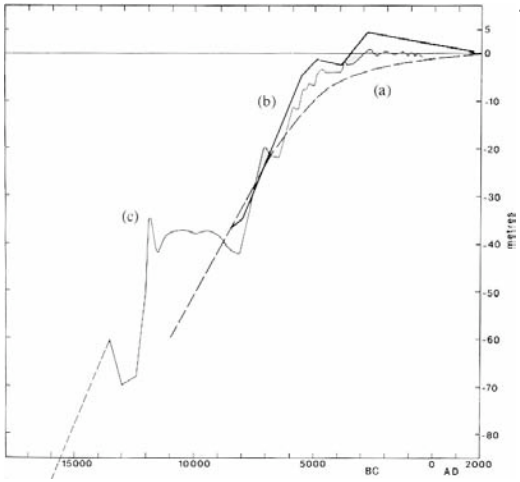
The rising sea level and its effects

Sea level began to rise before 15,000 BC as soon as the ice sheets began to recede. The most rapid phases were between 8000 BC and 5000 BC, and the general increase was effectively over by 2000 BC when it may have been one or 2 m higher than today. There were a couple of very rapid stages like the melting of the Scandinavian ice sheet after about 8200 BC until 6000 BC, and the entry of the sea into Hudson bay around 6000 BC followed by a quick reduction of the Great North American a sheet by about 3000 BC.



The rise in world sea level as the former ice sheets melted and through post-glacial times.

(a) a smooth mathematical 'best fit' curve;

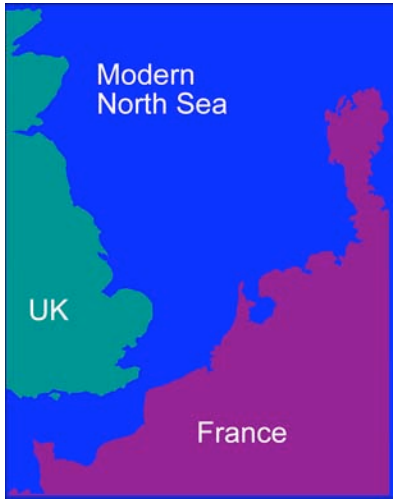
(b) main stages from numerous dated shorelines in the Baltic after subtracting glacial-eustatic rebound

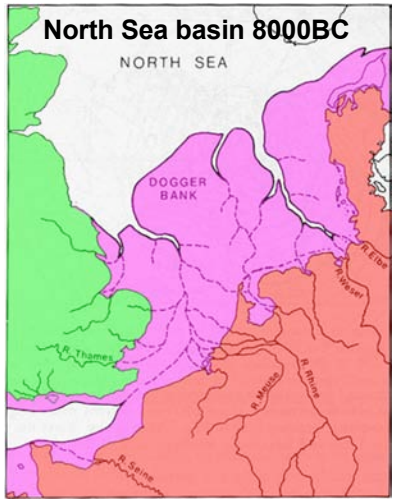
(c) curve based on agreement between different regions.

The isolation of the British Isles from the continent by the rising sea level stopped immigration of plants and animals. This accounts for the lower number of species in the British Isles compared to the European continent. The number of species is even lower in Ireland and on other small islands which were cut off by water from Britain sooner.

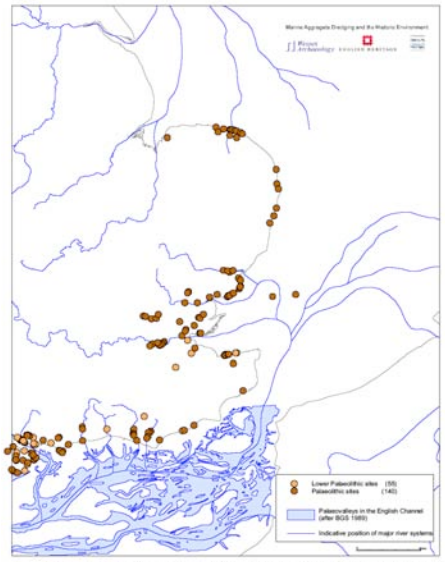
Coastal catastrophe- sea level change and its consequences 10,500 to 6,400BC

The 20-40mm sea level rise per year following 7,500BC is about the same predicted for the next century. Although this seems like a small change, the effects were catastrophic. At 7,500BC, the coast of northern Europe ran directly from eastern England to Denmark. Doggerland—the region now submerged below the North Sea—had a coastline of lagoons, marshes, mudflats, and beaches. It was probably the richest hunting, fowling and fishing ground in all of Europe. It is believed by some that Doggerland was the heart of Mesolithic culture.

