productus*, respectively, but direct comparison of specimens of both island showed that they were the same species.

Extinction

The Polynesians who lived at the Island for some time before the arrival of the Europeans hunted the Kākā for food before disapearing from the island around the 1600s. It was also hunted for food and trapped as a pet after the arrival of the first settlers in 1788. The species' population suffered heavily after a penal colony was maintained from 1788 to 1814 and again from 1825 to 1854. The species likely became extinct in the wild in the early nineteenth century sometime during the period of this second penal colony. It was not recorded by Ensign Abel D. W. Best on either Norfolk or Phillip Island in his 1838/1839 diary entires. As Best collected specimens for ornithology, including the Norfolk Island Parakeet (which he called "Lories", being similar in shape), it is hard to accept that he would not have documented this much more attractive quarry, had the Kākā still been present. The last bird in captivity died in London in 1851.



PHILLIP-ISLAND PARROT, *Nestor productus.*

Drawing from specimen in the British Museum

Skins

At least seven specimens survive in Melbourne, New York, Washington, D.C., Tring (2 skins?), Amsterdam (1 skin) and Leiden (2 skins). Forshaw has measurements of seven skins, one male, one female and 5 unsexed. In the older literature, several other musea are listed as having skins, including Birmingham (1 skin, purchased around 1899) and the Derby Museum, Liverpool (2 skins, one from Norfolk Island and one from Philip Island)

Naturalis in Leiden has 2 skins; one male (RMNH 110.061) and one female (RMNH 110.068). Both individuals originate from Philip Island. The male skin was acquired in 1863 long after the species' assumed disappearance, but it is unknown how it came to Leiden. It is more likely, given Phillip Island was already overrun with feral pigs, rabbits, goats and chicken in late 1838, that the 1863 specimen was purchased from another collection. The single unsexed individual from Philip Island at the Zoölogisch Museum Amsterdam (ZMA 3164) has been obtained before 1860 and originate probably from the same batch as the two specimens at Naturalis in Leiden. An old list of the specimens of birds present in the British Museum of Natural History list two individuals, both from Philip Island. One of the two specimens came from Mr. Bell's collection.

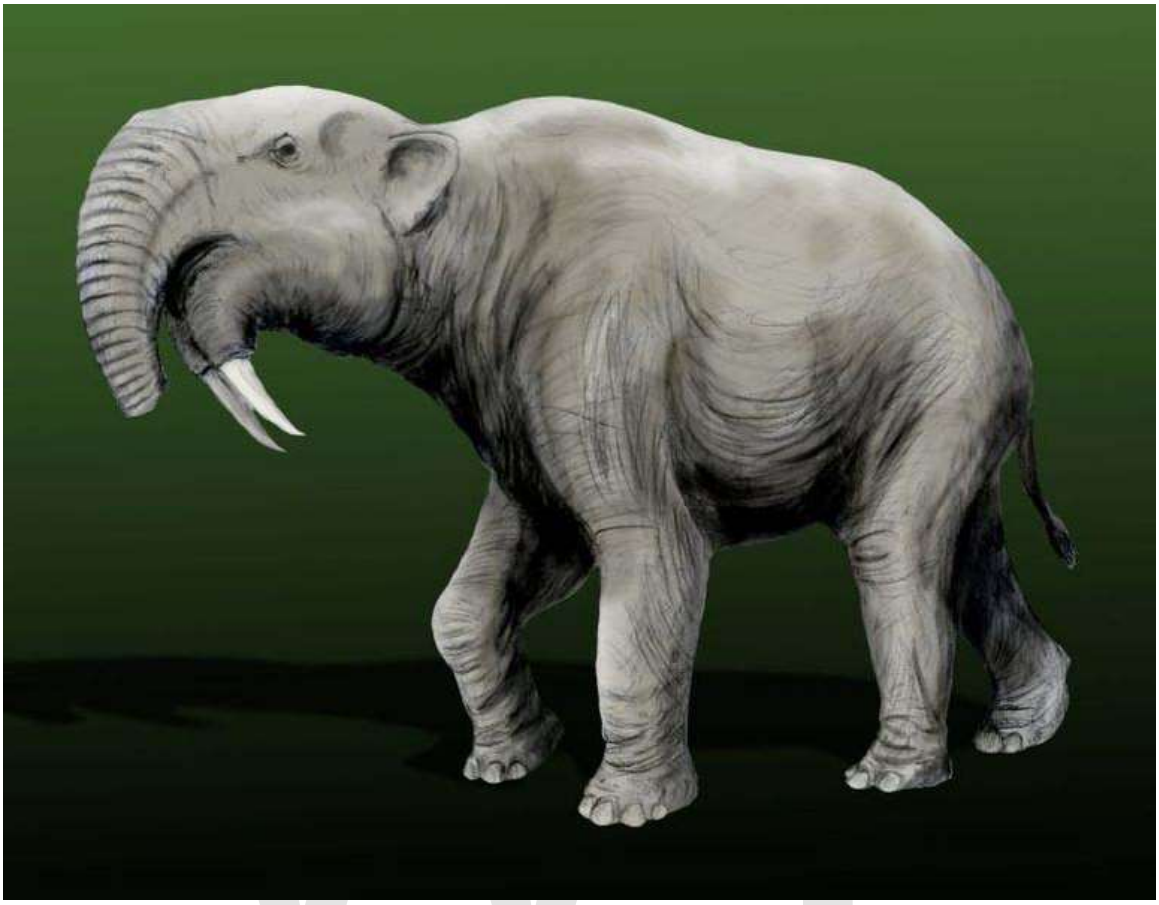
Chapter- 7

Deinotherium

Deinotherium ("terrible beast"), also called the **Hoe tusker**, was a gigantic prehistoric relative of modern-day elephants that appeared in the Middle Miocene and continued until the Early Pleistocene. During that time it changed very little. In life it probably resembled modern elephants, except that its trunk was shorter, and it had downward curving tusks attached to the lower jaw.

Deinotherium is the third largest land mammal known to have existed; only *Paraceratherium* and *Mammuthus sungari* were larger, although *Mammuthus imperator* may have rivaled it in size. Males were generally between 3.5 and 4.5 meters (12 and 15 feet) tall at the shoulders although large specimens may have been up to 5 m (16 ft). Their weight is estimated to have been between 5 and 10 tonnes (5.5 and 11 US Standard tons), with the largest males weighing in excess of 14 tonnes (15.4 US Standard tons). *Deinotherium's* range covered parts of Asia, Africa, and Europe. Adrienne Mayor, in *The First Fossil Hunters: Paleontology In Greek and Roman Times,* has suggested that deinothere fossils found in Greece helped generate myths of archaic giant beings. A tooth of a deinothere found on the island of Crete, in shallow marine sediments of the Miocene suggests that Crete was closer or connected to the mainland during the Messinian Salinity Crisis.

Evolutionary Relationships



Deinotherium giganteum

Deinotherium is the type genus of the family Deinotheriidae, evolving from the smaller, early Miocene *Prodeinotherium*. These proboscideans represent a totally distinct line of evolutionary descent to that of other elephants, one that probably diverged very early in the history of the group as a whole. The large group to which elephants belong formerly contained several other related groups: besides the deinotheres there were the gomphotheres (some of which had shovel-like lower front teeth), and the mastodons. Only elephants survive today.

Paleoecology

The way *Deinotherium* used its curious tusks has been much debated. It may have rooted in soil for underground plant parts like roots and tubers, pulled down branches to snap them and reach leaves, or stripped soft bark from tree trunks. *Deinotherium* fossils have been uncovered at several of the African sites where remains of prehistoric hominid relatives of modern humans have also been found.

Characteristics

Deinotherium skull from Oxford University Museum of Natural History

The following description is for *D. giganteus* but in general applies to the other two species as well.

Permanent tooth formula 0-0-2-3/1-0-2-3 (deciduous 0-0-3/1-0-3), with vertical cheek tooth replacement. Two sets of bilophodont and trilophodont teeth. Molars and rear premolars tapiroid, vertical shearing teeth, and show that deinotheres became an independent evolutionary branch very early on; other premolars used for crushing. The

cranium is short, low, and flattened on the top (in contrast to more advanced proboscids, which have a higher and more domed forehead; the implication may be that deinotheres were less intelligent than other proboscids), with very large, elevated occipital condyles. The nasal opening is retracted and large, indicating a large trunk. The rostrum is long and the rostral fossa broad. Mandibular symphyses (the lower jaw-bone) is very long and curved downward, which, with the backward curved tusks, is a distinguishing feature of the group; it possessed no upper tusks.

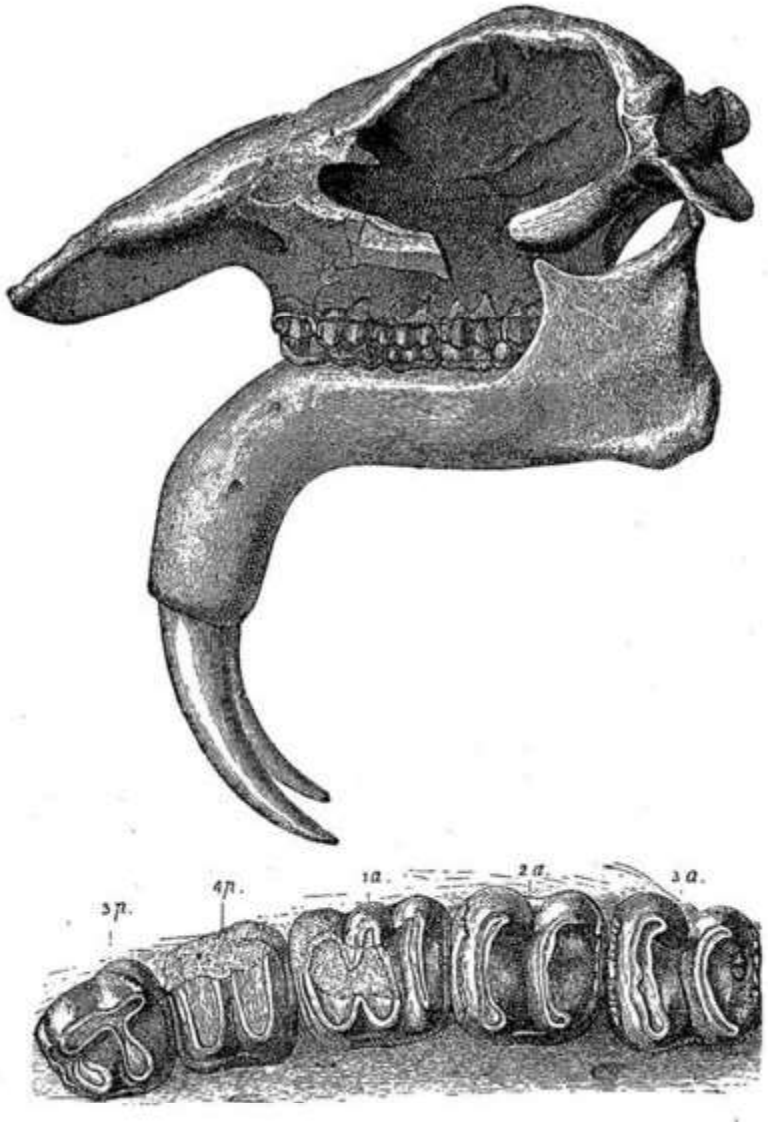
Mounted *Deinotherium* skelton

Deinotherium is distinguished from its predecessor *Prodeinotherium* by its much greater size, greater crown dimensions, and reduced development of posterior cingula ornamentation in the second and third molar.

Species

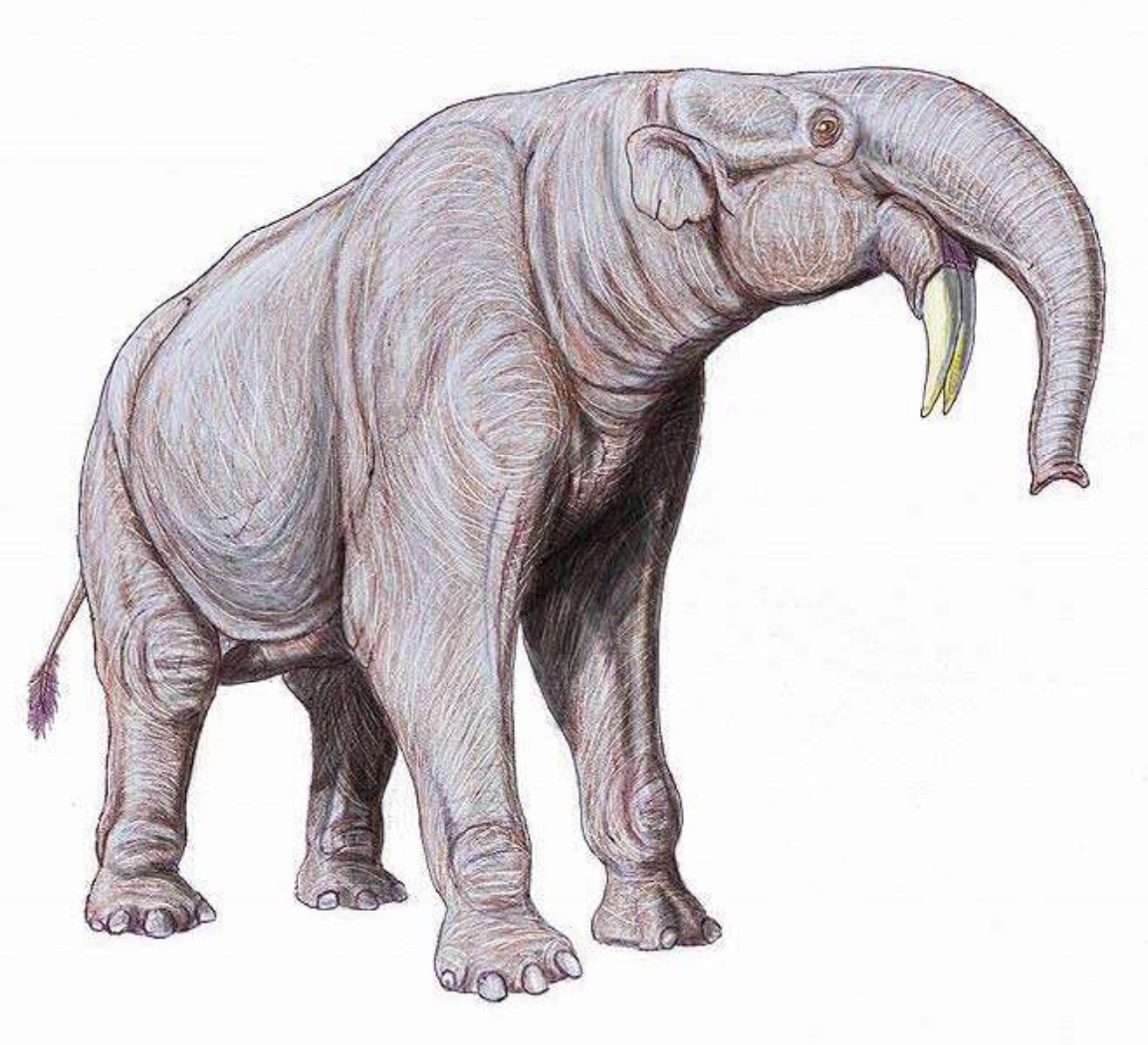
Three species are recognized, all of great size.

