European Commission

Science for Environment Policy

Europe could suffer major shellfish production losses due to ocean acidification

Ocean acidification threatens marine ecosystems worldwide, but economic assessments of its impact are lacking. A recent study has predicted the future cost of ocean acidification on mollusc production in Europe and showed that the highest economic impacts would be in France, Italy and Spain. For Europe overall, the annual damage could be in the region of €0.9 billion by 2100.

The role of carbon dioxide (CO_2) in climate change is well reported, but the greenhouse gas has many other environmental effects. One of these is lowering the pH of the oceans, making them less alkaline.

Oceans are a sink for carbon, taking up around one third of all CO_2 emitted by humans. The resulting drop in pH can have drastic effects on marine ecosystems. Calcifying organisms, such as corals, algae and shellfish, which use calcium carbonate from the water to build their skeletons or structures, are particularly vulnerable. This is because, as pH falls, the concentration of carbonate in the water decreases (meaning it takes longer to build structures) and may even cause structures to dissolve.

Environmental impact assessments of the damage caused by ocean acidification are critical. These assessments need to be supplemented by economic assessments to help policymakers plan adaptation and mitigation strategies.

This study focused on the economic impact of ocean acidification on mollusc production in Europe — including both EU and non-EU countries. Europe is a particularly useful case study due to the range of harvested mollusc species and environmental conditions across the continent. Europe is also the world's second biggest producer of molluscs from aquaculture, and collects the fourth most molluscs from natural resources (known as 'capture fishing'; for mussels, this is predominantly through ocean trawling). The study focused on molluscs as there is a wealth of scientific information available on the biological impacts of ocean acidification on these species.

The researchers gathered data from past biological experiments on reductions in calcification and growth caused by ocean acidification and from the UN Food and Agriculture Organisation (FAO) Fisheries and Aquaculture Department on the quantities and value of molluscs produced across Europe on farms for different countries and species between 2001 and 2010. The FAO data covered 54 species belonging to six groups: (1.) abalones, winkles and conches; (2.) oysters; (3.) mussels; (4.) scallops and pectinids; (5.) clams, cockles and arkshells; and (6.) marine molluscs and 'others'.

As the FAO does not hold data on capture fisheries the researchers assumed that the prices for capture and aquaculture are the same for identical species, and estimated values of captured molluscs using the aquaculture data. They also investigated impacts at a sub-national level using data from the Sea Around Us database.

Using these data, the researchers estimated the economic losses to mollusc production caused by ocean acidification for the year 2100. They used two methods for this: a simple multiplication of the value of mollusc production and a loss rate, and a more complex partial equilibrium model, which accounts for the effects of a price shift due to reduction of supply. They assumed pH changes consistent with the IPCC's Representative Concentration Pathway (RCP) 8.5 scenario ('business-as-usual').

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The simple estimate of annual economic loss in Europe due to damages to mollusc production by 2100 was $0.67 billion (€0.6 billion using today's exchange rate), but when income and price effects were included this rose to almost $1 billion (€0.9 billion).

Countries predicted to suffer most are those with the highest levels of production: France, Italy, Spain and the UK. There were also within-country differences. The regions that would be most affected are those on the Atlantic coast of France, which harvests significant numbers of oysters, as well as parts of Greece, Spain and the Netherlands, which make significant contributions to Europe's mussel production.

The study's authors point out that their estimates are small compared to the total economic costs of climate change. They also say that they only analysed a small selection of fisheries (due to limited data on ocean acidification), and that the total impact of ocean acidification on fisheries may be much greater. Furthermore, the ocean provides value other than fisheries, such as recreational value and biodiversity, which will also be affected by acidification.

While the authors acknowledge limitations to their estimates[1], the figures provided in the study give an idea of the scale of the impact of ocean acidification and could be useful for future policy discussions regarding climate change, provided that similar valuations are carried out on a much wider scope.

1. The paper makes several assumptions to derive these estimates, including that fisheries and aquaculture production will remain the same as 2001–2010 levels in the future, that acidification will equally affect the production of different species in capture fisheries and aquaculture, and that the prices per kilogram are the same for fisheries and aquaculture products.