Mussels and Oysters Threatened by Ocean Acidification

According to a recent study by French and Dutch researchers, ocean acidification resulting from human emissions of carbon dioxide is seriously threatening edible shellfish such as mussels and oysters. The predicted impacts on the ability of these species to produce their shells as a result of ocean acidification may have important consequences on the biodiversity and functioning of coastal ecosystems and potentially lead to substantial economic losses.

A large quantity of anthropogenic CO$_2$ emissions has been stored in the oceans, thus making them more acidic. Consequently, ocean pH has experienced some variations since the beginning of the industrial age, with a decline of 0.1 units. It is predicted that it will fall by a further 0.4 units by the end of the century. Sea water acidification will lead to a shift in the carbonate system equilibrium towards higher CO$_2$ and lower carbonate ion concentrations.

Several marine organisms such as coral reefs, coralline algae and molluscs produce calcareous skeletons or shells (calcifying organisms). They rely on steady carbonate ion concentrations in order to produce the calcium carbonate needed to develop their shells. Previous studies have shown how this pH decrease can slow up the production of calcium carbonate by marine organisms such as coral, algae and phytoplankton. Nevertheless, few studies have investigated the detrimental effect of acidic waters on bivalves such as mussels and oysters, especially within the range of atmospheric CO$_2$ values projected by the Intergovernmental Panel on Climate Change (IPCC).

As part of the EU-funded research projects MARBEF$^1$ and CARBOOCEAN IP$^1$, Dutch and French scientists have recently investigated the impact of elevated CO$_2$ on mussel and oyster calcification. To this end, the researchers used tanks with controlled seawater to observe these two species of shellfish, and in particular calcification rates, as greater amounts of CO$_2$ were added.

Their findings suggest that, like other calcifying organisms, oysters and mussels are seriously threatened by a change in the pH level of the world's seas. They found that the ability of mussels and oysters to produce shell material may decrease by 25% and 10% respectively in seawater with CO$_2$ levels of 740 parts per million per volume (ppmv), as expected for the year 2100 according to the IPCC scenarios. They also observed that when CO$_2$ reached 1,800 ppmv, mussel shells started to dissolve.

These findings may have important consequences in the future, given the important role that mussels and oysters play in the environment in governing energy and nutrient flows in coastal ecosystems, providing habitats for other species, and constituting important food sources for birds. Any decline in these species of shellfish would have major consequences for coastal biodiversity.

Furthermore, these two species represent a large part of worldwide aquaculture production. Indeed, for the last 30 years, global shellfish production has increased by approximately 8% annually. In 2002, it reached 11.7 million tonnes, corresponding to a commercial value of €7.9 billion. The pacific oyster, the one investigated in this study, was the most cultivated species in 2002 (10.8% of the total world aquaculture production). The predicted decrease in calcification will probably cause important economic losses in the sector.

Finally, the authors highlight that in order to fully assess the impacts of ocean acidification, further investigation on the adaptive responses of these organisms to long term CO$_2$ enrichment is required.

$^1$The MARBEF project “MARine Biodiversity and Ecosystem Functioning” (http://www.marbef.org) and the CARBOOCEAN IP project “CarboOcean Integrated Project- Marine carbon sources and sinks assessment” (http://www.carboocean.org) are supported by the European Commission under the 6th Framework Programme within the thematic programme “Sustainable development, global change and ecosystems”.

Contact: f.gazeau@nioo.knaw.nl
Theme(s): Marine ecosystems, climate change and energy
Opinions expressed in this News Alert do not necessarily reflect those of the European Commission
To cite this article/service: “Science for Environment policy”, European Commission DG Environment News Alert Service, edited by BIO Intelligence Service.