Deinotherium giganteum Kaup 1829



Head and teeth of *Deinotherium giganteum*

Deinotherium giganteum is the type species, and is described above. It is primarily a late Miocene species, most common in Europe, and is the only species known from the circum-Mediterranean. Its last reported occurrence is from the middle Pliocene of Romania (2 to 4 million BP). The "Grigore Antipa" museum of natural history in Bucharest, Romania, has the only complete skeleton of Deinotherium giganteum in the world. It was unearthed in 1894, in Vaslui county, by the Romanian paleontologist Gregoriu Stefanescu.



Deinotherium giganteum

An entire skull, found in the Lower Pliocene beds of Eppelsheim, Hesse-Darmstadt in 1836, measured 4 ft (1.2 m) in length and 3 ft (.9 meters) in breadth, indicating an animal exceeding modern elephants in size.

Deinotherium indicum Falconer 1945

Deinotherium indicum is the Asian species, known from India and Pakistan. It is distinguished by a more robust dentition and p4-m3 intravalley tubercles. *D. indicum* appears in the middle Miocene, and is most common in the late Miocene. It disappears from the fossil record about 7 million years BP (late Miocene).

Deinotherium bozasi Arambourg 1934

Deinotherium bozasi is the African species. It is characterized by a narrower rostral trough and smaller but higher nasal aperture, and a higher and narrower cranium, and

shorter mandibular symphysis, than the other two species. *D. bozasi* appears at the beginning of the late Miocene, and continues there after the other two species have died out elsewhere. The youngest fossils are from the Kanjera Formation, Kenya, about a million years old (early Pleistocene)

Chapter- 8

Dinofelis

Dinofelis ("terrible cat") is a genus of false sabre-toothed cats belonging to the tribe Metailurini. They were widespread in Europe, Asia, Africa and North America at least 5 million to about 1.2 million years ago (Early Pliocene to Early Pleistocene). Fossils very similar to *Dinofelis* from Lothagam range back to the Late Miocene, some 8 million years ago.

Description and ecology

In size they were between a modern leopard and a lion, most being about the size of a jaguar (70 cm tall and up to 120 kg), medium-sized but powerful cats that possessed two prominent sabre teeth. The front limbs were particularly robust compared to the modern cats (even the jaguar). This stout body may implicate a preference for dense or mixed habitats although it may also have been similar to the extant jaguar with its range from forest to open range including wetland.

Body mass

Two specimens were examined by Serge Legendre and Roth for body mass The first specimen was estimated to have a weight of 31.4 kg (69 lb). The second was estimated to have a weight of 87.8 kg (190 lb).

Dentition

The canine teeth of *Dinofelis* are longer and more flattened than those of modern cats but less so than those of true saber-tooths. *Dinofelis* and other Nimravids are generally referred to as "false saber-tooth" cats because of this. While the lower canines are robust, the cheek teeth are not nearly as robust as those of the lion and other modern big cats.

Fossils

Dinofelis fossils and bones have been found in South Africa along with those of the baboons that it possibly killed. Bones from several specimens of *Dinofelis* and baboons were found in a natural trap. *Dinofelis* may have entered the place to feed on trapped animals or may have simply wandered into a location and was not able to escape again.

Several fossils sites from South Africa seem to show that *Dinofelis* may have hunted and killed *Australopithecus afarensis* since they harbored fossilized remains of Dinofelis, hominids, and other large contemporary animals of the period. Also, since *Dinofelis* remains have been found near *Paranthropus* fossil skulls in South Africa, a few of which have peculiar twin holes in their crania matching the *Dinofelis* upper canines's spacing almost exactly, it is possible that *Dinofelis* was preying on robust hominids as well.

It is thought that the gradual disappearance of the forests in which *Dinofelis* hunted may have contributed to its extinction at the start of the ice age.

Diet

Dinofelis hunted animals including, mammoth calves, young and old mastodons, homo habilis (an ancestor of modern humans) and other animals.

Species

Other undescribed species may exist.

- *Dinofelis aronoki* (East Africa) - recently split from *D. barlowi*
- *Dinofelis barlowi* (South Africa)
- *Dinofelis cristata* (China) - includes *D. abeli*
- *Dinofelis darti* (South Africa)
- *Dinofelis diastemata* (Europe)
- *Dinofelis paleoonca* (North America)
- *Dinofelis petteri* (East Africa)
- *Dinofelis piveteaui* (South Africa)
- *Dinofelis* sp. "Langebaanweg"
- *Dinofelis* sp. "Lothagam"

Description of Some Above Species: -

Dinofelis aronoki

Dinofelis aronoki is a member of a Machairodontinae family the true sabre tooths. it lived in Villafranchian and Biharian stage in Kenya and Ethiopia.

Dinofelis barlowi

Dinofelis Barlowi "Barlow's terrible cat" is a probably the smallest subspecies of Dinofelis. It lived during the late Pleistocene in South Africa. It was 70 cm high and 1 m long. like all dinofelis species it belongs to family Machairodontinae "true sabre tooths", tribe Metailurini.

Dinofelis cristata

Dinofelis is an extinct prehistoric saber-toothed cat belonging to the family Felidae endemic to Southern Europe, Africa, and Southwest Asia from the Pliocene to Pleistocene living from 5.3 Ma—11,000 years ago and existed for approximately 5.289 million years. .

Dinofelis darti

Dinofelis darti is a subspecies of dinofelis, a genus of saber-toothed cats, which lived in South Africa during the Villafranchian stage (3.6–1.2 Ma BP) .

Dinofelis paleoonca

Dinofelis paleoonca ("terrible cat") is a genus of saber-toothed cats belonging to the tribe Metailurini of the family *Felidae* endemic to North America during the Pliocene living from 4.9—1.8 mya, existing for approximately 3.1 million years.

Taxonomy

Dinofelis paleoonca was named by Meade (1945) . Its type locality is Meade's Quarry 11, which is in a Blancan terrestrial horizon in the Blanco Formation of Texas. It was recombined as Dinofelis palaeoonca by Kurten (1972), Hemmer (1973), Dalquest (1975), Kurten and Anderson (1980), Schultz (1990) and Werdelin and Lewis (2001).

Morphology

Body mass

Two specimens were examined by Legendre and Roth for body mass The first specimen was estimated to have a weight of 31.4 kg (69 lb). The second was estimated to have a weight of 87.8 kg (190 lb).

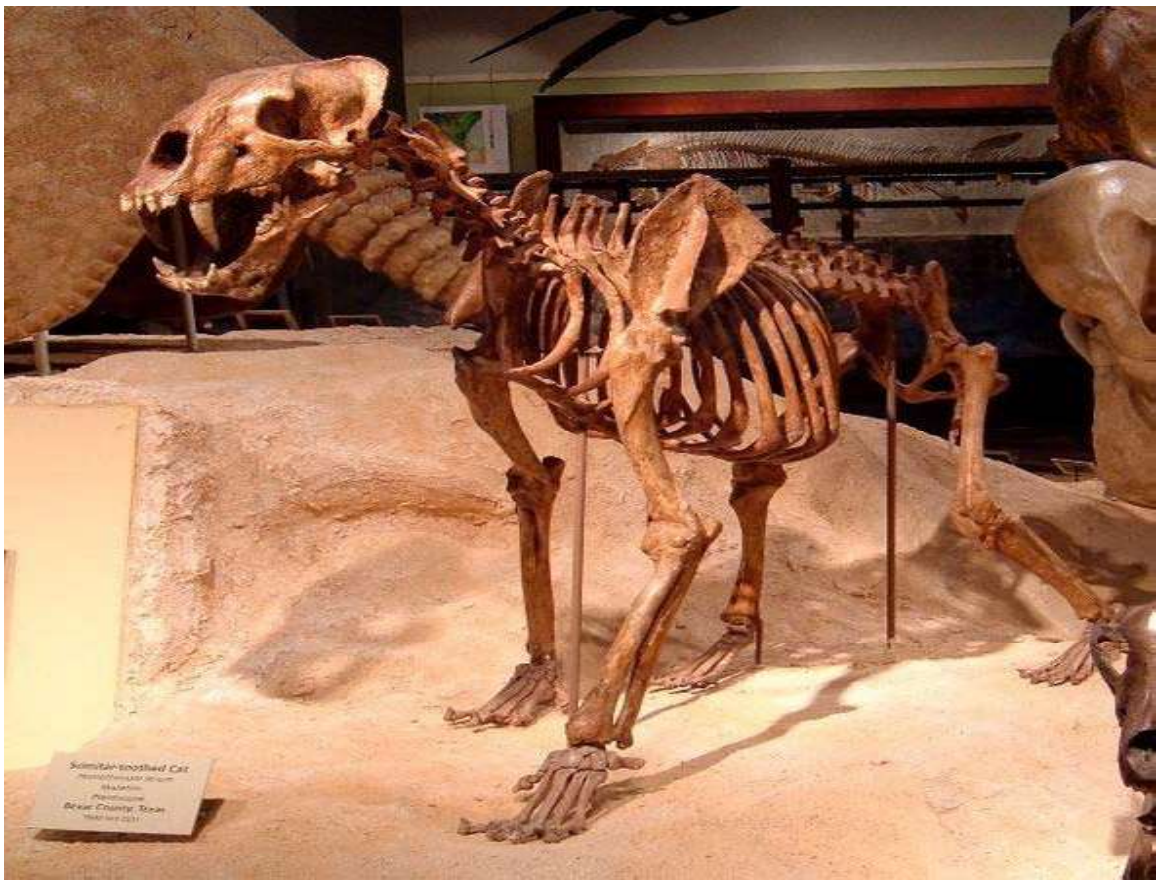
Fossil distribution

Three specimens were found in Texas and Washington.

Chapter- 9

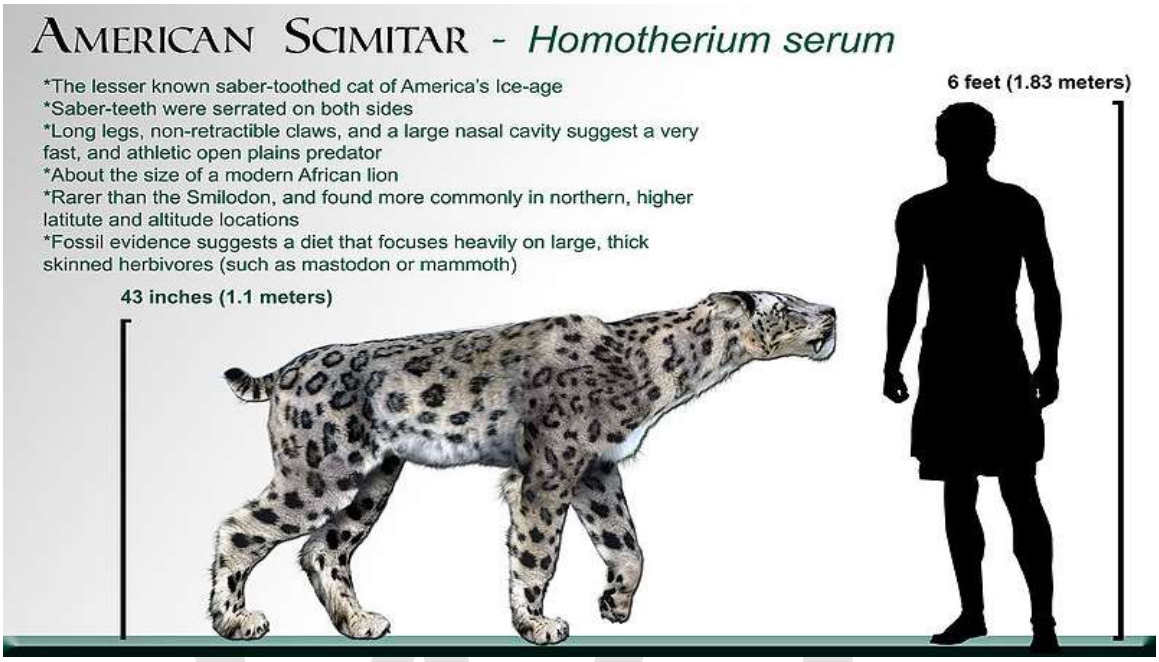
Homotherium

Homotherium is an extinct genus of machairodontine saber-toothed cats, often termed **scimitar cats**, endemic to North America, Europe, Asia, and Africa during the Pliocene and Pleistocene epochs (5 mya–10 000 years ago), existing for approximately 5 million years.



It first became extinct in Africa some 1.5 million years ago. In Eurasia it survived until about 30 000 years ago. The last scimitar cat could have survived in North America until 10 000 years ago.

Anatomy



Homotherium serum life-restoration.

Homotherium serum. a rare felid.

Homotherium reached 1.1 m at the shoulder and was therefore about the size of a lioness, weighing an estimated 190 kg. Compared to some other machairodonts, like *Smilodon* or *Megantereon*, *Homotherium* had relatively shorter upper canines, but they were flat, serrated and longer than those of any living cat. Incisors and lower canines formed a powerful puncturing and gripping device. Among living cats, only the tiger (*Panthera tigris*) has such large incisors, which aid in lifting and carrying prey. The molars of Homotherium were rather weak and not adapted for bone crushing. The skull was longer than in *Smilodon* and had a well-developed crest, where muscles were attached to power the lower jaw. This jaw had down-turned forward flanges to protect the scimitars. Its large canine teeth were crenulated and designed for slashing rather than purely stabbing.

It had the general appearance of a cat, but some of its physical characteristics are rather unusual for a large cat. The limb proportions of *Homotherium* gave it a hyena-like appearance. The forelegs were elongated, while the hind quarters were rather squat with feet perhaps partially plantigrade, causing the back to slope towards the short tail. Features of the hindlimbs indicate that this cat was moderately capable of leaping. The pelvic region, including the sacral vertebrae, were bear-like, as was the short tail composed of 13 vertebrae—about half the number in long-tailed cats.

The unusually large, square nasal opening, like that of the cheetah (*Acinonyx jubatus*), presumably allowed quicker oxygen intake, which aided in rapid running and in cooling the brain. As in the cheetah, too, the brain's visual cortex was large and complex, emphasizing the scimitar cat's ability to see well and function in the day, rather than the night, as in most cats.

