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OCEAN ACIDIFICATION & CALCIFYING PLANKTON IN SCOTTISH COASTAL WATERS

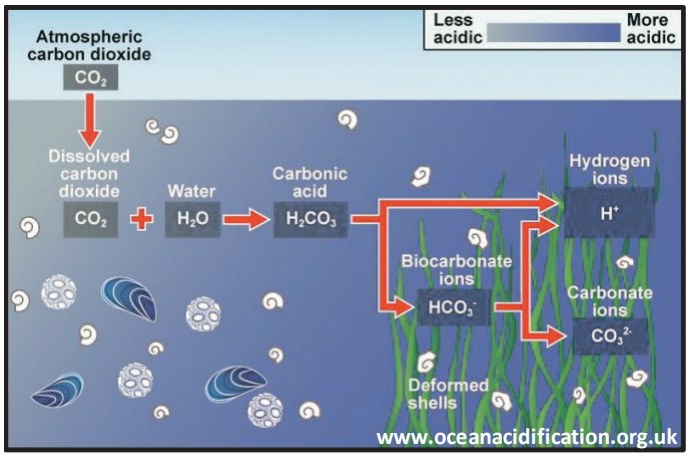

FIGURE 1
POTENTIAL IMPACTS OF OCEAN ACIDIFICATION ON MARINE ORGANISMS WITH OUTER SKELETONS CONTAINING CALCIUM CARBONATE.

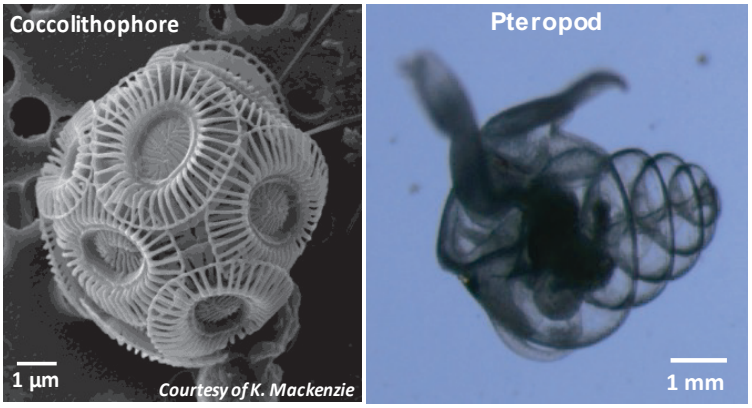

FIGURE 2
SOME CALCIFYING PLANKTON SPECIES MONITORED IN SCOTTISH WATERS: COCCOLITHOPHORES AND PELAGIC GASTROPODS.

What is ocean acidification?

Ocean acidification (OA) is a change in the carbonate chemistry of the ocean making it more acidic (e.g. a decrease in the pH of the earth's oceans). This is primarily as a result of the increased absorption of anthropogenic carbon dioxide (CO_2) from the atmosphere by the ocean.

There is real concern amongst the scientific community that this decrease in pH will impact marine life living in the oceans.

Calcifying plankton as a proxy for ocean acidification

Plants and animals with outer skeletons made of calcium carbonate are thought to be particularly vulnerable. Increased acidity may dissolve the calcareous shells and impact shell formation (*see* fig 1).

Calcifying plankton are microscopic organisms widely distributed in the world's oceans. They play a key role in the marine carbon cycle and are important components of the pelagic food webs. The potential impacts of OA on this group may transfer through the food chain to upper levels, potentially affecting fish and aquaculture species of commercial importance. Thus, calcifying plankton have been suggested as potential indicators for assessing the biological effects of ocean acidification.

Calcifying plankton and ocean acidification in Scottish waters

As part of the Scottish Coastal Observatory (SCObs), Marine Scotland Science (MSS) is operating one of two monitoring stations in the UK where OA and plankton are monitored in coastal waters. The other is the L4 station offshore from Plymouth.

Carbonate chemistry parameters have been measured since 2009 at the SCObs monitoring site at Stonehaven in the north east of Scotland. Samples have also been examined to investigate the diversity of calcifying phytoplankton

(coccolithophores) and zooplankton (pelagic gastropods) at this site to assess the potential impacts of OA on these species (*see* fig 2).

