PICCOLO

PML | Plymouth Marine Laboratory

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The dual effect of Antarctic krill on phytoplankton blooms - grazing and nutrient supply

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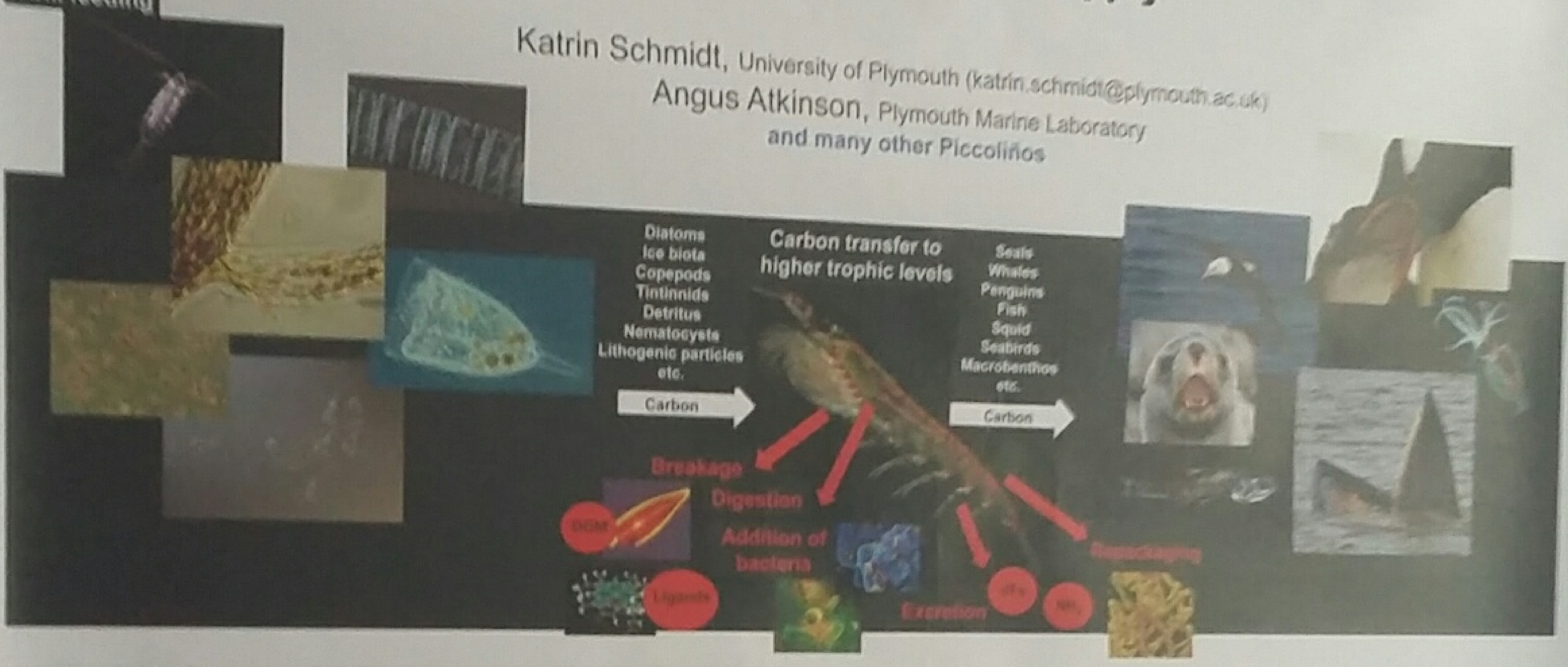
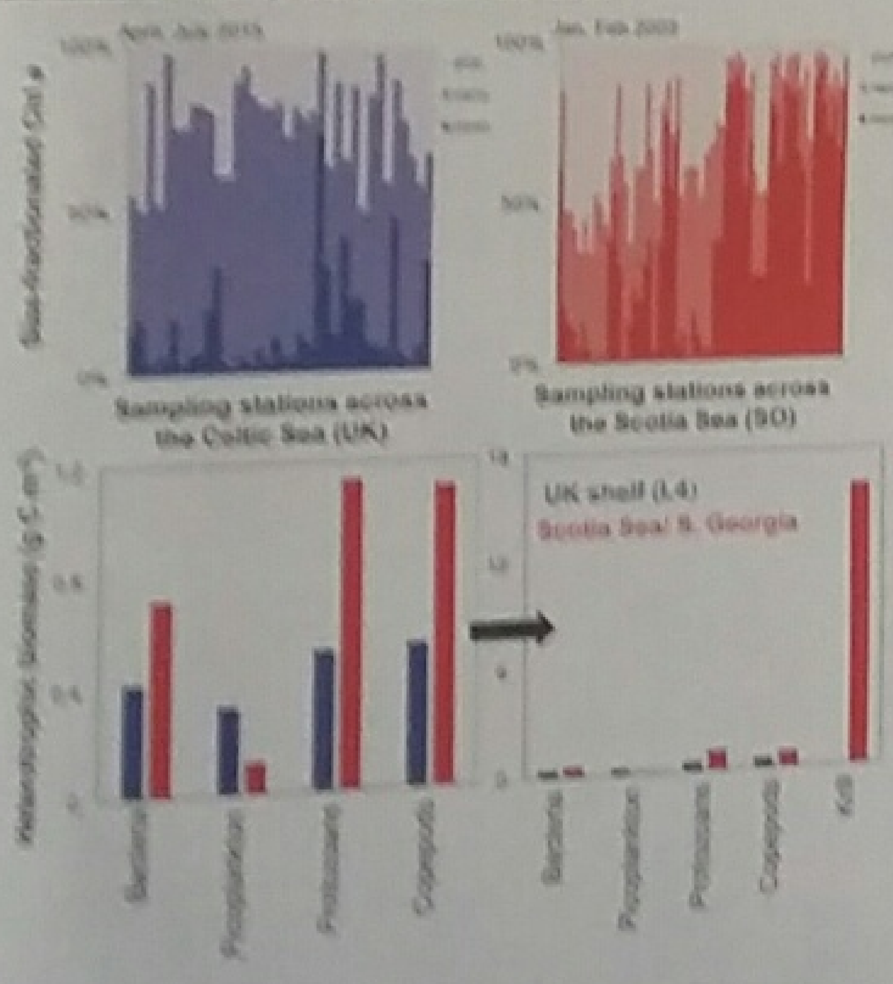
Krill feeding