Range and species

Homotherium crenatidens skull on display at the Paleozoological Museum of China

Homotherium probably derived from *Machairodus* and appeared for the first time at the Miocene-Pliocene border, about 5 million years ago. During the Pleistocene it occurred in vast parts of Eurasia, North America and until the middle Pleistocene (about 1.5 million years ago) even in Africa. A fossil of *H. crenatidens* was inadvertently dredged from the bed of the North Sea, which was a flat, low-lying extent of marshy tundra laced with rivers during the recent glaciation. There has also been a discovery of 1.8 million-year-old fossils in Venezuela, indicating that scimitar cats were able to invade South America along with *Smilodon* during the Great American Interchange. How long they lasted in South America is not yet evident. *Homotherium* survived in Eurasia and North America until about 30 000 and 10 000 years ago, respectively.

Several species (*H. nestianus*, *sainzelli*, *crenatidens*, *nihowanensis*, *ultimum*) are recognized from Eurasia, which differ mainly in the shape of the canines and in body size. But given the fluctuation range of the size of modern large cats, it is highly probable that all belong to just one species, *Homotherium latidens*.

Two species described form the early Pleistocene of Africa are *Homotherium ethiopicum* and *Homotherium hadarensis*. But they also hardly differ from the Eurasian forms. On the African continent the genus disappeared about 1.5 million years ago. In North America, a very similar species, *Homotherium serum* occurred from the latest Pliocene until the latest Pleistocene. Remains have been found at various sites between Alaska and Texas. In the southern parts of its range the American *Homotherium* co-existed with *Smilodon*; in the northern parts it was the only species of saber-toothed cat. The American *Homotherium* was originally described by the name *Dinobastis*.

Despite *Homotherium'*s vast range and the large amount of fossil remains from Eurasia, Africa and North America, complete skeletons of this cat are relatively rare. One of the most famous sites of *Homotherium* remains is Friesenhahn cave in Texas, where 30 *Homotherium* skeletons were found, along with hundreds of juvenile mammoths and several dire wolves.

Diet and habitat

Skull of *Homotherium serum* from Friesenhahn cave, Texas Memorial Museum, UT Austin, Austin, Texas

Friesenhahn cave in Texas contained the remains of over 30 *H. serum* individuals, which were discovered along with the remains of between 300 and 400 juvenile Columbian Mammoths (*Mammuthus columbii*). Besides mammoth, very few other potential prey species were found in the cave - it is therefore unlikely that *Homotherium* carried scavenged carcasses of already dead animals to the cave. Such specialization on prey of a particular species and age structure is not covenant with a scavenging lifestyle. For the same reason it is also unlikely that the dire wolves carried the mammoths into the cave.

Homotherium crenatidens skull

The worldwide association of *Homotherium* species with proboscidean (elephant and mastodon) and Rhinoceros remains, mainly those of juveniles, suggests that *Homotherium* preyed selectively on these tough-skinned animals and probably hunted in packs, carrying away the large animals it brought down. The decline of *Homotherium* could be due to the disappearance of large herbivorous mammals like mammoths in America at the end of the Pleistocene. In North America fossil remains of *Homotherium* are less abundant than those of its contemporary *Smilodon*. For the most part it probably inhabited higher latitudes and altitudes, and therefore was likely to be well adapted to the colder conditions of the mammoth steppe environment.

The suggested large prey species make it probable that *Homotherium* hunted in packs. Reduced claws, relatively slender limbs and the sloping back indicate adaptations for endurance running in open habitats.

Chapter- 10

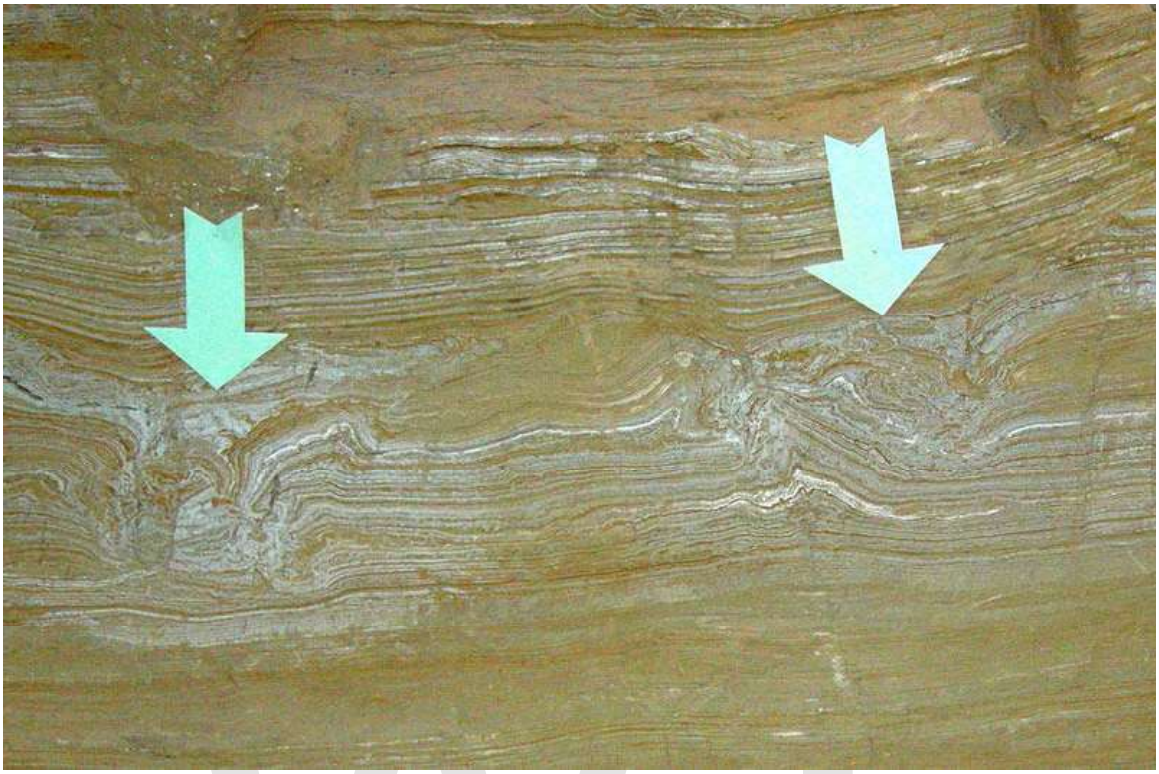
Mammoth

A **mammoth** is any species of the extinct genus ***Mammuthus***. These proboscideans are members of Elephantidae, the family of elephants and mammoths, and close relatives of modern elephants. They were often equipped with long curved tusks and, in northern species, a covering of long hair. They lived from the Pliocene epoch from around 4.8 million to 4,500 years ago. The word *mammoth* comes from the Russian мамонт *mamont*, probably in turn from the Vogul (Mansi) language, *mang ont*, meaning "earth horn".

Size

Like their modern relative the elephant (Asian or African), mammoths were quite large; in English the noun "mammoth" has become an adjective meaning "large" or "massive". The largest known species, Songhua River mammoth (*Mammuthus sungari*) , reached heights of at least 5 metres (16 feet) at the shoulder. Mammoths would probably normally weigh in the region of 6 to 8 tons, but exceptionally large males may have exceeded 12 tons. However, most species of mammoth were only about as large as a modern Asian elephant. Fossils of species of dwarf mammoth have been found on the Californian Channel Islands (*Mammuthus exilis*) and the Mediterranean island of Sardinia (*Mammuthus lamarmorae*). There was also a race of dwarf woolly mammoths on Wrangel Island, north of Siberia, within the Arctic Circle.

A full size reconstruction of a mammoth species, the woolly mammoth, at Ipswich Museum, Ipswich, Suffolk



Cross-section of mammoth footprints (a type of trace fossil) at the Hot Springs Mammoth Site in South Dakota

An 11-foot (3.4 m) long mammoth tusk was discovered north of Lincoln, Illinois in 2005.

Based on studies of their close relatives the modern elephants, mammoths probably had a gestation period of 22 months, resulting in a single calf being born. Their social structure was probably the same as that of African and Asian elephants, with females living in herds headed by a matriarch, whilst bulls lived solitary lives or formed loose groups after sexual maturity.

Well-preserved specimens and prospects of cloning

In May 2007, the carcass of a one-month-old female woolly mammoth calf was discovered in a layer of permafrost near the Yuribei River in Russia, where it had been buried for 37,000 years. Alexei Tikhonov, the Russian Academy of Science's Zoological Institute's deputy director, has dismissed the prospect of cloning the animal, as the whole cells required for cloning would have burst under the freezing conditions. Nonetheless, DNA is expected to be well-enough preserved to be useful for research on mammoth phylogeny and perhaps physiology. However, Dr Sayaka Wakayama from the RIKEN Center for Developmental Biology in Kobe, Japan, believes that a technique she has used to clone mice from specimens frozen for sixteen years could be used successfully on recovered mammoth tissue: she cites that in her experiments the dead mice had been

frozen to -20°C under simulated natural conditions, without using the usual preservative chemicals.

Researchers at Penn State University have sequenced about 85% of the gene map of the woolly mammoth, using DNA taken from hair samples collected from a selection of specimens, advancing the possibility of bringing the woolly mammoth back to life by inserting mammoth DNA sequences into the genome of the modern-day elephant, transferring it into an egg cell and, in turn, into the uterus of an elephant as a variant of interspecific pregnancy. Although the samples were washed with bleach to remove possible contamination by bacteria or fungi, some DNA bases identified may be from the contaminating organisms and these have yet to be distinguished. To this end, scientists at the Broad Institute are currently generating a comparison with the genome of the African elephant. The information cannot be used to synthesize mammoth DNA, but Dr Stephan Schuster, leader of the project, notes that the mammoth's genes differ at only some 400,000 sites from the genome of the African elephant and it would be possible (though not with presently available technology) to modify an elephant cell at these sites to make it resemble one bearing a mammoth's genome, and implant it into a surrogate elephant mother.

There is an estimate of 150 million mammoth remains in Russia's Siberian permafrost, which covers a vast sparsely inhabited area. Some of the remains are frozen complete, others in pieces of bone, tusk, tissue and wool, from less than a metre (3.3 ft) to 1 km (3300 ft) below ground.

Extinction

Mammuthus armeniacus skull

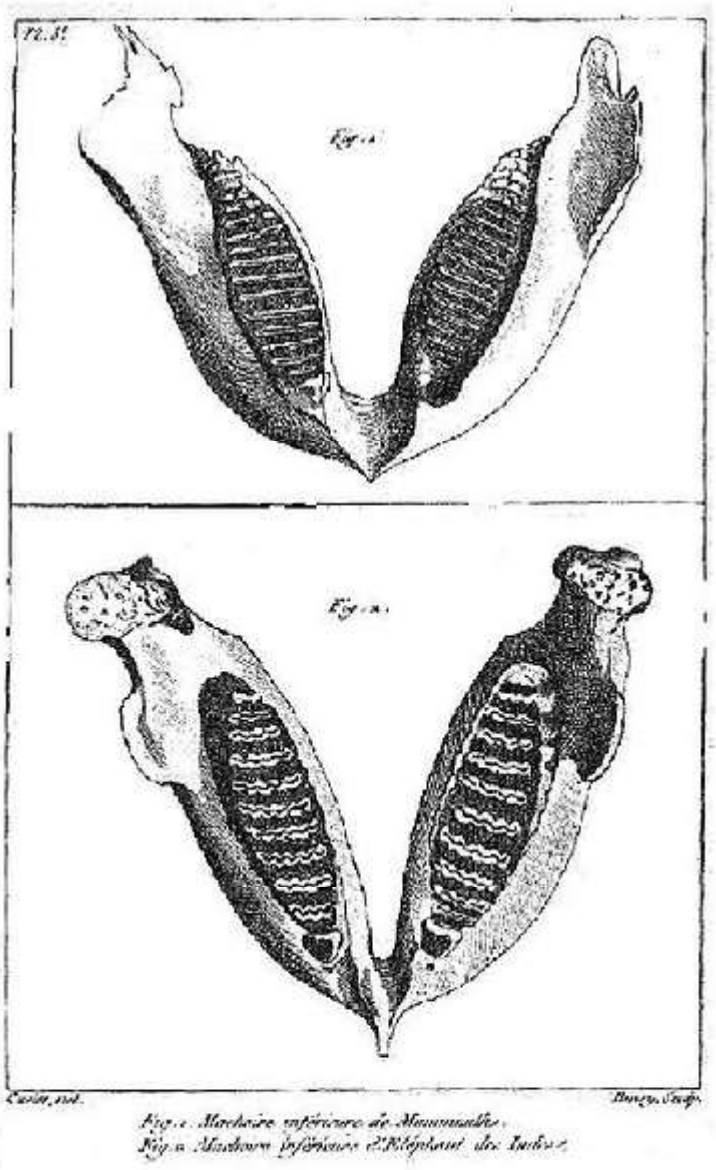
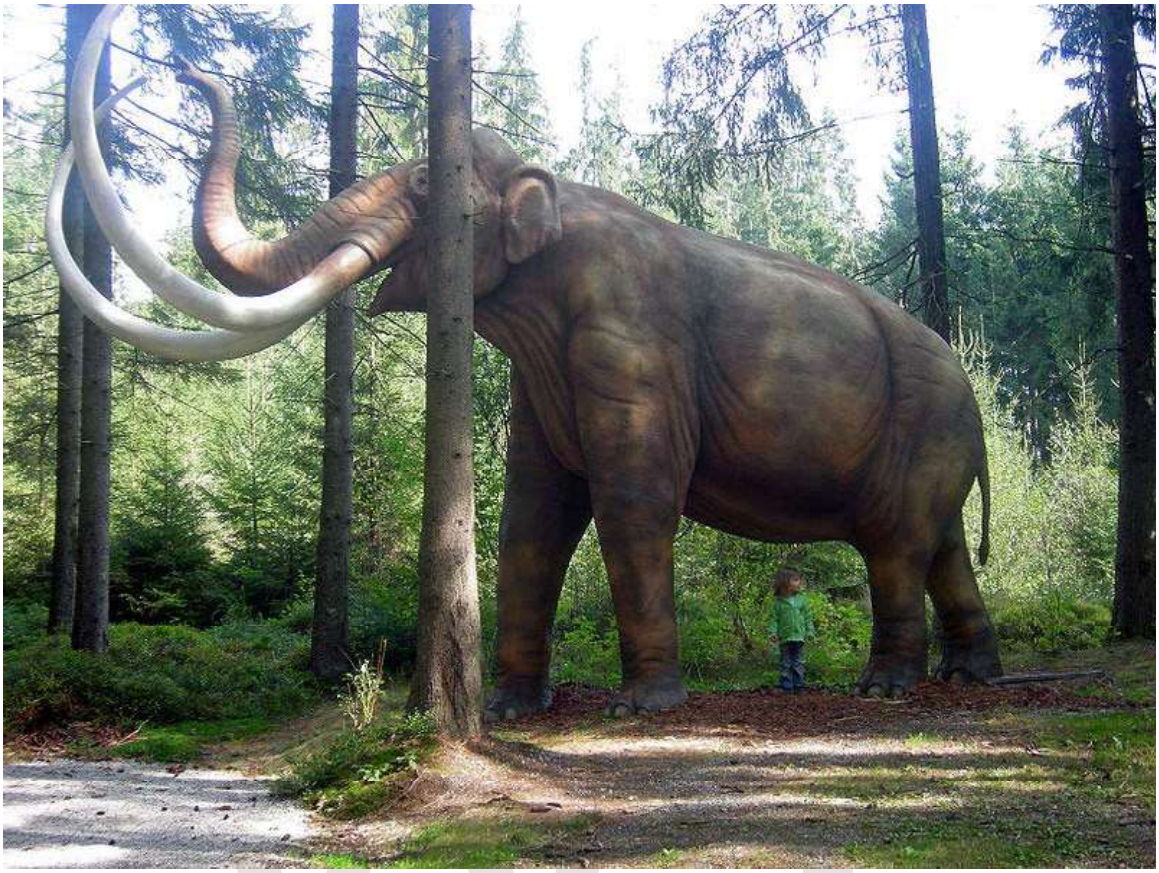


Illustration of an Indian elephant jaw and a mammoth jaw from Georges Cuvier's 1796 paper on living and fossil elephants.



