

Science for Environment Policy

Warming in the Channel leads to a decline in cold-water fish

Results from a long-term study of fish communities in the Bay of Somme in the English Channel show that numbers of cold-water fish, such as dab and plaice, have been dropping since 1998, as sea temperatures have risen. The researchers say this is evidence of 'tropicalisation' in an English-Channel ecosystem. The findings may have implications for conservation policies in the Bay, which is a Marine Protected Area¹ designated under the Natura 2000 programme, as well as other marine sites affected by warming.

Water temperature is the 'master factor' in aquatic ecosystems, influencing the behaviour, growth and physiological processes of fish and other organisms. Shifts in temperature can consequently affect the distribution of fish communities, as waters become more or less habitable for particular species. A number of recent studies have shown that the effect of global warming on sea temperatures can cause tropicalisation of fish communities²; species preferring warmer waters are increasingly inhabiting seas formerly dominated by cold-adapted fish. As well as altering local ecosystems, these modifications may have socio-economic impacts, for example changing the composition of catches for fishermen.

The researchers behind this study aimed to investigate whether tropicalisation has occurred in the Bay of Somme, the largest estuarine ecosystem in Northern France, covering more than 50 square kilometres (km²). They note that since the 1980s, sea-surface temperature in the North Atlantic area has risen by 0.2–0.6 °C, with the most noticeable shift occurring in the late 1990s, especially affecting the English Channel. According to the researchers, warming in the 1990s also seems to have been exacerbated by the Atlantic Multidecadal Oscillation, a natural climate cycle that affects the sea-surface temperature of the North Atlantic Ocean, seeing it swing between warm and cold phases every few decades.

Fish were sampled every year in late summer, from 1980 to 2012. A total of 49 types of commonly found fish, categorised by researchers as taxa (families, genera and species), were included in the study, with an average for each type calculated per km², per year, indicating changes in community structure. Fish were categorised by their preferred sea temperature; for example, sprats (*Sprattus sprattus*) were in the 9–10 °C group. This allowed the researchers to analyse fish numbers in terms of the mean temperature of the catch (MTC) index³, which indicates the average temperature preference of the whole fish community in a sample site.

On average, the researchers found an annual increase in MTC of 0.2 °C per decade, over the course of the study. However, analysis showed a significant change in community structure from 1998 to 2003, with the MTC index jumping from just over 11 °C to approximately 12.2 °C during this period. Before 1998, the community was relatively stable, with an average MTC of 11.49 °C, and stabilised again after 2003, but with a higher MTC of 11.91 °C.

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1. http://ec.europa.eu/environment/nature/natura2000/marine/index_en.htm

2. e.g. Fortibuoni, T., Aldighieri, F., Giovanardi, O., et al. (2015). Climate impact on Italian fisheries (Mediterranean Sea). *Regional Environmental Change*, 15(5): 931–937.

3. e.g. Cheung, W.W.L., Watson, R. and Pauly, D. (2013). Signature of ocean warming in global fisheries catch. *Nature*, 497: 365–368.

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After 1998, the study found a significant decline in fish from the Gobiidae family — dragonet (*Callionymus lyra*) and dab (*Limanda limanda*) — all in the 10–11 °C group — and plaice (*Pleuronectes platessa*) and sprat (*Sprattus sprattus*), in the 9–10 °C group. A minor fall in mackerel (*Scomber scombrus*), whiting (*Merlangius merlangus*), European pollock (*Pollachius pollachius*) and lemon sole (*Microstomus kitt*), also contributed to the drop in the 10–11 °C group of fish. However, scaldfish (genus *Arnoglossus*) — a warmer-water fish — saw a significant increase. The increase in MTC was, therefore, chiefly attributed to a decrease in colder-water species, rather than a rise in warmer-water fish, although there was a slight increase in some warmer-water species, such as sardines (*Sardina pilchardus*) and red mullet (*Mullus surmuletus*).

To positively link changes in fish communities with warming sea temperatures, the researchers correlated sampling results with data on oceanic and atmospheric conditions in the Atlantic, obtained from the [US National Oceanographic and Atmospheric Administration](#) and the [Hadley Centre for Research and Climate Prediction](#). Data on local surface sea temperature and weather in the Bay of Somme over the time period was also compiled. Significant relationships were found between the Atlantic conditions and the structure of the fish community up to six years later, while local conditions appeared to influence variation over a shorter timescale, up to two years later. Although the effects of warming may not be detectable in the short term, the researchers conclude that the causes of changes in the fish community relate to wider, global conditions.

The researchers also acknowledge that other biological and ecological factors — for instance, an increase in predators or a decrease in plankton — are likely to directly and indirectly affect fish communities, as is fishing. The key factor, though, is sea temperature, indicating the need to monitor changes in marine ecology in response to climate change over long timescales. This monitoring data can be used to inform policies relating to marine protection.

Importantly, the researchers hypothesise that colder-water species are migrating northwards from the Channel to the North Sea in response to warming, so analysis of communities in more northerly seas could provide further evidence of tropicalisation.

