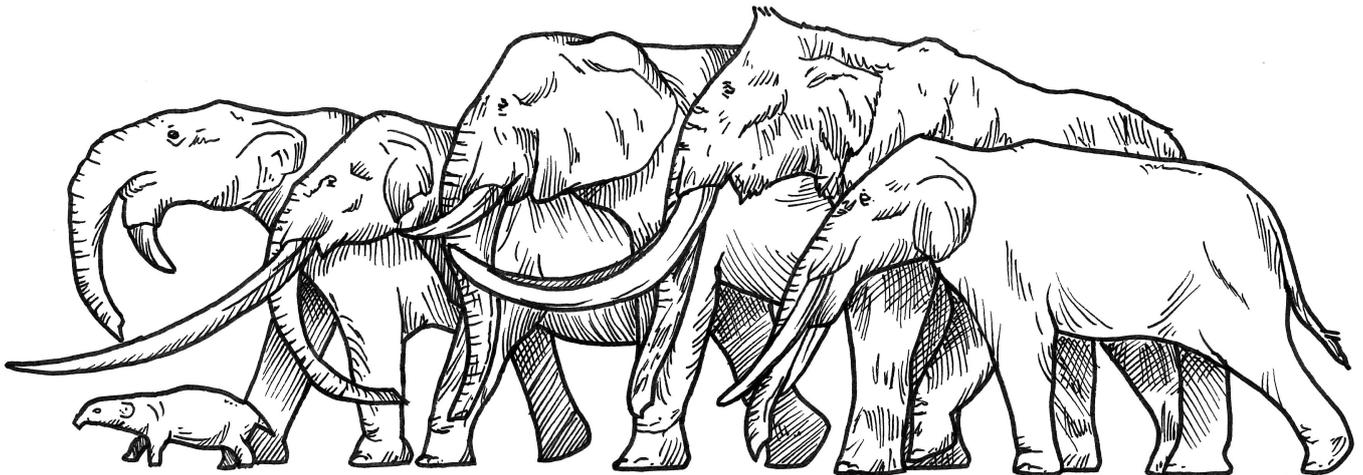


Geology fact sheet: MAMMOTHS

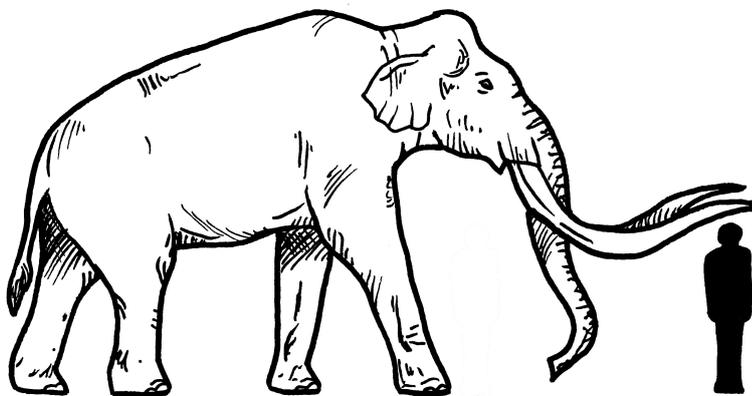
The three species of elephant alive today (the African Bush, African Forest and the Asian elephant) are all that remain of a very diverse group of 'elephantids'. Elephantids evolved and diversified during the last five million years. The earliest species lived in the tropical woodlands of Africa, but later species migrated into Europe, Asia and even North America.

The mammoths were a group of elephantids which specialised in eating grasses and shrubs of the cooler areas of northern Europe. When the Ice Age brought freezing temperatures to most of Europe, mammoths were well adapted to survive.

Norfolk is one of the best places in the world to find mammoth fossils because much of the county has sediments of the right age (from the last 3 million years).



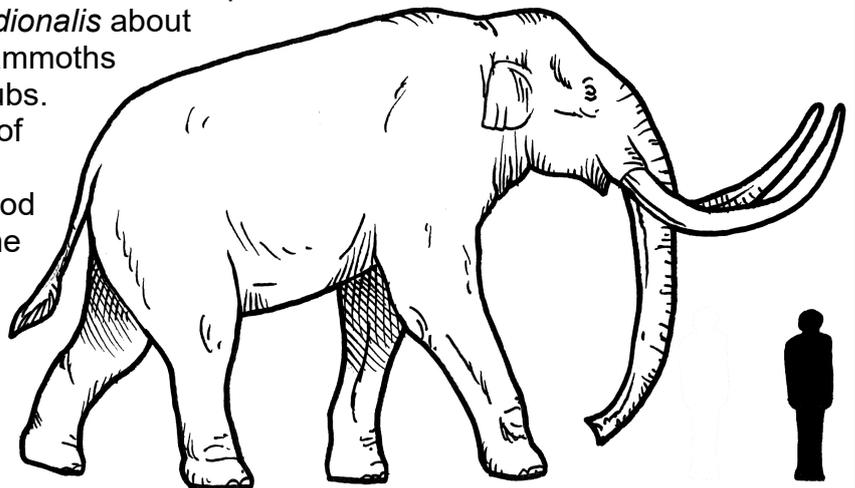
A diverse group of animals – just a few extinct and extant proboscidean (including the elephantids).