Full size life reconstruction of a mammoth (*Mammuthus trogontherii*).

The woolly mammoth was the last species of the genus. Most populations of the woolly mammoth in North America and Eurasia, as well all the Columbian mammoths in North America, died out around the time of the last glacial retreat, as part of a mass extinction of megafauna in northern Eurasia and the Americas. Until recently, it was generally assumed that the last woolly mammoths vanished from Europe and southern Siberia about 10,000 BC, but new findings show that some were still present there about 8000 BC. Only slightly later, the woolly mammoths also disappeared from continental northern Siberia. A small population survived on St. Paul Island, Alaska, up until 3,750 BC, and the small mammoths of Wrangel Island survived until 1,650 BC.

A definitive explanation for their mass extinction is yet to be agreed upon. The warming trend (Holocene) that occurred 12,000 years ago, accompanied by a glacial retreat and rising sea levels, has been suggested as a contributing factor. Forests replaced open woodlands and grasslands across the continent. The available habitat may have been reduced for some megafaunal species, such as the mammoth. However, such climate changes were nothing new; numerous very similar warming episodes had occurred previously within the ice age of the last several million years without producing comparable megafaunal extinctions, so climate alone is unlikely to have played a decisive role. The spread of advanced human hunters through northern Eurasia and the Americas

around the time of the extinctions *was* a new development, and thus probably contributed significantly.

Whether the general mammoth population died out for climatic reasons or due to overhunting by humans is controversial. Another theory suggests that mammoths may have fallen victim to an infectious disease. A combination of climate change and hunting by humans has been suggested as the most likely explanation for their extinction.

Data derived from studies done on living elephants suggest human hunting was likely a strong contributing factor in the mammoth's final extinction . *Homo erectus* is known to have consumed mammoth meat as early as 1.8 million years ago.

However, the American Institute of Biological Sciences also notes bones of dead elephants, left on the ground and subsequently trampled by other elephants, tend to bear marks resembling butchery marks, which have previously been misinterpreted as such by archaeologists .

The survival of the dwarf mammoths on Russia's Wrangel Island was due to the island's very remote location and lack of inhabitants in the early Holocene period . The European discovery of the island (by American whalers) did not occur until the 1820s . A similar dwarfing occurred with the pygmy mammoth on the outer Channel Islands of California, but at an earlier period. Those animals were very likely killed by early Paleo-Native Americans, and habitat loss caused by a rising sea level that split Santa Rosae into the outer Channel Islands .

Recent research indicates that mammoths survived on the American mainland until 10,000 years ago. This conclusion is from research, by James Haile and Eske Willerslev of the University of Copenhagen, of sediments found in central Alaska, and reported in the Proceedings of the National Academy of Sciences.

Chapter- 11

Megantereon

Megantereon was an ancient machairodontine saber-toothed cat that lived in North America, Eurasia, and Africa. It may be the ancestor of *Smilodon*.

Fossil range

Fossil fragments have been found in Africa, Eurasia, and North America. *Megantereon* seems to have first appeared in the early Late Miocene roughly 11.61—5.33 million years ago with fossil evidence of *M. praecox* recovered in Punjab, Pakistan. In North America,

the oldest specimen was *M. hesperus* unearthed in Polk County, Florida, USA dating to 7.9—-7.8 Ma (AEO).

About 3-3.5 Million years ago it is firmly recorded also from Africa and Eurasia. At the end of the Pliocene it evolved into the larger *Smilodon* in North America, while it survived in the Old World until the middle Pleistocene. The youngest remains from east Africa are about 1.5 million years old. In southern Africa the genus is recorded from Elandsfontein, a site dated to around 700,000-400,000 years old. Remains from Untermaßfeld show that *Megantereon* lived until 900,000 years ago in Europe. In Asia it may have survived until 500,000 years ago, as it is recorded together with *Homo erectus* at the famous site of Zho-Khou-Dien in China. The only full skeleton was found in Senéze, France.

Morphology

Megantereon was built like a modern jaguar or somewhat heavier. It had stocky forelimbs with the lower half of these forelimbs lion-sized. It had large neck muscles designed to deliver a powerful bite. The elongated upper canines were protected by flanges at the mandible. Mauricio Anton's reconstruction in *The big cats and their fossil relatives* depicts the full specimen found at Seneze in France as 72 centimetres (28 in) at the shoulder. The largest specimens with an estimated body weight of 90–150 kilograms (200–330 lb) (average 120 kilograms (260 lb)) are known from India. Medium sized species of *Megantereon* are known from other parts of Eurasia and the Pliocene of North America. The smallest species from Africa and the lower Pleistocene of Europe have been estimated to only 60–70 kilograms (130–150 lb). However, other sources estimated *Megantereon* from the European lower Pleistocene at 100–160 kilograms (220–350 lb).

Hunting technique

It is unlikely that *Megantereon* simply bit its prey as the long, sabre-teeth that *Smilodon* is famed for are not strong enough to leave buried inside a struggling prey animal: the teeth would break off. It is possible that they bit their prey and then allowed it to bleed to death, but then they would have to protect that animal from other predators and thus their tactic for killing remains uncertain. It is now generally thought that *Megantereon*, like other saber-toothed cats, used its long saber teeth to deliver a killing throat bite, severing most of the major nerves and blood vessels. While the teeth would still risk damage, the prey animal would be killed quickly enough that any struggles would be feeble at best.

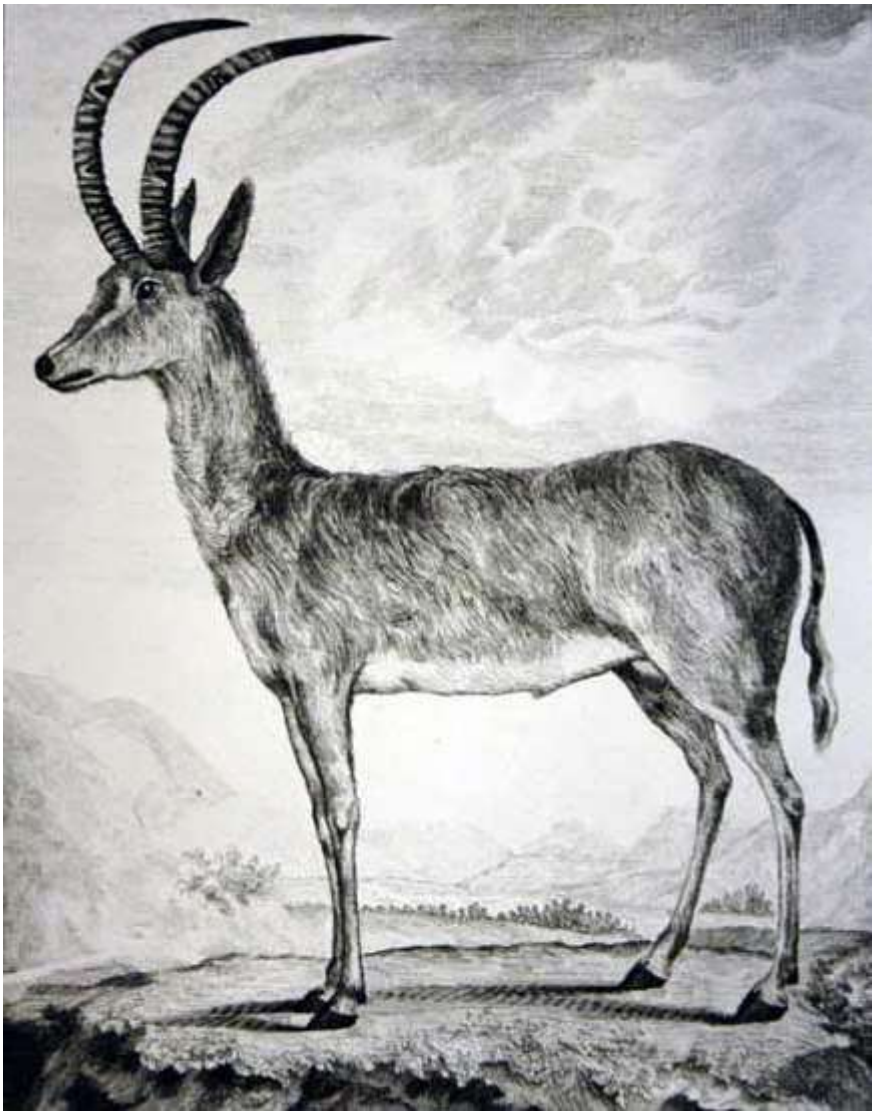
Species

The number of species is unclear, with some known from only fragmentary evidence. Some researchers have argued that three species should be distinguished: *M. cultridens* from North America, Asia (except the Indian subcontinent) and the European Pliocene, *M. whitei* from Africa and the European Lower Pleistocene and *M. falconeri* from India. Therefore, the true number of species may be less than the full list of described species reproduced below.

- *Megantereon nihowanensis* - probably a junior synonym of *M cultridens*
- *Megantereon cultridens*
- *Megantereon whitei*
- *Megantereon gracile*
- *Megantereon eurynodon*
- *Megantereon megantereon*
- *Megantereon vakhshensis*
- *Megantereon ekidoit*
- *Megantereon falconeri*
- *Megantereon hesperus*
- *Megantereon spiryleris*

Chapter- 12

Bluebuck



The **Bluebuck** or **Blue Antelope** (*Hippotragus leucophaeus*), sometimes called **Blaubok**, is an extinct species of antelope, the first large African mammal to disappear in historic

times. It is related to the Roan Antelope and Sable Antelope, but slightly smaller than either. It lived in the southwestern coastal region of South Africa savannahs, but was more widespread during the last glacial. It was probably a selective feeder, preferring high-quality grasses.

Europeans encountered the Bluebuck in the 17th century, but it was already uncommon by then. European settlers hunted it avidly, despite its flesh being distasteful, while converting its habitat to agriculture. The Bluebuck became extinct around 1800. There are only four mounted specimens – in museums in Vienna, Stockholm, Paris, and Leiden – along with some bones and horns elsewhere. None of the museum specimens show a blue colour, which may have derived from a mixture of black and yellow hairs.

Characteristics

Illustration of a Bluebuck and a Klipspringer from 1851.

Total length: 250–300 cm (8.2–9.8 ft) (bull); 230–280 cm (7.5–9.2 ft) (cow)

Shoulder height: 100–120 cm (3.3–3.9 ft)

Skull length: 396 mm (15.6 in)

Horn length: 50–61 cm (20–24 in)

Body mass: 160 kg (350 lb)

Eighteenth century travellers provided contradictory descriptions of this species, perhaps because some were embellishing, while others had not actually seen it and were simply repeating hearsay - Peter Kolb in 1719 incorrectly described it as having a long goat-like beard and tail, straight horns like an oryx, and short ears . They did send some skulls and skins back to Europe. In 1967, Erna Mohr reported that the four existing mounted blue antelopes vary from 102 to 116 cm (3.35 to 3.81 ft) at the shoulder. Adult Bluebuck probably rarely exceeded 160 kg (350 lb). None of the four museum specimens show any sheen of blue. The dark skin showing through the thinning fur of older animals may have caused the blue colours described by several authors or the mix of black and yellow hairs.

Like most antelopes, the Bluebuck had six teeth along the cheek in each half of the upper and lower jaws. These formed two distinct series three premolars immediately followed by three molars. Its remains can be distinguished from those of the roan by smaller molars and premolars, and from the sable by larger premolars, and a higher ratio of premolar row length to molar row length.

The Bluebuck was a large, horse-like antelope, as heavy as a Javan or English horse, but smaller than the roan or sable. The proportions of its body were similar to that of the southern reedbuck .

It had a relatively long, strong neck with a very short, underdeveloped mane , long white legs with dark bands on the anterior, and a long tail, up to the hock, with a dark, horse-like whisk. It had a long muzzle. Its ears were long and donkey-like, rufous and narrow-pointed, without the black tufts of hair found in the roan.

The long, scimitar-shaped horns inserted directly above the orbits, extending upwards at almost right angles to the skull , and then curving back gently, without any torsion, towards the shoulders . These horns were heavily ridged, with 20-35 rings up to the tip of the horn, comparable to the roan (20-50 rings). Its horns were however more lightly built than those of the roan and sable, and slightly transversely compressed to the inside. The back-curved horns reminded Jan van Riebeeck of the European ibex, and he called it the 'steinbok'. It remains uncertain how long this name was used, or when it was changed to 'blaauwbok' or Bluebuck.

Its hair was short and glossy, and of a delicate light blue to grey - which quickly faded to a bluish grey after death. Its belly was pale white, and didn't actually contrast with the colour of the flanks. Its forehead and the upper muzzle was brown, becoming lighter towards the cheeks and upper lips. It had distinct white patches in front of the eyes not reaching the white muzzle.

The bulls resembled the cows up to the age of three years, after which they became paler (almost white) and developed large, more curved horns; the horns of the cows where more or less of the same length, although thinner and 10-20% smaller. The calves younger than 2 months were light tan, with no or very indistinct markings.

Range

When the Europeans settled in the Cape Colony in the 17th and 18th century, they found the Bluebuck on the coastal plains of the southwestern Cape Province , east of the Hottentots Holland mountains. It was never very common, and was probably restricted to a grassland area of less than 4 000 km^2 in the triangle formed by the towns of Caledon, Swellendam and Bredasdorp, South Africa. Lieutenant W.J. St. John also recorded 'roans' of a bluish grey colour at Liebenbergsvlei (28º15’S, 28º29’E) near Bethlehem in the Free State Province on 28–29 July 1853, and it is now thought that he actually saw the last remnants of a relict population of Bluebuck.

From archaeological and palaeontological evidence it is known that the Bluebuck had a wider distribution, and was more common, during the early Holocene Epoch 10,000 years ago. At one time it could be found on the coastal plain of the Cape Province from Elands Bay in the northwest to Uniondale in the east. Researchers of the National Museum in Bloemfontein have found San (Bushman) rock paintings near Ficksburg and Golden Gate Highlands National Park , while Pleistocene deposits (100 000 to 10 000 years ago) confirm its existence at Rose Cottage cave near Ladybrand .