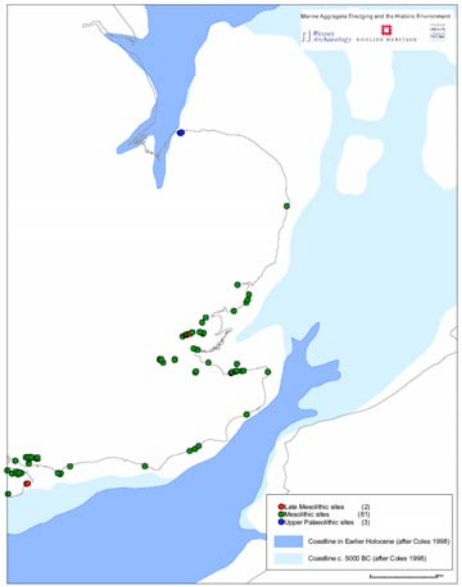




This lost world was first discovered in 1931 when a trawler (the Colinda) was fishing at night 25 miles east of Norfolk near the Owen Bank. Its skipper Pilgrim E. Lockwood, hauled up a lump of peat and broke it open with a spade. Inside was an elegant barbed antler point. Pollen studies of peat dredged from the area indicate that it was covered with woodlands. The age of the barb it turns out was 2,000 years older, indicating that is was lost while Doggerland was a tundra.

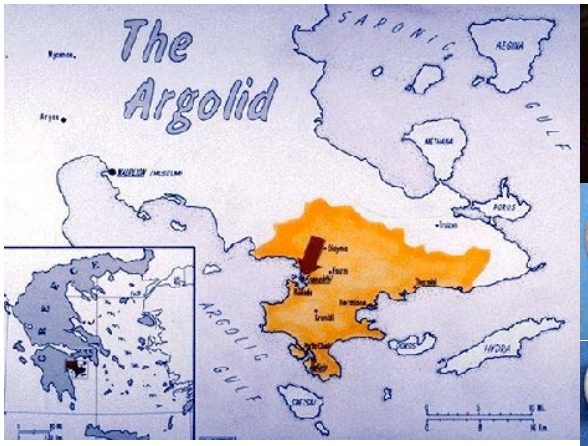


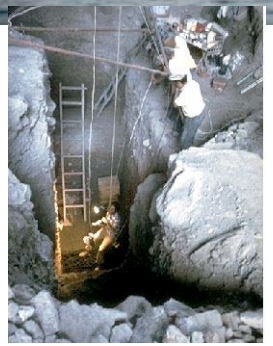
Palaeolithic site and drainage patterns in the English Channel and North Sea. This map was prepared using coastal data from the National Monuments Record and from the English Rivers Palaeolithic Project (see J. Wymer, *The Lower Palaeolithic Occupation of Britain*, 1999). The paths of major rivers, shown for the later Devensian, are based on B.J. Coles 'Doggerland: a speculative survey' (*Proceedings of the Prehistoric Society* 64, 1998). The pattern of former river valleys in the English Channel is based on R.J.O. Hamblin et al. (*The Geology of the English Channel*, 1992, Figure 62). Drainage patterns have changed massively in the period covered by the Lower, Middle and Early Upper Palaeolithic, the changing route of the Thames being but one example. However, the association of river valleys and Palaeolithic finds that is so evident on land is important in gauging the archaeological potential of river valleys that once traversed the now-submerged lowlands of Britain and its neighbours.



