

Science from a historical perspective: 175 years of change in the North Sea

Engelhard Georg H.^{1,2}

¹ Centre for Environment, Fisheries & Aquaculture Science (Cefas), Pakefield Road, Lowestoft NR33 0HT, United Kingdom

E-mail: georg.engelhard@cefas.co.uk

² School of Environmental Sciences, University of East Anglia (UEA), Norwich NR4 7TJ, United Kingdom

The world's seas and oceans have been subject to anthropogenic pressures for a very long time – from decades to centuries – and a newly emerged discipline, termed 'marine historical ecology', studies the long-term 'footprint' of human society on the marine environment. This plenary addresses 175 years of change in the North Sea, a shelf sea which is highly productive, but also subject to a particularly broad range of pressures. The talk is partly based on historical datasets, digitised from archives at Cefas and other government institutes in recent years. Already 175 years ago fisheries were extensive with thousands of sailing trawlers, and the North Sea far from 'virgin.' Steam power was introduced, and by the early 1900s the UK fleet alone numbered over 1200 steam trawlers, fishing in the entire North Sea. Fishing pressure increased steadily throughout the twentieth century, apart from temporary reductions during both World Wars, and especially accelerated from the 1960s onwards with developments such as mechanised beam trawling and improved fish finding techniques. It is only since the turn of the millennium that fishing pressure has decreased, aided by the European Union fleet reduction scheme, so that by now, many stocks are exploited sustainably. Meanwhile the North Sea has been a 'hotspot of marine climate change,' warming up more rapidly than surrounding seas; and has also undergone major changes in nutrient inputs from rivers, with associated periods of eutrophication.

This talk shows that climate change, fishing, changing nutrient inputs from rivers, and political events have been, and currently are, major drivers of the North Sea ecosystem. For example, each of these pressures have left a 'mark' on what might be the world's longest time-series on fish size distribution: North Sea plaice, from 1902–present. At different times, either larger or smaller plaice predominated the size distribution, and changes in average sizes of fish can be attributed to prevailing pressures or drivers. A range of North Sea fish species have also shifted their distribution over the past century – often northward and deepening as may be expected with global warming, but sometimes southward and into shallower waters. Not only climate change, but also fishing has acted as driver of distribution shifts; this has been the case in at least cod, sole, and turbot. The North Sea has also seen changes in the elasmobranch (skates and sharks) assemblage over the past century, shifts in the timing of spawning of fish, and a marked range expansion of squid. Combined these changes, which have come to light through analysis of long-term, historical datasets, indicate a fundamental reorganisation of marine communities over time. This demonstrates how 'marine historical ecology' can provide us with a substantially improved, and more holistic perspective of long-term change: not only to help understand what happened long ago, but in support of current and future management of our marine environment.

Keywords: North Sea; marine historical ecology; climate change; fisheries; fishing pressure; nutrients; size distribution; distribution shifts