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The world’s shellfish are under threat as our oceans become more acidic

January 28, 2019 3.06pm GMT

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For the past few million years the world’s oceans have existed in a slightly alkaline state, with an average pH of 8.2. Now, with carbon emissions escalating, there is more CO_2 in the world’s atmosphere. This dissolves in the oceans, altering the chemistry of the seawater by lowering the pH and making it more acidic – up to 30% more in the past 200 years. This growing acidification of the oceans is becoming a serious problem for the production of shellfish around the world.

Author

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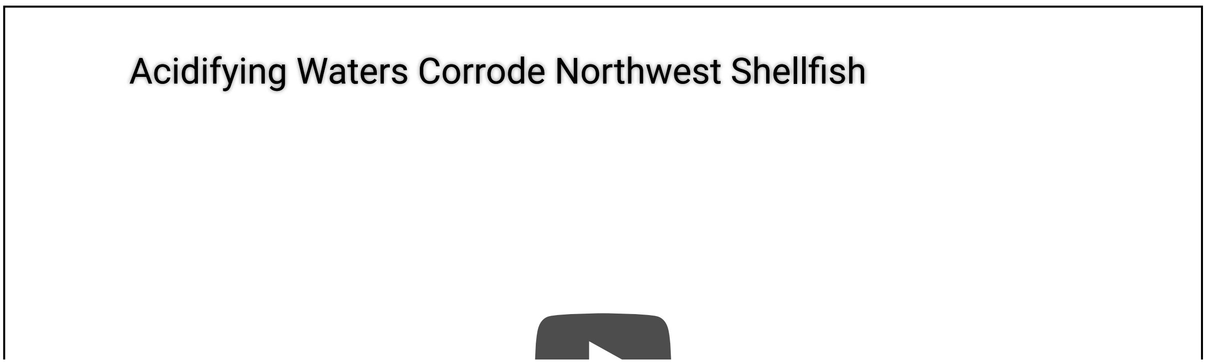
Shellfish are creatures which produce calcium carbonate shells and skeletons, such as mussels, oysters and corals. They create their protective shell structures through a process known as biomineralisation – producing hard minerals such as calcium carbonate by filtering calcium and carbonate from the water. If the amount of carbonate available in the oceans is reduced by acidification, it limits the ability of these creatures to create shells.

But now coastal acidification is happening close to land in regions where freshwater run-off can release sulphate soils and excess carbon, which also lowers pH and carbonate available for producing shells. This is being exacerbated by flooding and rises in sea levels caused by climate change.



A global problem

Recent studies reported these implications for the Sydney rock oyster in New South Wales, Australia. Historically, oyster production in the region has seen a decline in larger "plate-grade" oysters and an increase in smaller oysters. This can be due to a number of reasons which are physical, biological and economic, including pressures on farmers to harvest oysters early to avoid high winter mortalities in cold dry weather.

But our recent study suggests that coastal acidification in Australia is damaging oysters' ability to grow properly as well. The change in shell growth mechanisms could have implications for the future, such as producing thinner shells which are prone to fracture, causing potential risk of shell damage during culture and harvesting.

The situation in New South Wales is not an isolated case. In Washington state in the US, acidification caused by deeper, colder seawater with high levels of CO_2 rising to the surface has caused malformations in oyster larvae and loss of hatchery seed production.

Read more: Explainer: why ocean acidification is the evil twin of climate change

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A report by one shellfish hatchery detailed the impact on shell formation in oyster larvae under these detrimental conditions. Oyster farms in Washington, have put measures in place to sustain oyster shellfisheries under increasingly acidic conditions. This includes treating hatchery water to increase pH, making more carbonate available for early larvae shell formation, and growing oyster seed in different locations to ensure their survival for future production.

In Scotland, a country famous for its high-quality shellfish, acidification is less of an imminent threat. There are no sulphate soils or deeper water with high levels of CO_2 rising to the surface, as can be found in Australia and America. But as coastal acidification is made worse by climate change – in particular freshwater run-off from increased rainfall and sea-level rise – this could have a serious effect on commercial shellfisheries all over the world, including Scotland.

The changes in seawater chemistry associated with freshwater run-off include lowered salinity and pH, and carbonate availability. This, coupled with increasing temperatures, adds pressures to shellfish farmers producing mussels and oysters.

An acidic seawater environment can produce thinner shells in oysters that can be more easily damaged in transit.
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I have previously reported on the effect of experimentally induced high CO_2 acidification on mussels, where shells showed reduced growth and became more brittle. Shellfish are predicted to produce thinner shells which may also be more prone to fracture throughout harvesting, transportation or when another animal attempts to eat them.

Breeding and resilience

The industry needs to consider ways to reduce this risk. In Washington producers have adjusted the carbonate chemistry in oyster hatcheries to develop larvae before release into farms where acidification has the potential to reduce early shell development.

In New South Wales, the Department of Primary Industries has done studies on the Sydney rock oyster to examine the potential for selective breeding to develop resilient strains that can cope better with more acidic seawater conditions. Researchers have reported on the potential for selective breeding for disease resistance and faster shell growth, which could create acidification resilience in the oyster.

Our next step working with Australia's DPI is to examine these selectively bred oysters to understand the potential for combating the acidification problem. It is important for the Scottish shellfish industry to understand the risks posed by climate change already playing out in Australia and the US. With climate change in the future threatening freshwater and CO_2-induced ocean acidification in UK waters, the country could suffer the same fate.

Carbon emissions Scotland Shellfish Ocean acidification