Habitat

The early travellers found the Bluebuck only in rolling grassland with extensive marshes and open areas with medium to long (0,5-1,5 m), perennial tuft grass and little hillside shrub. It was also at home at higher elevations, up to 2 400 m above sea-level. It was susceptible to droughts, and water was a necessary habitat requirement.

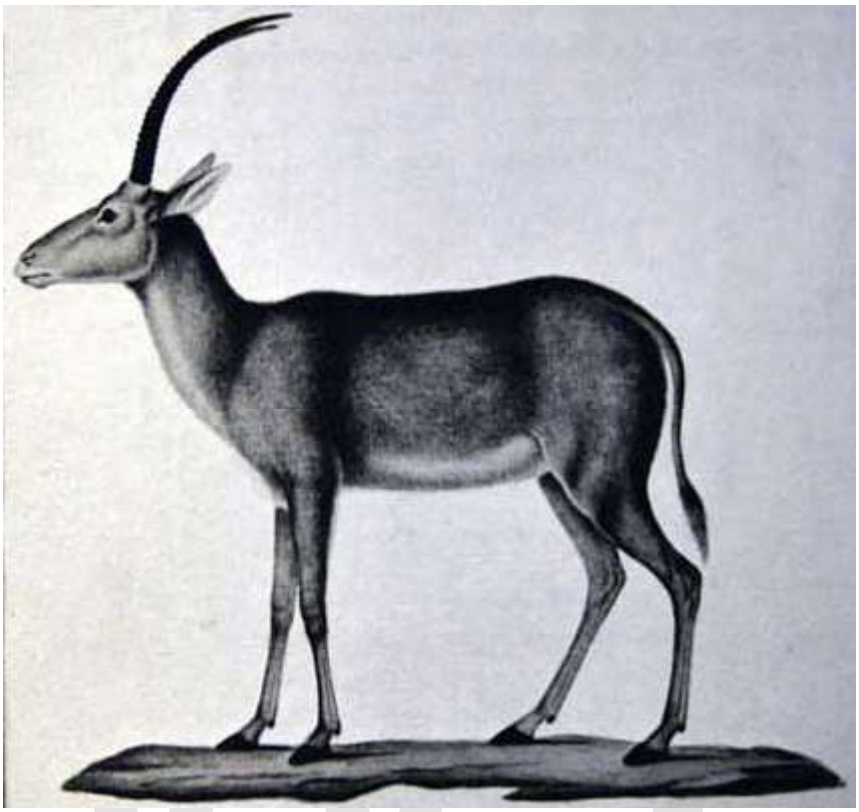
They avoided areas with short grass and woodland where trees formed a thick canopy or thickets. Habitat change, due to overgrazing of grassland by other species, like sheep, thus threatened this species.

Food

Like the roan and sable, it had to drink daily. Many other antelopes can obtain the moisture they need from the plants they eat and they can go for long periods without drinking.

The Bluebuck was a selective grazer of medium to long (0.5-1.5 m), perennial tuft grasses, like high-quality red grass (*Themeda triandra*), spear grass (*Heteropogon contortus*), buffalo grass (*Panicum* spp.) and love grass (*Eragrostis* spp.). Unlike most other antelope, it was not particularly attracted to fresh grass, except during the dry season, when it would graze for short periods along drainage-lines and on floodplains on the fresh growth following the yearly fires. However, like most grazers, it would probably browse during the dry season.

Behavior



Drawing from 1781, by Le Vaillant

Most of its activities took place during the day, especially early in the morning and late in the afternoon.

Bluebucks followed the conventional territorial system among the Hippotragini or 'horse antelopes': territorial bulls, herds of cows and calves, and bachelor herds which were kept segregate by the territorial bulls.

Bluebuck cows and calves lived in small to medium-sized herds of 5 to 20 individuals, although herds of 35 to 80 was not unusual. They normally occurred at a low density of about 4/km^2. Cows shared a traditional home range, which included the territories of several bulls and occupied it for up to 30 years. At very low densities in substandard habitat the cows ranged across larger areas, and were accompanied by the same bull, which in the absence of resistance by territorial neighbours, defended a movable space around his own private harem.

Because they were equipped with long, dangerous horns, cows tended to be more aggressive than those antelope whose females are hornless. Dominance hierarchies based on age and individual prowess were vigorously maintained by both sexes. Maternal herds, composed of animals that shared the same home range, were closed to outsiders.

Herd members kept out of range of each other's horns, by increasing the individual space between them.

Herd composition changed daily and seasonally; members split into small groups during the rainy season, and concentrated into larger groups on the best available grazing near water during the dry season. The most cohesive groups were maintained by calves of different ages, which clustered around the youngest calf and usually lagged behind the herd.

Bulls were accepted in the natal herd up to the age of 15–18 months, which was unusually long. Until then, their similarity to cows suppressed the aggression of the territorial bulls. Subadult bulls were driven from the herd, and if these juveniles didn't escape quickly enough, they were killed. They then joined bachelor herds, where they stayed until they reached five or six years of age, when they would be strong enough to defend their own territory.

The adult bull would advertise his presence and high social status by standing or lying alone or away from the herd, at a conspicuous place. The bull stood in an erect manner, which was a sign of high status, and it was self-advertising if it was not directed. When another bull approached his herd, the dominant bull would stand with his neck arched, head high, and ears turned sideways. Unless the intruder showed submission by lowering his head, the bull kept his ears erect, and waved his tail or tucked it between his legs, and a clash of horns and head-butting would take place. Its sound was a blowing snort.

Reproduction

One calf, with a birth mass of 12–14 kg, was dropped after a gestation period of 268–281 days at any time of the year, with a peak during late summer. Bluebuck are thought to have lived for up to 18 years.

Predators

The calves were vulnerable to attacks from spotted hyenas (*Crocuta crocuta*), leopards (*Panthera pardus*) and wild dogs (*Lycaon pictus*). The adults were large and formidable, and resistant to predation in areas with low predator densities. They did sometimes fall prey to lions (*Panthera leo*), but were attacked with caution. Normally they would flee from predators, but when wounded, a bluebuck would lay down, preferably in a marsh, and defended itself with its razor-sharp horns - the angle-horn threat display indicating that it intended to stab sideways or over its shoulder.

History and population

The Bluebuck or Blue Antelope was the first large African mammal to become extinct in historical times.

Shortly after the last Ice Age, about 10 000 years ago, the Bluebuck must have been common in the far south of Africa, which was largely covered with grassy plains. Numerous finds of subfossil bones indicate a former distribution area from Elands Bay in the present Cape Colony to about 25° E at Uniondale, as well as in the Eastern Free State. Bluebuck numbers dropped about 3 200-2 000 years ago, due to the change of grassland into bush and forest when the climate became warmer.

They showed a sharp decline around 400 A.D., which coincided with the introduction of livestock, particularly sheep, by man at about that time. Competition for grazing with sheep, the resulting habitat degradation due to overgrazing, and diseases may all have contributed to a decline in Bluebuck. Subsistence hunting could also have played a role - it is known that the Late Stone Age inhabitants of Rose Cottage cave hunted several game species, including Bluebuck. To the San (Bushman) the Bluebuck was an important animal, since rock art indicates that these animals contained supernatural power.

Jan van Riebeeck mentioned a "steinbok" or ibex with back-curved horns near Cape Town, while the German Peter Kolb was the first to write about the existence of a "blaauwbok" or Bluebuck in 1719. The Bluebuck was clearly on its way to extinction when European naturalists and hunters finally discovered it. Its range was already small when Europeans who settled in the Cape Colony in the 17th and 18th century first saw this antelope. The Swedish naturalist Carl Peter Thunberg noted in 1774 that these animals were becoming rare. European hunters and farmers hunted it mainly for its skin. Its meat was not fatty, and generally fed to the dogs, although it was just as tasty as that of deer. According to the German zoologist Martin Lichtenstein, the last Bluebuck in the Cape Province was killed in 1799/1800 in the Swellendam district . However, there is good evidence to suggest that an isolated remnant population still existed further north in the 18th century, and that the last Bluebuck died in the Eastern Free State more than fifty years later.

Extinction

A Bluebuck on display in the Naturhistorisches Museum Wien.

Cultivation of the Cape Colony and hunting with firearms quickly destroyed the last small herds. The Bluebuck disappeared before the early natural history cabinets and museums had a chance to obtain a fair number of specimens.

Museum specimens

There are four mounted Bluebuck skins: in the National Museum of Natural History "Naturalis" in Leiden (the Netherlands), and in the natural history museums of Stockholm (Sweden), Paris (France) and Vienna (Austria). Not counting the many bones

excavated throughout the species' former range, there are two skulls, in Amsterdam (the Netherlands) and Glasgow (United Kingdom), and three pairs of horns, in Uppsala (Sweden), London (United Kingdom) and Cape Town (South Africa). None of these specimens are properly documented. .

Relatives

Two close relatives of the Bluebuck are the roan antelope (*Hippotragus equinus*) and the sable antelope (*Hippotragus niger*). Although some naturalists in the past classified the Bluebuck merely as a subspecies of the roan, it is now generally accepted as a separate species. This is based on the fact that Bluebuck and roan occurred in sympatry on the coastal plain of the southwestern Cape from Oakhurst to Uniondale during the early Holocene.

There were a lot of speculations that the Giant or Giant Sable Antelope (*Hippotragus niger variani*) had become extinct. There had been unconfirmed sightings in recent years, but no confirmed sightings for 20 years. This subspecies of the Sable Antelope only occurred in Angola, and there are no specimens present in zoos.

An expedition headed to Angola on 14 August 2002 to search for the giant sable antelope. The expedition had tried hunting for the antelope by helicopter, but the animals avoid sound at all costs. Interviews with tribal chiefs revealed that locals often sighted the animals in the Luando reserve, so the expedition changed tactics and carried out ground surveys on foot. They recorded five separate sightings but were not able to take any photographs. These five animals were spotted in Cangandala National Park in Malanje province in north-central Angola by a team led by Professor Wouter van Hoven of the University of Pretoria.

Chapter- 13

Cave Bear

The **Cave Bear** (*Ursus spelaeus*) was a species of bear which lived in Europe during the Pleistocene and became extinct at the beginning of the Last Glacial Maximum about 27,500 years ago. Both the name *Cave Bear* and the scientific name *spelaeus* derive from the fact that fossils of this species were mostly found in caves, indicating that this species spent more time in caves than the Brown Bear, which only uses caves for hibernation. Consequently, in the course of time, whole layers of bones, almost entirely those of cave bears, were found in many caves.

History of cave bear discoveries

Rearing *Ursus spelaeus* skeleton

Cave bear skeletons were first described in 1774 by Johann Friederich Esper in his book *Newly Discovered Zoolites of Unknown Four Footed Animals*. Originally thought to belong to dragons, unicorns, apes, canids or felids, Esper postulated that they actually belonged to polar bears. Twenty years later, Johann Christian Rosenmüller, an anatomist at the Leipzig University, gave the species its binomial name. Cave bear bones were so numerous that most researchers held little respect for them. During World War I, large amounts of cave bear bones were used as a source of phosphates, leaving behind little more than skulls and leg bones.

Many caves in Europe have skeletons of cave bears on display, for example the *Heinrichshöhle* in Hemer or the *Dechenhöhle* in Iserlohn, Germany. In Romania, there is a cave called Peştera Urşilor (Bears' Cave) where 140 cave bear skeletons were discovered in 1983.

Description and Biology

Range and habitat

The cave bear's range stretched across Europe, from Spain to Eurasia, from Italy and Greece to Belgium, the Netherlands and possibly Great Britain, across a portion of Germany through Poland, then south into Hungary, Romania and parts of Russia, Caucasus and northern Iran. There have been no traces of cave bears living in northern Britain, Scandinavia or the Baltic countries, which were covered in extensive glaciers at the time. The largest numbers of cave bear remains have been found in Austria, Switzerland, southern Germany, northern Italy, northern Spain, Croatia, Hungary, and Romania. The huge number of bones found in south, central and east Europe has led some scientists to think that Europe may have once had literal herds of cave bears. Some however point out that though some caves have thousands of bones, they were accumulated over a period of 100,000 years or more, thus requiring only two deaths in a cave per year to account for the large numbers.

The cave bear inhabited low mountainous areas, especially in regions rich in limestone caves. They seem to have avoided open plains, preferring forested or forest-edged terrains.

Anatomy

Life restoration

The cave bear had a very broad, domed skull with a steep forehead. Its stout body had long thighs, massive shins and in-turning feet, making it similar in skeletal structure to the brown bear. Cave bears were comparable in size to the largest modern day bears. The average weight for males was 400-500 kilograms (880-1102 pounds), while females weighed 225–250 kg (496-551 lbs). Of cave bear skeletons in museums, 90% are male due to a misconception that the female skeletons were merely "dwarfs". Cave bears grew larger during glaciations and smaller during interglacials, probably to adjust heat loss rate. Cave bears of the last ice age lacked the usual 2-3 premolars present in other bears; to compensate, the last molar is very elongated, with supplementary cusps. The humerus of the cave bear was similar in size to that of the polar bear, as were the femora of females. The femora of male cave bears, however, bore more similarities in size to those of kodiak bears.

Dietary habits

Cave bear teeth show greater wear than most modern bear species, suggesting a diet of tough materials. However, tubers and other gritty food, which cause distinctive tooth wear in modern brown bears, do not appear to have constituted a major part of cave bears' diet on the basis of dental microwear analysis.

Skull of *Ursus spelaeus*. Cave bears lacked the usual 2-3 premolars present in other bear species

The morphological features of the cave bear chewing apparatus, including loss of premolars, have long been suggested to indicate that their diets displayed a higher degree of herbivory than the Eurasian brown bear. Indeed, a solely vegetarian diet has been inferred on the basis of tooth morphology. Results obtained on the stable isotopes of cave bear bones also point to a largely vegetarian diet in having low levels of nitrogen-15 and carbon-13, which are accumulated at a faster rate by meat eaters as opposed to herbivores.

However, some evidence points toward inclusion of at least occasional animal protein in the cave bear diet. For example, toothmarks on cave bear remains in areas where cave bears are the only recorded potential carnivores suggests occasional cannibalistic scavenging, possibly on individuals that died during hibernation, and dental microwear analysis indicates that the cave bear may have fed on a greater quantity of bone than its contemporary, the smaller Eurasian Brown Bear. Additionally, cave bear remains from Peştera cu Oase in the southwestern tip of the Carpathian mountains had elevated levels of nitrogen-15 in their bones, indicative of an omnivorous diet, although the values are within the range of those found for the strictly herbivorous mammoth.

Although the current prevailing opinion concludes that cave bears were largely herbivorous, and more so than any modern species of the genus *Ursus*, increasing evidence points to an omnivorous diet, based both on regional variability of isotopic composition of bone remains indicative of dietary plasticity, and on a recent reevaluation

of its craniodental morphology that places the cave bear squarely among omnivorous modern bear species with respect to its skull and tooth shapes.