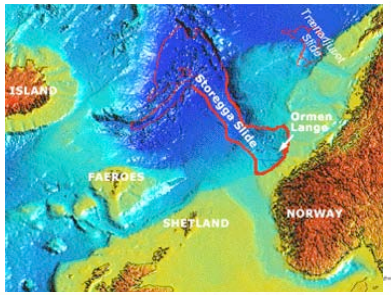
Late Upper Palaeolithic and Mesolithic sites with contemporary coastlines in the English Channel and North Sea. This map is based on coastal data from the National Monuments Record. Indicative coastlines are taken from B.J. Coles 'Doggerland: a speculative survey' (*Proceedings of the Prehistoric Society* 64, 1998). The presence of prehistoric artefacts at the coast and the influence of sea-level change on early-mid Holocene shorelines are both subject to research supported by the Aggregate Levy Sustainability Fund. Archaeological investigation of these submerged lands in coming years may profoundly change our understanding of the societies that re-inhabited Britain following the last glaciation.

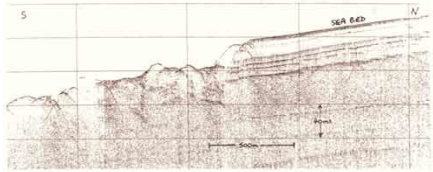
The Mesolithic coastal dwellers began to see their landscape change—sometimes within a single day, sometimes within a lifetime. High tides became higher then refused to retreat. Sandy beaches were washed away, coastal grasslands and woodlands became salt marshland washed daily by the sea which saturated the soil with salt.
As the North Sea invaded Doggerland, the Mediterranean edged closer to Franchthi Cave. By 7,500BC, the seashore was an afternoon walk away compared to a days walk for earlier inhabitants. Layers of buried food waste within the cave show how the Franchthi people first began to gather limpets and periwinkles and then became sea-going fishermen. This new lifestyle favored exploration and colonization: Corsica, Sardinia and the Balearic islands were settled for the first time.

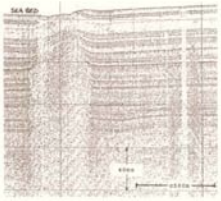




For some people of this period, the change may have been so slow as to go unnoticed; minute year-by-year shifts in diet, technology and knowledge, a subtle, unconscious moulding of lifestyle. Others would have witnessed the sea racing inland at the breaching of a shingle ridge or dune. Still others such as the inhabitants of what would one day become the town of Inverness in eastern Scotland faced catastrophe. Archaeologists have recovered almost 5,000 flint artifacts, bone fragments and a fireplace so far. On some day close to 7,000BC a small group of Mesolithic hunters were in a natural hollow in the dune. A few hours earlier, the massive sub-marine Storegga landslide occurred 1,000km to the north within the Arctic Ocean between Norway and Iceland.







Profiles across the scarp show the great change in the seismic character of the disturbed sediments. They become jumbled, massive and form an irregular sea-bed, and produce strongly hyperbolic reflectors. The figure also shows an almost intact slumped block immediately below the scarp. Seismic reflection profile from the Storegga Slide. Disruption of the layering indicating fluid escape structures due to degassing from the sediment.
It created a huge tsunami that probably hit their beach with a height of 8m. More than 17,000 cubic kilometers of white, stony sand buried everything as far as could be seen to the north and south. The impact of this tsunami across the low-lying coast of Doggerland must have been devastating. Many km of coastline are likely to have been destroyed within a few hours, perhaps minutes and many lives were lost.

Another catastrophe happened on the other side of Europe 3,500km away. The victims lived on the shore of the freshwater lake that would become the Black Sea. The lowlands around the lake provided flat fertile soil covered with oak woodlands in which people hunted and gathered for thousands of years. By the date of the event, however, a new people had arrived: Neolithic farmers. They had come from Turkey and settled on the rich alluvial soil; felling trees to make way for fields of wheat and barley and to provide wood for their houses, fences, and pens for cattle and goats. The Black Sea had become a lake during the Ice Age.

