'Black box' plankton found to have huge role in ocean carbon fixation

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Carbon fixation by phytoplankton in the open ocean plays a key role in the global carbon cycle but is not fully understood. Until now researchers believed that cyanobacteria overwhelmingly accounted for phytoplankton's role in carbon fixation in the open ocean. But now scientists at the University of Warwick and the National Oceanography Centre in Southampton have opened 'the black box' of eukaryotic phytoplankton and discovered that they actually account for almost half the ocean's carbon fixation by phytoplankton.

Blue-green algae, or cyanobacteria, grow in vast numbers in the sunlit surface waters of the oceans, the photic zone. They use sunlight to 'fix' carbon by converting carbon dioxide into sugars and other organic compounds through photosynthesis.

Cyanobacteria belong to the 'picophytoplankton', the tiniest phytoplankton. Until now they have been thought to dominate carbon fixation in the open ocean, with species belonging to the genera *Prochlorococcus* and *Synechococcus* being particularly abundant.

Like all bacteria, cyanobacteria are prokaryotes, distinguished from eukaryotes by the absence of a cell nucleus. However, although much less abundant than cyanobacteria, the photic zone also has a high biomass of small eukaryotic phytoplankton capable of carbon fixation.

"The eukaryotic phytoplankton community has long been a 'black box' in terms of its composition as well as contribution to carbon fixation," says

Professor Dave Scanlan of the University of Warwick; "Determining how much carbon different groups fix into biomass is required for a full understanding of the Earth's carbon cycle," adds Professor Mikhail Zubkov of the National Oceanography Centre.

In research, published today 15th April 2010 in the *Journal of the International Society for Microbial Ecology*, the scientists report how they measured carbon fixation by dominant phytoplankton groups in the subtropical and tropical northeast Atlantic Ocean, using samples collected from surface waters during a research cruise aboard the Royal Research Ship Discovery.

They discovered that eukaryotic phytoplankton actually fix significant amounts of carbon, contributing up to 44% of the total, despite being considerably less abundant than cyanobacteria. "This is most likely because eukaryotic phytoplankton cells, although small, are bigger than cyanobacteria, allowing them to assimilate more fixed carbon," says Zubkov.

Two groups of eukaryotes were distinguished, 'EukA' cells being more abundant but smaller than 'EukB' cells. Molecular techniques revealed that EukB largely comprised photosynthetic organisms called prymnesiophytes, most of which have never been cultured in the laboratory. Many of these are probably previously unknown species.

"Prymnesiophytes accounted for up to 38 per cent of total primary production in the subtropical and tropical northeast Atlantic Ocean," says Scanlan: "This suggests that they play a key role in oceanic carbon fixation, but this needs to be confirmed by widespread sampling from the world's oceans."

Zubkov recently showed that small eukaryotic phytoplankton can obtain carbon by feeding on bacteria, supplementing carbon fixed through

photosynthesis.

It is likely that some of the organic carbon of prymnesiophytes and other eukaryotic phytoplankton is eventually exported from the photic zone to the deep ocean, rather than being returned to the atmosphere in the form of carbon dioxide.

"Given their clear importance, it is crucial that we now go on to understand the factors controlling growth of small eukaryotes in the oceans," concludes Scanlan.

More information: The paper is entitled “Significant CO2 fixation by small prymnesiophytes in the subtropical and tropical northeast Atlantic Ocean” first published online by ISME on 15th April 2010. see www.nature.com/ismej/journal/v … ll/ismej201036a.html

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