Mortality

Standing skeleton of juvenile cave bear

Death during hibernation was a common end for cave bears, mainly befalling specimens that failed ecologically during the summer season through inexperience, sickness or old age. Some cave bear bones show signs of numerous different ailments, including fusion of the spine, bone tumours, cavities, tooth resorption, necrosis (particularly in younger specimens), osteomyelitis, periostitis, rickets and kidney stones. Male cave bear skeletons have been found with broken baculums, probably due to fighting during breeding season. Cave bear longevity is unknown, though it has been estimated that they

seldom exceeded 20 years of age. Paleontologists doubt adult cave bears had any natural predators, save for pack hunting wolves and cave hyenas which would probably have attacked sick or infirm specimens. Cave hyenas are thought to be responsible for the dis-articulation and destruction of some cave bear skeletons. Such large carcasses were an optimal food resource for the hyenas, especially at the end of the winter, when food was scarce. The presence of fully articulated adult cave lion skeletons, deep in cave bear dens, indicates that lions may have occasionally entered dens to prey on hibernating cave bears, with some dying in the attempt.

Evolution

Skeleton mounted in quadrupedal posture

Both the cave bear and the brown bear are thought to be descended from the Plio-Pleistocene Etruscan bear (*Ursus etruscus*) that lived ~5.3 Mya to 10,000 years ago. The last common ancestor of cave bears and brown bears lived between 1.2 and 1.4 million years ago. The immediate precursor of the cave bear was probably *Ursus deningeri* (Deninger's bear), a species restricted to Pleistocene Europe ~1.8 Mya to 100,000 years ago. The transition between Deninger's bear and the cave bear is given as the last Interglacial, although the boundary between these forms is arbitrary and intermediate or transitional taxa have been proposed, e.g. *Ursus spelaeus deningeroides*, while other authorities consider both taxa to be chronological variants of the same species.

Cave bears found in different regions vary in age, thus facilitating investigations into evolutionary trends. The three anterior premolars were gradually reduced, then disappeared, possibly in response to a largely vegetarian diet. In a fourth of the skulls found in the Conturines, the third premolar is still present, while more derived specimens elsewhere lack it. The last remaining premolar became conjugated with the true molars, enlarging the crown and granting it more cusps and cutting borders. This phenomenon known as molarization improved the mastication capacities of the molars, facilitating the processing of tough vegetation. This allowed the cave bear to gain more energy for hibernation while eating less than its ancestors.

Recovery of fossil DNA

In May 2005, scientists in California succeeded in recovering and sequencing nuclear DNA of a cave bear that lived between 42,000 and 44,000 years ago. The procedure used genomic DNA extracted from the animal's tooth. Sequencing the DNA directly (rather than first replicating it with the polymerase chain reaction), the scientists were able to recover 21 cave bear genes from remains that did not yield significant amounts of DNA with traditional techniques. This study confirmed and built on results from a previous study using mitochondrial DNA extracted from cave bear remains ranging from 20,000 to 130,000 years old. Both show the cave bear to be more closely related to the brown bear and polar bear than the American black bear, but having split from the brown bear lineage prior to the diversification of distinct eastern and western brown bear lineages and prior to the split of brown bears and polar bears. The divergence date estimate of cave bears and brown bears is ~1.2-1.4 Mya.

Causes of extinction

Recent reassessment of fossils indicate the cave bear probably died out 27,800 years ago. It has been suggested that a complex of factors, rather than a single factor, led to the extinction.

Compared with other megafaunal species that also became extinct during the last Glacial Maximum, the cave bear was believed to have had a more specialized diet of high-quality plants and a relatively restricted geographical range. This was suggested as an explanation as to why it died out so much earlier than the rest. Some experts have disputed this claim as the cave bear had survived multiple climate changes prior to extinction. Additionally, mitochondrial DNA research indicated that the genetic decline of the cave bear began long before it went extinct, demonstrating that habitat loss due to climate change was not responsible. Finally, high $\delta^{15}N$ levels were found in cave bear bones from Romania, indicating wider dietary possibilities than previously believed.

Overhunting by humans has been largely dismissed because human populations at the time were too small to pose a serious threat to the cave bear's survival, though there is evidence that the two species may have competed for living space in caves. Unlike brown bears, cave bears are seldom represented in cave paintings, leading some experts to believe that the cave bear may have been avoided by human hunters or their habitat

preferences may not have overlapped. One theory proposed by late paleontologist Bjorn Kurten states that the cave bear populations were fragmented and under stress even before the advent of the glaciers. It is possible that populations living south of the Alps survived significantly longer.

There is some evidence that the cave bear only used caves for hibernation and was not inclined to use other locations, such as thickets, for this purpose, in contrast to the more versatile Brown Bear. This specialized hibernation behavior would have caused a high winter mortality rate for Cave Bears that failed to find available caves. Therefore, as human populations slowly increased, the Cave Bear faced a shrinking pool of suitable caves, and slowly faded away to extinction, as both Neanderthals and anatomically modern humans sought out caves as living quarters, depriving the cave bear of vital habitat. This hypothesis is being researched at this time.

Cave bear worship

Collections of bear bones at several widely dispersed sites suggest that Neanderthals may have worshipped cave bears, especially at Drachenloch, in Switzerland, where a stone chest was discovered with a number of bear skulls stacked upon it. Neanderthals, who also inhabited the entrance of the cave, are believed to have built it. A massive stone slab covered the top of the structure. At the cave entrance, seven bear skulls were arranged with their muzzles facing the cave entrance, while deeper in the cave, a further six bear skulls were lodged in niches along the wall. Next to these remains were bundles of limb bones belonging to different bears. Consequently, it was at this site that the supposed symbol of the "Cult of the Cave Bear" was found. This consisted of the skull of a three-year-old bear pierced in the cheek by the leg-bone of younger bear. The arrangement of these bones of different bears are not believed to have happened by chance.

A similar phenomenon was encountered in Regourdou, southern France. A rectangular pit contained the remains of at least twenty bears, covered by a massive stone slab. The remains of a Neanderthal lay nearby in another stone pit, with various objects, including a bear humerus, a scraper, a core, and some flakes, which were interpreted as grave offerings.

The unusual finding in a deep chamber of Basua Cave in Savona, Italy, is thought to be related to cave bear worship, as there is a vaguely zoomorphic stalagmite surrounded by clay pellets. It was apparently used by Neanderthals for a ceremony; the fact that bear bones lay scattered on the floor further suggests that this was likely to have had some sort of ritual purpose.

Chapter- 14

Cave Hyena

The **Cave Hyena** (*Crocuta crocuta spelaea*) is an extinct subspecies of spotted hyena (*Crocuta crocuta*) native to Eurasia, ranging from Northern China to Spain and into the British Isles. Though originally described as a separate species from the spotted hyena due to large differences in fore and hind extremities, genetic analysis indicates no sizeable differences in DNA between Pleistocene cave hyena and modern day spotted hyena populations. It is known from a range of fossils and prehistoric cave art. With the decline of grasslands 12,500 years ago, Europe experienced a massive loss of lowland habitats favoured by cave hyenas, and a corresponding increase in mixed woodlands. Cave hyenas, under these circumstances, would have been outcompeted by wolves and

humans which were as much at home in forests as in open lands, and in highlands as in lowlands. Cave hyena populations began to shrink after roughly 20,000 years ago, completely disappearing from Western Europe between 14-11,000 years ago, and earlier in some areas.

Description

The main distinction between the spotted hyena and the cave hyena is grounded on different lengths of the hind and fore limb bones. The humerus and femur are longer in the cave hyena, indicating an adaptation to a different habitat to that of the spotted hyena. It is unknown if they showed the same sexual dimorphism of the spotted hyena. It has been estimated that they weighed 102 kg (225 lbs).

Little is known of their social habits. It is widely accepted that they used caves as dens, although sites in the open-air are also known. There is no indication of cave hyenas living in large clans or on a more solitary basis, though large clans are not considered likely in their Pleistocene habitat.

Dietary habits

Reconstruction of cave hyena

Like modern hyenas, cave hyenas accumulated the bones and horns of their food at den sites for later consumption or for play, though it is unknown if the discovered remains were from scavenged or killed animals. Studies of animal remains in hyena den sites in the Bohemian Karst show that Przewalski's Horses were apparently their most common prey, which amounted to 16-51% of the cave hyena's prey. Their largest prey was the woolly rhinoceros, the bones and skulls of which have been found in many hyena den sites. In some regions, rhino remains can comprise 25-30% of the total prey bone material in den sites. Reindeer were another important food source, as they made up 7-15% of the cave hyena's prey. The Steppe Wisent made up only 1-6% of the cave hyena's prey. Red deer only comprised 3% of found remains, with Irish elk being even rarer. The remains of alpine fauna including chamois and ibex are absent in some places, representing less than 3% of the prey, possibly due to their greater fragility. There is evidence that cave hyenas occasionally practiced cannibalism.

Interspecific predatory relationships

Cave hyenas were highly successful predators, and were especially numerous in Northeast Asia, where it seems they outcompeted most other predators. This was deduced from the relative scarcity of cave lion, cave bear and wolf remains in areas where they are sympatric with hyenas.

Cave hyenas are thought to be responsible for the dis-articulation and destruction of some cave bear skeletons. Such large carcasses were an optimal food resource for the hyenas, especially at the end of the winter, when food was scarce.

Cave hyenas were sympatric with gray wolves in Italy. Unlike the hyenas, which preferentially preyed on lowland animals such as horses, wolves relied more on smaller, slope-dwelling prey such as ibex and roe deer, thus minimizing competition. Wolves and cave hyenas seem to display negative abundance relations over time, with wolf populations expanding their ranges as hyenas disappeared.

Interactions with hominids

Cave hyena painting found in the Chauvet Cave in 1994.

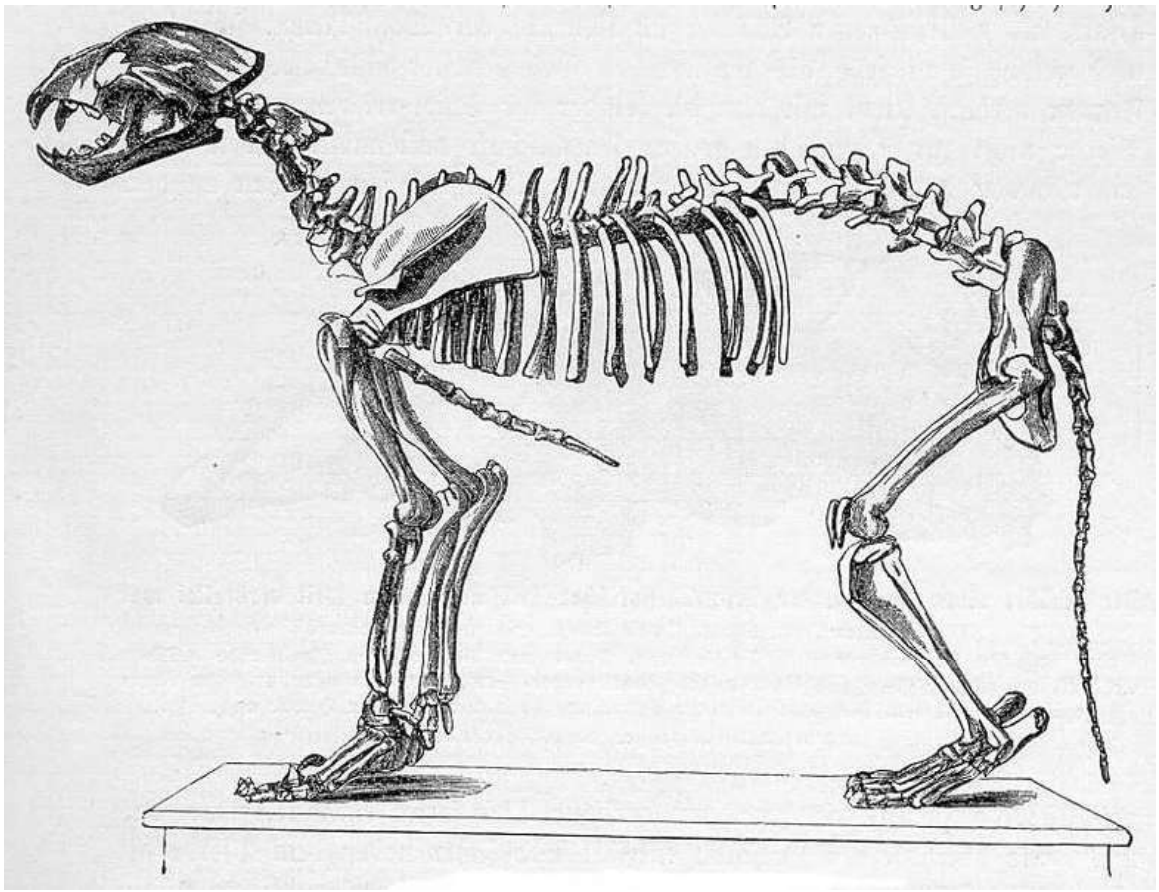
Kills partially processed by Neanderthal and then by cave hyena indicate that hyena would occasionally steal Neanderthal kills, and cave hyena and Neanderthal both competed for cave sites. Many caves show alternating occupations of hyenas and Neanderthals. Numerous hominid bones, including Neanderthal, have also been found partially consumed by cave hyena. Modern humans also lived alongside cave hyena, and may have had similar interaction with them. Some paleontologists believe that competition and predation by cave hyenas in Siberia was a significant factor in delaying human colonization of Alaska. Cave hyenas may have occasionally stolen human kills, or entered campsites to drag off the young and weak, much like modern spotted hyenas in Africa. The oldest Alaskan human remains coincide with roughly the same time cave hyenas became extinct, leading certain paleontologists to infer that hyena predation was what prevented humans from crossing the Bering strait earlier.

Chapter- 15

Panthera Leo Spelaea

Panthera leo spelaea also known as the **European** or **Eurasian cave lion**, is an extinct subspecies of lion known from fossils and many examples of prehistoric art.