The level of the Mediterranean Sea had fallen below the Bosphorous channel, which became blocked with silt. The people who lived to the north of Doggerland, in what is now called Scotland, Norway and Sweden, also lost the coastline of their parents, grandparents, and earlier generations. But instead of becoming seafloor, their coastline became permanently dry as it was elevated. The weight of the glaciers had forced the land downward—causing the land to the immediate south to bulge upward. Consequently, when the ice melted the land evened out with the bulge dropping and the dent rising. Much of Doggerland had been within the bulge, and therefore the impact of rising sea level was exacerbated: just as the bulge was dying away, millions of gallons of meltwater were entering the oceans. Further north, where the bulk of the ice sat a race was on between isostatic rebound and sea level rise. In the far north the land was an easy winner.
The former center of the ice sheet located north of Stockholm has risen more than 800m and is still rising a couple mm per year. Further south along the coastlines of southern Sweden, the Baltic states Poland and Germany, the sea and the land had a neck and neck race periodically swapping the lead. This caused repeated havoc to all communities—plant, animal, and human, land and water—that managed to establish themselves just before the lead changed again. This story was put together by Svante Björck from the Danish Institute of Geology, who has studied the shells found buried at the bottom of the Baltic Sea together with sediment, raised beaches and drowned forests of that region.

By 6000 B.C., dense oak forests stretched from the Atlantic coast to western Russia, from the Alps to southern Scandinavia. Europe's long summers were several degrees warmer than today's, and it seized rose rapidly to near modern levels. During these warming millennia, Europe was home to sparse populations of hunters and forgers, many living along seashores, in river valleys, or by freshwater lakes. Most Europeans were constantly on the move, following the seasons of plant foods, exploiting salmon runs, and pursuing a migrating game. People lived in small bands of a few families.

Heavy rains what third Southwest Asia and North Africa. Lush oak forests grew along the flanks of the Euphrates and Jordan river valleys in what is now Syria and Jordan. Shallow lakes and semi-arid grasslands covered hundreds of square kilometers of the Sahara. Only 5000 years after the Scandinavian ice sheet began retreating, forests covered most of Europe and sparse human populations had settled on the shores of the newly exposed Baltic Sea. In about 6200 B.C., four centuries of cooler, much drier near-Younger Dryas conditions brought drought to South Eastern Europe and the eastern Mediterranean. Many farming settlements or abandoned as many communities retreated to the shores of permanent lakes and rivers, including the margins of the Black Sea, at the time a huge freshwater lake.

6000BC--southeastern Europeans used southwest Asian cereal crops, pulse crops, and livestock. These spread rapidly by 5000 B.C. Increased rainfall and warmer conditions returned in about 5800 B.C. deep sea cores and pollen analysis have documented the environmental catastrophe that followed.

When global warming began to melt the ice, sea level rose. As sea level rose, the Black Sea lake level fell due to decreased runoff and increased evaporation. As sea level rose above the base of the channel, the plug of silt held firm. It held as a giant wall of marine water built up on its western face. Then it began to seep and finally burst one day about 6,400BC, a cascade of salty water crashed with the force of 200 Niagara Falls into the lake and continued for many months. The roar would have been heard 100km away as 50 cubic kilometers of water filled the lake each day. Within a matter of months, 100,000sq km of lakeside woodland, marshland, and arable fields were submerged—an area the size of Austria.

The Bosporus

Many of these fugitives must have entered the forested European world. They lived by fire and ax, cultivating rich, weathered glacial soils, clearing the now temperate continent of its boreal forests. Slash and burn agriculture is a wasteful way of farming land.

The first such a farmers settled in the Danube Valley in about 5300 B.C. Within the seven centuries their descendants had slashed and burned their way from the Balkans to the Netherlands and east into the Ukraine. By 6000 B.C., these farmers were in Greece, at the boundary of Europe. Over the next 3000 years, most Europeans became farmers and transformed the landscape of the continent beyond recognition. In 3000 B.C. the world's first agriculturally based Urban and civilizations appeared in Egypt and Mesopotamia. At about the same time, maize farming began in Central America. 3000 BC hunter-gatherers of southern Sweden adopted farming of Southwest Asian crops but abandoned it around 2700 BC for 400 years.