The MSS programme on OA has recently expanded to the SCObs monitoring site at Loch Ewe (west coast).

FIGURE 3
LOCATION OF THE STONEHAVEN AND L. EWE MONITORING SITES WHERE CARBONATE CHEMISTRY AND PLANKTON ARE BEING MONITORED.

What the Stonehaven data tell us

The calcareous phytoplankton (tiny "plants" called coccolithophores) present at Stonehaven are dominated by the species *Emiliania huxleyi*.

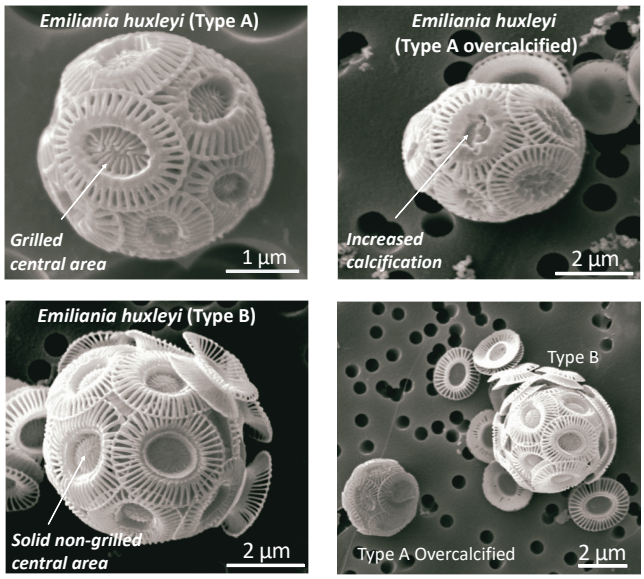

FIGURE 4
THE DIFFERENT *E. huxleyi* MORPHOTYPES OBSERVED AT STONEHAVEN.

Three different morphological forms of *E. huxleyi* categorised by size and degree of calcification have been observed. The distribution of these different forms throughout the year follows a seasonal pattern independent of the carbonate chemistry conditions at the site.

The pelagic gastropod ("sea snails") community at Stonehaven includes a number of species groups: pteropods (which live their entire life in the plankton) and the pelagic larvae of otherwise benthic (sea bed) species.

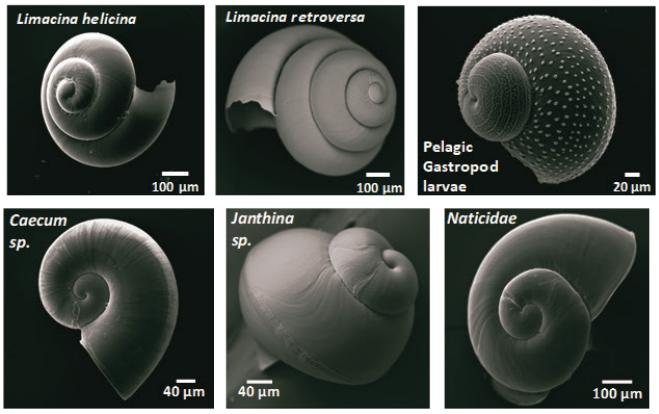

FIGURE 5
SOME PELAGIC GASTROPOD SPECIES OBSERVED AT STONEHAVEN.

An investigation into pelagic gastropod larvae shells has shown evidence of shell dissolution in these animals at the Stonehaven site. Shell dissolution has been also observed in some bivalve larvae. How this dissolution relates to environmental parameters is still under investigation.

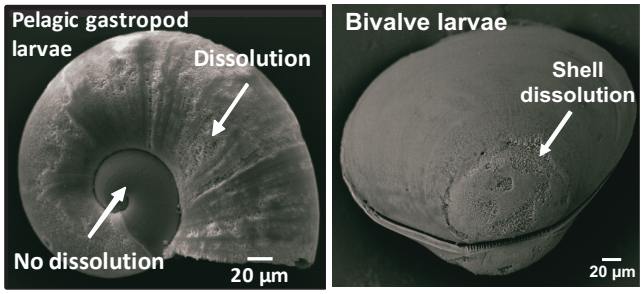

FIGURE 6
PELAGIC GASTROPOD AND BIVALVE LARVAE SHOWING SHELL DISSOLUTION.