Physical characteristics



Skeleton of a cave lion from the Sloup Caves near Brno in the Czech Republic

This subspecies was one of the largest lions. The skeleton of an adult male, which was found in 1985 near Siegsdorf (Germany), had a shoulder height of around 1.2 m (4 ft) and a body length of 2.1 m (7 ft) without tail. This is similar to the size of a very large

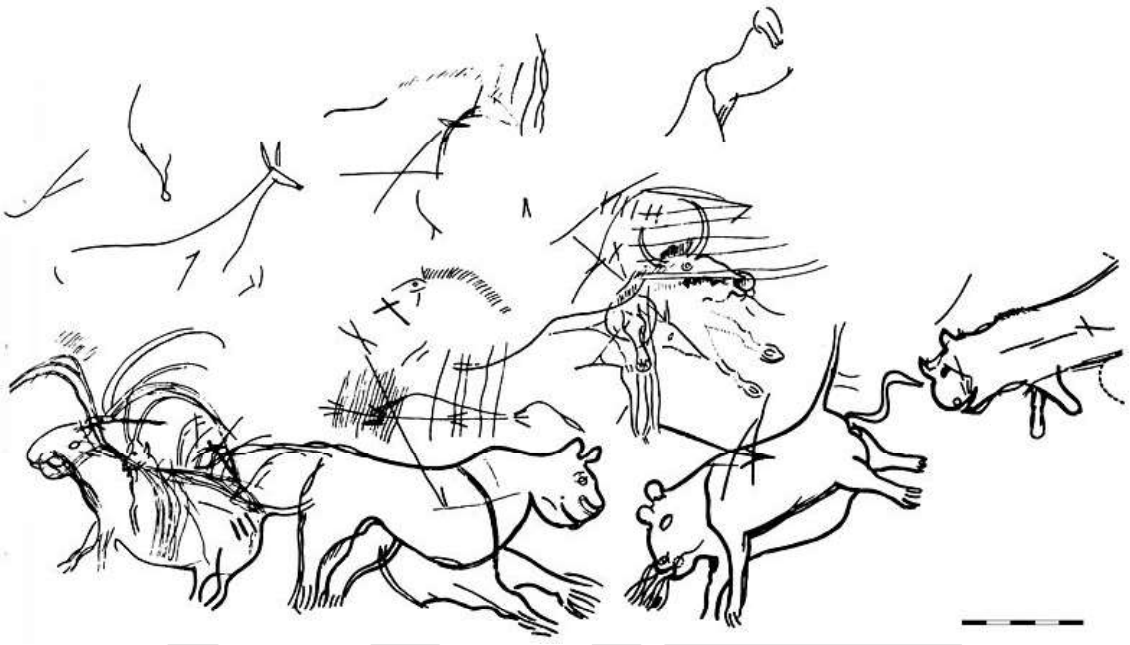
modern lion. The size of this male has been exceeded by other specimens of this subspecies. Therefore this cat may have been around 8%-10% bigger than modern lions, but it surpassed the reach of measures of the earlier cave lion subspecies *Panthera leo fossilis* or those of the huge American lion (*Panthera leo atrox*). The cave lion is known from Paleolithic cave paintings, ivory carvings, and clay figurines. These representations indicate that cave lions had rounded, protruding ears, tufted tails, possibly faint tiger-like stripes, and that at least some had a "ruff" or primitive mane around their neck, indicating males. Other archaeological artifacts indicate that they were featured in Paleolithic religious rituals.

Environment

Restoration by Heinrich Harder

The cave lion received its common name because large quantities of its remains are found in caves , but it is doubtful whether they lived in them. It had a wide habitat tolerance, but probably preferred conifer forests and grasslands , where medium-sized to large herbivores occurred. Fossil footprints of lions, which were found together with those of reindeer, demonstrate that lions once occurred even in subpolar climates. The presence of fully articulated adult cave lion skeletons, deep in cave bear dens, indicates that lions may have occasionally entered dens to prey on hibernating cave bears, with some dying in the attempt.

These active carnivores probably preyed upon the large herbivorous animals of their time, including horses, deer and bison. Some paintings of them in caves show several hunting together, which suggests the hunting strategy of contemporary lionesses.



Cave lions, *Chamber of Felines*, Lascaux caves in France

Small prey was usually brought down with a blow of the front paw and then held down with both front feet. The animal was finally killed by a powerful bite of the sharp teeth , at the back of the neck, in the region of the throat and even in the chest. A cave lion usually could not run as fast as its prey, but could pounce on it from behind or run up next to it and bring it down with the paws. In this manner a running animal's balance could very easily be disturbed.

It was most likely the most common predator (after the cave hyena) in plains ecosystems. Its extinction may have been related to the Quaternary extinction event, which wiped out most of the megafauna prey in those regions. Cave paintings and remains found in the refuse piles of ancient camp sites indicate that they were hunted by early humans, which also may have contributed to their demise.

Classification

The cave lion is sometimes considered a species in its own right, under the name *Panthera spelaea* , and at least one authority, based on a comparison of skull shapes, considers the cave lion to be more closely related to the tiger, which would result in the formal name *Panthera tigris spelaea*. However, recent genetic research shows that it was a close relative of the modern lion and that it formed a single population with the Beringian cave lion, which has been sometimes considered as to represent a distinct form. Therefore the cave lion ranged from Europe to Alaska over the Bering land bridge until the latest Pleistocene. However it is still not completely clear, whether it was a subspecies of the lion or rather a very close relative

History and distribution

Cave lions with a reindeer (artist's impression).

The cave lion (*Panthera leo spelea*) was derived from the earlier *Panthera leo fossilis*, which first appeared in Europe about 700,000 years ago. The cave lion itself lived from 370,000 to 10,000 years ago, during the Pleistocene epoch. Apparently, it became extinct about 12,500 C-14 years ago , during the Würm glaciation, although there are some indications it may have existed into historic times in southeastern Europe, as recently as 2,000 years ago in the Balkans.

Cave lions were widespread in parts of Europe and Asia, from Great Britain, Germany and Spain (Arduini & Teruzzi, 1993) all the way to the Bering Strait and from Siberia to Turkistan.

Chapter- 16

Dwarf Elephant

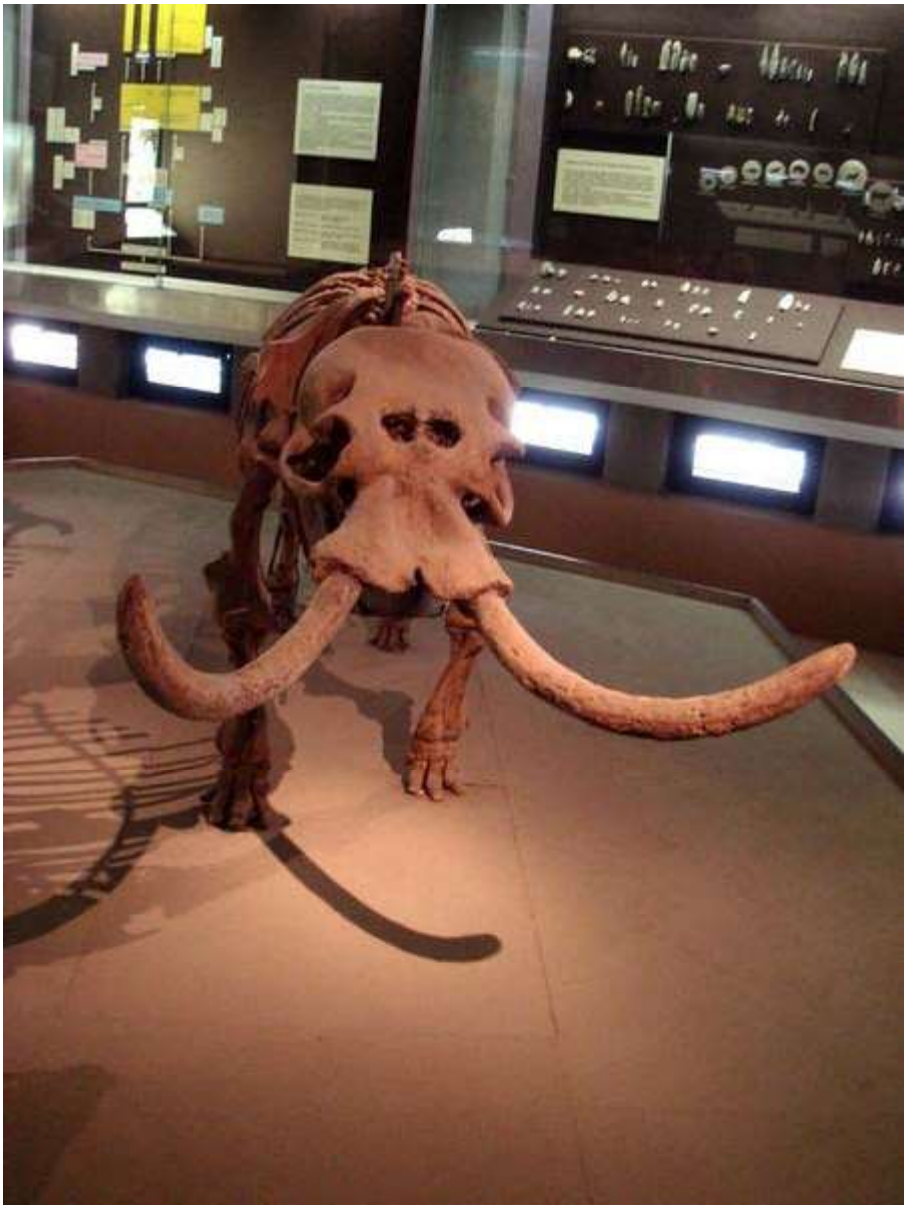
Dwarf elephants are prehistoric members of the order Proboscidea, that, through the process of allopatric speciation, evolved to a fraction of the size of their immediate ancestors. Insular dwarfism is a biological phenomenon by which the size of animals isolated on an island shrinks dramatically over time for the smaller animals have survived because of the underabundance of food.

Fossil remains of dwarf elephants have been found on the Mediterranean islands of Cyprus, Malta (at Ghar Dalam), Crete, Sicily, Sardinia, the Cyclades Islands and the

Dodecanese Islands. Other islands where dwarf elephants have been found are Sulawesi, Flores, Timor and other islands of the Lesser Sundas. The Channel Islands of California once supported a dwarf species descended from Columbian mammoths, while small races of woolly mammoths were once found on Wrangel Island and Saint Paul Island.

Mediterranean Islands

Dwarf elephants were, after the Messinian salinity crisis, part of the Pleistocene fauna of all the larger Mediterranean islands, with the apparent exception of Corsica and the Balearics. Mediterranean dwarf elephants have generally been considered as paleoloxodontine, derived from the continental Straight-tusked Elephant, *Elephas (Palaeoloxodon) antiquus* Falconer & Cautley, 1847. An exception is the dwarf Sardinian Mammoth, *Mammuthus lamarmorae* (Major, 1883), the only endemic elephant of the Mediterranean islands belonging to the mammoth line. A DNA research published in 2006 theorized that the *Elephas creticus* could be from the mammoth line too. This old theory, proposed by Dorothea Bate as early as 1905, is not widely accepted. A scientific study of 2007 demonstrates the mistakes of the DNA research of 2006.



Elephas Falconeri

During low sea levels, the Mediterranean islands were colonised again and again, giving rise, sometimes on the same island, to several species (or subspecies) of different body sizes. These endemic dwarf elephants were taxonomically different on each island or group of very close islands, like the Cyclades archipelago.

There are many uncertainties about the time of colonisation, the phylogenetic relationships and the taxonomic status of dwarf elephants on the Mediterranean islands. Extinction of the insular dwarf elephants has not been correlated with the arrival in the islands of man. Furthermore, it has been suggested by the paleontologist Othenio Abel in 1914, that the finding of skeletons of such elephants sparked the idea that they belonged

to giant cyclopses, because the center nasal opening was thought to be a cyclopic eye socket.

Dwarf elephant skeleton of Malta

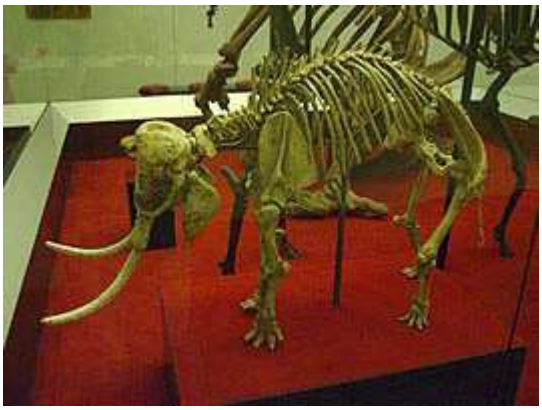
Sardinia

- *Mammuthus lamarmorae* (Major, 1883)
- *Elephas (Palaeoloxodon) antiquus* (Acconci, 1881)
- *Elephas (Palaeoloxodon) melitensis* Falconer, 1868

Sicily & Malta

- *Elephas (Palaeoloxodon) antiquus leonardii* Aguirre, 1969
- *Elephas (Palaeoloxodon) mnaidriensis* (Adams, 1874)
- *Elephas (Palaeoloxodon) melitensis* Falconer, 1868
- *Elephas (Palaeoloxodon) falconeri* Busk, 1867

Crete



Skeleton of a Cretan Dwarf Elephant.

- *Elephas (Palaeoloxodon) creticus* (Bate, 1907)
- *Elephas (Palaeoloxodon) creutzburgi* (Kuss, 1965)
- *Elephas (Palaeoloxodon) chaniensis* (Symeonides et al., 2001)

After DNA research, published in 2006, it has been proposed to rename *Elephas (Palaeoloxodon) creticus* into *Mammuthus creticus* (Bate, 1907). Others proposed (in 2002) to rename all the described specimens of larger size under the new subspecies name *Elephas antiquus creutzburgi* (Kuss, 1965). In a recent study of 2007, it was argued for the groundlessness of the theory by Poulakakis et al. in 2006, showing the weak points of that DNA research.

Cyprus

- *Elephas (Palaeoloxodon) cypriotes* Bate, 1903

The Cyprus dwarf elephant survived at least until 11,000 BP. Its estimated body weight was only 200 kg, only 2% of its 10,000 kg ancestor. Molars of this dwarf are reduced to approximately 40% the size of mainland straight-tusked elephants.

Remains of the species were first discovered and recorded by Dorothea Bate in a cave in the Kyrenia hills of Cyprus in 1902 and reported in 1903.

Cyclades Islands

Remains of paleoloxodontine elephants have been reported from the islands of Delos, Naxos, Kythnos, Serifos and Milos. The Delos elephant is of similar size to a small *Elephas antiquus*, while the Naxos elephant is of similar size to *Elephas melitensis*. The remains from Kythnos, Serifos and Milos have not been described.

Dodecanese Islands

On the island of Rhodes, bones of an endemic dwarf elephant have been discovered. This elephant was similar in size to *Elephas mnaidriensis*.

Two groups of remains of dwarf elephants have been found on the island of Tilos. They are similar in size to *Elephas mnaidriensis* and the smaller *Elephas falconeri*, but the two groups indicate sexual dimorphism. The remains had originally been designated to *Palaeoloxodon antiquus falconeri* (Busk, 1867). However, this name refers to the dwarf elephants from the island of Malta. As a result, since no migration route between the two islands can be proved, this name should not be used when referring to the elephant remnants from Tilos, although some scientists have accepted the temporary use of this name until further material can be examined.

