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Herring organs damaged by acidified seawater

Ocean acidification could damage the organs of Atlantic herring, as well as slow their growth and development, recent experiments show. It adds to the list of pressures currently threatening this commercially important species, including over-fishing and marine pollution.

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Our oceans are changing as high levels of atmospheric CO_2 dissolve into seawater and lower its pH to become more acidic. The average pH of the world's oceans has dropped from an estimated 8.2 to around 8.1 since the beginning of industrialisation. It has been predicted that it will fall by another 0.4 units by 2100. While it is already known that ocean acidification will have damaging effects on some marine creatures, its impacts vary by species and very little work has been done on herring.

The study investigated acidification's likely effects on Atlantic herring (*Clupea harengus*), which has a range stretching from the east coast of North America to the west coast of Europe and the Baltic Sea. The Baltic Sea suffers with eutrophication, which aggravates acidification. Acidification is therefore expected to be particularly severe in the Baltic, an important spawning ground for this heavily-fished species. In fact, pH values of 7.2 have already been recorded in parts of the Baltic.

The research team, part-funded by the EU EPOCA project[1], hatched eggs taken from herring caught off the Norwegian coast. They reared the larvae to 39 days old in large outdoor tanks, also in Norway. Conditions in the tanks were designed to recreate natural marine conditions, including temperature, salinity and water quality (such as ammonia levels).

The researchers then varied the water's acidity by dissolving different amounts of CO_2 into different tanks. The first tank (the control) recreated the average acidity of today's oceans, with a pH value of 8.08. The second and third had higher acidification levels, with pH values of 7.45 and 7.07, labelled 'medium' and 'high', respectively.

Larvae raised in the medium and high treatments showed more signs of organ damage than the controls. Cell damage was seen in the liver, kidneys and pancreas, and fins were abnormally shaped.

Their development was also delayed. Over 80% of medium treatment fish, and over 90% of high treatment fish, did not develop beyond the first two life stages of herring development during the study. This compares with around 55% in the control group.

Fish reared in more acidic waters were also smaller. At 39 days old, the herring larvae raised in the medium water typically weighed 30% less than the control larvae, and were around 6% shorter. Those from the high treatment were around 40% lighter than the controls, and 10% shorter. This is a concern because, in the wild, small fish are more likely to be preyed upon than larger fish, and are less able to survive.

In theory, herring could evolve and adapt to more acidic waters, the study says. There are a number of factors which would aid their evolution, including their geographic spread over a large area, large population sizes, genetically-distinct sub-populations and relatively short generations.

In practice, however, evolution will be limited by other major environmental pressures that threaten their survival. These include over-fishing, pollution, warming and eutrophication. Acidification's effects should be considered when forecasting future sizes of herring populations, the study recommends.

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1.EPOCA (European Project on Ocean Acidification) was supported by the European Commission under the Seventh Framework Programme: www.epoca-project.eu