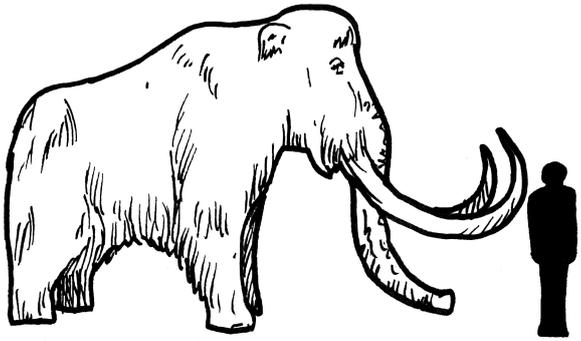
A Southern Mammoth, with an average-height human silhouette for scale

Mammuthus meridionalis, the 'Southern Mammoth', is the ancestor of the two later species found in Norfolk. It lived between about 3 million and 750,000 years ago in Europe. It lived on a varied diet of grasses, shrubs and trees.

Mammuthus trogontherii, the 'Steppe Mammoth', replaced its ancestor species *Mammuthus meridionalis* about 750,000 years ago. These large mammoths ate grasses, but also trees and shrubs. It was probably the largest species of elephantid ever to have lived. It weighed at least ten tonnes and stood four metres high at the shoulder. The famous West Runton Mammoth skeleton is from this species. The largest living elephants today weigh only about five tonnes and are three to three and a half metres high.



A Steppe Mammoth, with an average-height human silhouette for scale

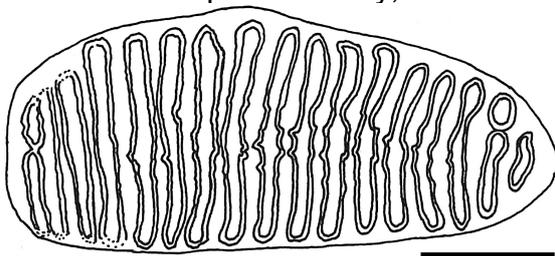


A Woolly Mammoth, with an average-height human silhouette for scale

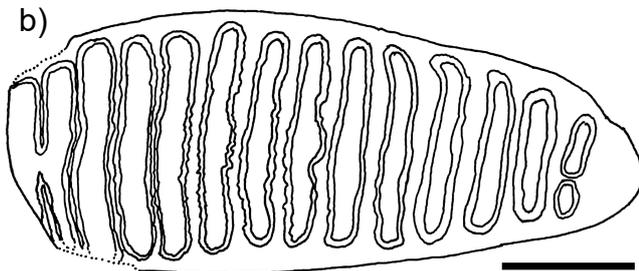
One group of *Mammuthus trogontherii* evolved into *Mammuthus primigenius*, the 'Woolly Mammoth', during intensely cold periods of the Ice Ages about 500,000 to 300,000 years ago. The Woolly Mammoths were able to survive in cold environments, not just because of their woolly coats, but because they adapted to survive on a grass-rich diet. This was essential as during cold periods only grasses, sedges, mosses and wild flowers could survive in northern Europe.

Mammoths are amongst the most commonly found vertebrate fossil remains on the Norfolk coast. However, most of these fossils are fragments of bones, tusks and teeth of these huge creatures.

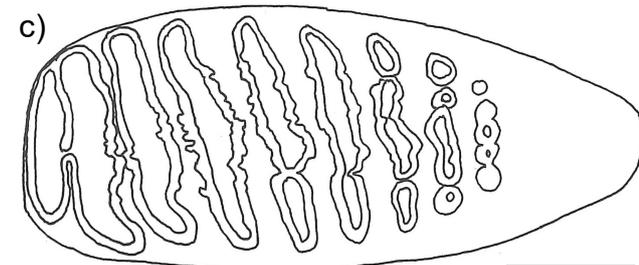
By far the easiest way to tell the three different Norfolk mammoths apart is by looking at their teeth. Like elephants today, mammoths had large tusks, which were modified incisor teeth, but they had only four molars in use at any one time.



Surface of the right upper molar of a Woolly Mammoth.



Surface of the right upper molar of a Steppe Mammoth.



Surface of the right upper molar of a Southern Mammoth.

Tooth illustrations from Lister A. 1996. *Evolution and Taxonomy of Eurasian Mammoths*. In *The Proboscidea: evolution and palaeoecology of elephants and their relatives*. Shoshani J. and Tassy P. (Eds). Oxford University Press. Oxford, UK.

Each type of mammoth had a slightly different type of molar, adapted for eating slightly different food. Southern Mammoths (c) required fewer enamel plates because it ate soft leaves, which were easily chewed. Woolly Mammoths (a), however, ate tough sedges and grasses, so they needed a greater number of plates in order to grind their food.

As the different species evolved, the enamel plates (lamellae) that make up the teeth became more numerous, but the enamel thickness decreased over time. If you find a mammoth tooth in Norfolk made up of lots of plates (18 or more), it is most likely to be from a Woolly Mammoth. If there are slightly fewer plates (around 15), it is probably from a Steppe Mammoth (b). But, if there are only around eight or nine plates, it is probably a Southern Mammoth molar.

Between about 40,000 and 10,000 years ago, many large mammals became extinct in Europe. Mammoths died out just 10,000 years ago with the exception of two small populations. One population survived on St Paul Island, west of Alaska, until about 6,000 years ago, and another located on Wrangel Island in the Arctic Ocean, north of Siberia, lasted until about 4,000 years ago. Their extinction was probably due to a combination of global climatic changes and the more successful hunting techniques of modern humans.

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**NORTH NORFOLK
DEEP HISTORY
COAST**