The Tilos dwarf elephant is the first dwarf elephant whose DNA sequence has been studied. The results of this research are consistent with previous morphological reports, according to which *Palaeoloxodon* is more closely related to *Elephas* than to *Loxodonta* or *Mammuthus*. After the study of new osteological material <Theodorou et al. 2007> that has been excavated in anatomical connection in the Charkadio Cave on Tilos island the new species name *Elephas tiliensis* has been assigned to the Tilos dwarf elephants. It was the latest paleoloxodontine to survive in Europe. They became extinct just less than 4,000 years BP, so this elephant survived well into the Holocene.

Channel Islands of California

The Columbian mammoth (*Mammuthus columbii*) produced a separate, isolated population at the end of the Pleistocene. One of these isolated groups was formed on the Channel Islands of California, most likely about 40,000 years ago (although the time of isolation is not fully known). Selective forces on the Channel Islands resulted in smaller animals, forming a new species, the Pygmy Mammoth *Mammuthus exilis*. Channel Islands mammoths ranged from 150–190 cm in shoulder height.

Wrangel Island

During the last ice age, woolly mammoths (*Mammuthus primigenius*) lived on Wrangel Island in the Arctic Ocean. It has been shown that mammoths survived on Wrangel Island until 1700 BCE, the most recent survival of any known mammoth population. They also survived on Saint Paul Island in the Bering Sea until 6000 BCE. Wrangel Island is thought to have become separated from the mainland by 12,000 years BP. Survival of a mammoth population may be explained by local geographic, topographic and climatic features, which entailed preservation of communities of steppe plants, as well as a degree of isolation sufficient to delay colonization by humans. St. Paul Island shares this characteristic of geographic isolation, implying that human hunting played a role in the disappearance of the woolly mammoth. Wrangel Island mammoths ranged from 180–230 cm in shoulder height and were for a time considered "dwarf mammoths". However this classification has been re-evaluated and since the Second International Mammoth

Conference in 1999, these mammoths are no longer considered to be true "dwarf mammoths".

Indonesia

On Sulawesi and Flores evidence of a succession of distinct endemic island faunas has been found, including dwarfed elephants, dating until the Middle Pleistocene. Around the early Middle Pleistocene these dwarfed elephants were replaced by new immigrants of larger to intermediate sizes.

Flores

The present understanding of the succession of *Stegodon* species on Flores is that endemic dwarfs, represented by the Early Pleistocene species *Stegodon sondaarii*, became extinct around 840,000 years ago. These dwarf forms were then replaced by the medium to large-sized *Stegodon florensis*, a species closely related to the *Stegodon trigonocephalus* group found both in Java and in the islands of biogeographical Wallacea, separated by deep water from the Asian and Australian continental shelves. This Stegodon species went extinct about 12,000 years ago, presumably because of a volcanic eruption.

Sulawesi

The dwarfed *Stegodon sompoensis* lived during the Pleistocene on the island of Sulawesi. They had a shoulder height of only 1.5m.

Chapter- 17

Elasmotherium

Elasmotherium ("Thin Plate Beast") is an extinct genus of giant rhinoceros endemic to Asia during the Pliocene through Pleistocene living from 3.6 mya—126,000 existing for approximately 3.5 million years.

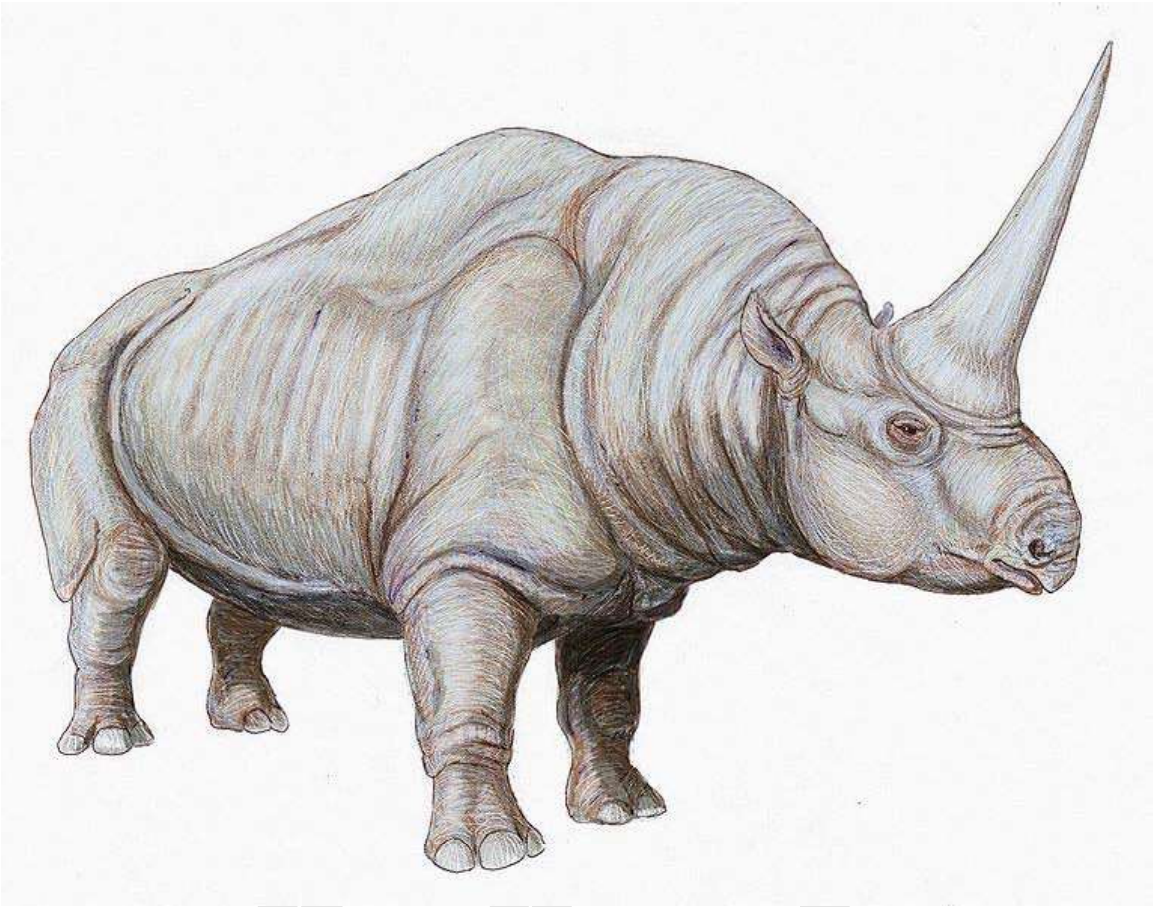
Taxonomy

Elasmotherium sibiricum

Elasmotherium stood, on average, 2.7 metres (8.9 ft) high and 6 metres (20 ft) long, with a single two-meter-long (depending on the size) horn in the forehead. The animal may have weighed up to 7 tonnes (7.7 short tons). Its legs were longer than those of other rhinos and were designed for galloping, giving it a horse-like gait. It was probably a fast runner, in spite of its size. Its teeth were similar to those of horses, and it probably grazed low herbs and for the low areas of tree leaves.

The genus appeared during the Late Pliocene in Central Asia, being derived from the genus *Sinotherium*. *E. inexpectatum* and *E. pei* inhabited Eastern China during the Upper Pliocene to Early Pleistocene. They disappeared approximately 1.6 Ma. The earliest records of *Elasmotherium* species in Russia are known from the Upper Pliocene assemblages near the Black Sea. *E. caucasicum* was widely distributed in this area between 1.1 Ma and 0.8 Ma. The more advanced (and largest member of the genus) *E. sibiricum* appeared in the Middle Pleistocene. It occupied all of the southwestern part of Russia, reaching eastward to western Siberia, then south into Ukraine and Moldova. Elasmotherians persisted in eastern Europe until the end of the Middle Pleistocene.

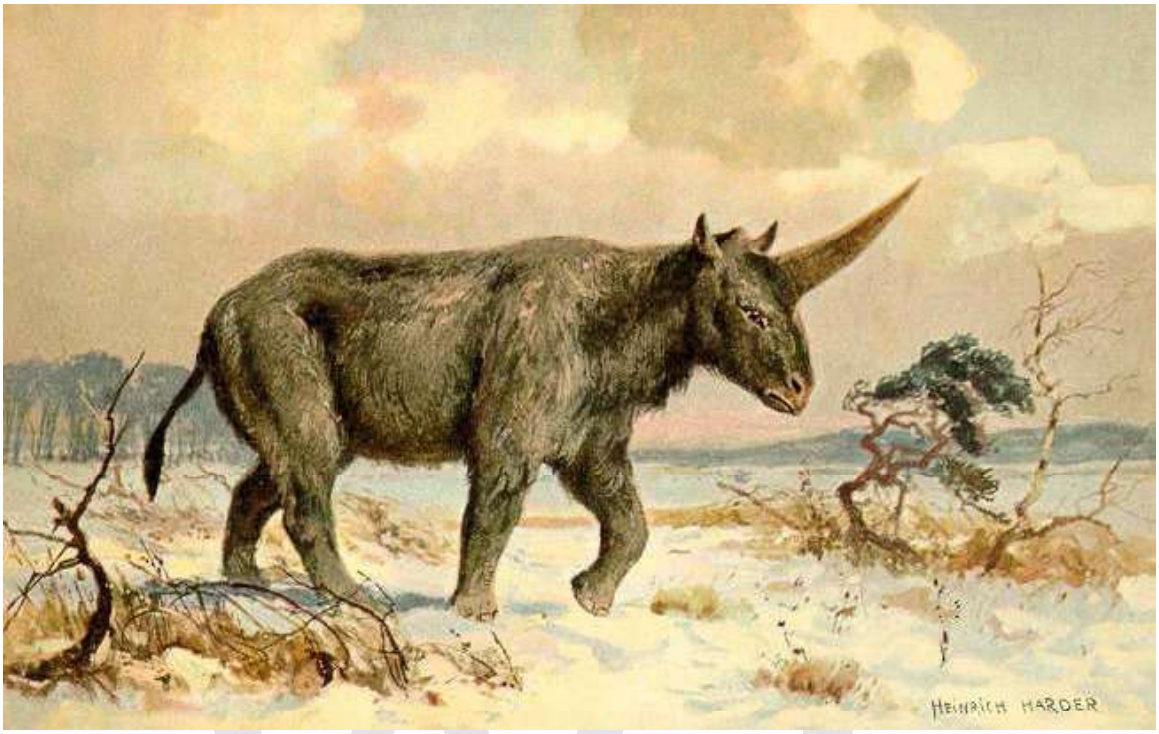
Description and paleobiology



Elasmotherium caucasicum

Morphological peculiarities of elasmotherians have generated two main hypotheses concerning their appearance and the character of their habitat. The first, most widely accepted view which was also described above, portrays them as large woolly animals with a large forehead horn that thrived on an open steppe. Fossils of the horn, however, have not been found. The other view assigns elasmotherians to riparian biotopes. It is probable that elasmotherians dwelt in both riparian and steppe biotope . The riparian biotope is suggested by dental and skull morphology. The combination of such characteristics as the absence of canines and strongly developed lateral processes of the atlas implies lateral movements of the head, presumably for grasping grass. The hypsodont dentition indicates presence of mineral grains in the food. Such food could be obtained by pulling out dense plants from the moist soil. These conditions are typical for riparian biotopes. On the other hand, a steppe biotope is indicated by their rather long and slender limbs, which would have served well for creatures grazing over vast areas.

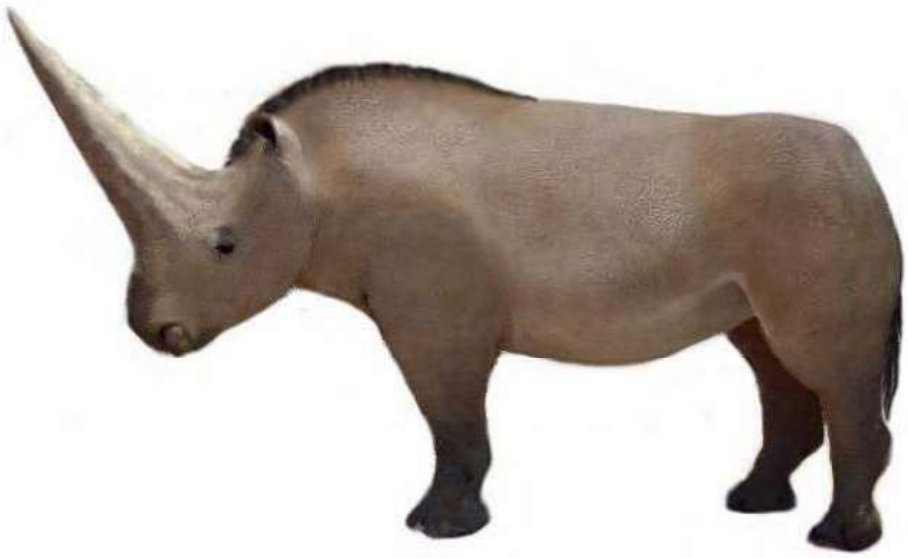
Possible historical witnesses



Elasmotherium by Heinrich Harder

It is believed that *Elasmotherium* died out in prehistoric times. However, according to science writer and cryptozoologist Willy Ley, the animal may have survived long enough to be remembered in the legends of the Evenk and Yakut people of Russia as a huge black or gray bull with long fur and a single horn in the forehead.

There is also a testimony by the medieval traveller Ibn Fadlan which has been interpreted by some to indicate that *Elasmotherium* may have survived into historical times.



Elasmotherium as the "zhi"

Ibn Fadlan's account states :

Near this river is a vast wilderness wherein they say is an animal that is less than a camel and more like a bull in size. Its head is like the head of a camel, and its tail is like the tail of a bull, while its body is like the body of a mule, and its hooves are like the cloven hooves of a bull. In the center of its head, it has a thick round horn, which as it rises from the head of the animal gets to be thinner until it becomes like the point of a lance. The length of some of these horns is from three to five cubits, and there are those that may attain to a greater or lesser length. The animal grazes on the leaves of trees, which are quite green. When it sees a horseman, it makes straight for him, and if he happens to have under him a fast horse, he is rendered safe from it with some effort. If it overtakes him, it removes him from the back of his horse with its horn, hurls him into the air, and then catches him with its horn. It continues in this manner until it kills him. It does not bother the horse in any form or manner. They seek out this animal in the forests in order to kill it. They do that by climbing the tall trees among which it is found, and with this object in mind, they assemble a number of archers with poisoned arrows. When it stands in their midst, they shoot at it until it is severely wounded and killed by them.

I saw in the king's house three large bowls which looked like [they were made of] the onyx of Yemen. The king informed me that it was made from the base of the horn of the animal. Some of the people of the country told me that it was a rhinoceros.

Some have argued that the survival of *Elasmotherium* into historical times may be the source of the unicorn myth, as the animal's description could be argued to fit with the Persian *karkadann* unicorn, and the Chinese *zhi* unicorn.

An article that appeared in a 1993 issue of French magazine *Le Point* refers to a sighting of a large horned animal, with a woolly fur coat in Siberia by a young man the previous year but gives no further details on the incident.