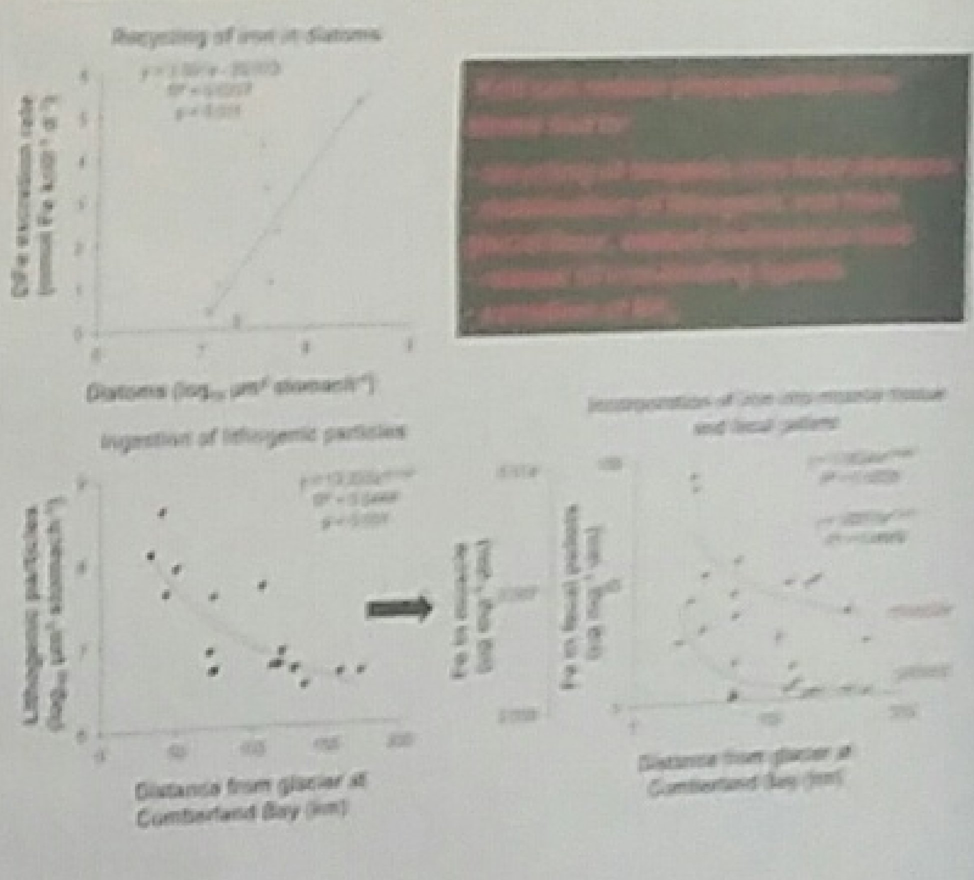
Why are krill likely to be important in SO carbon- and nutrient cycles?

(1) The SO is a 'sea of giants'



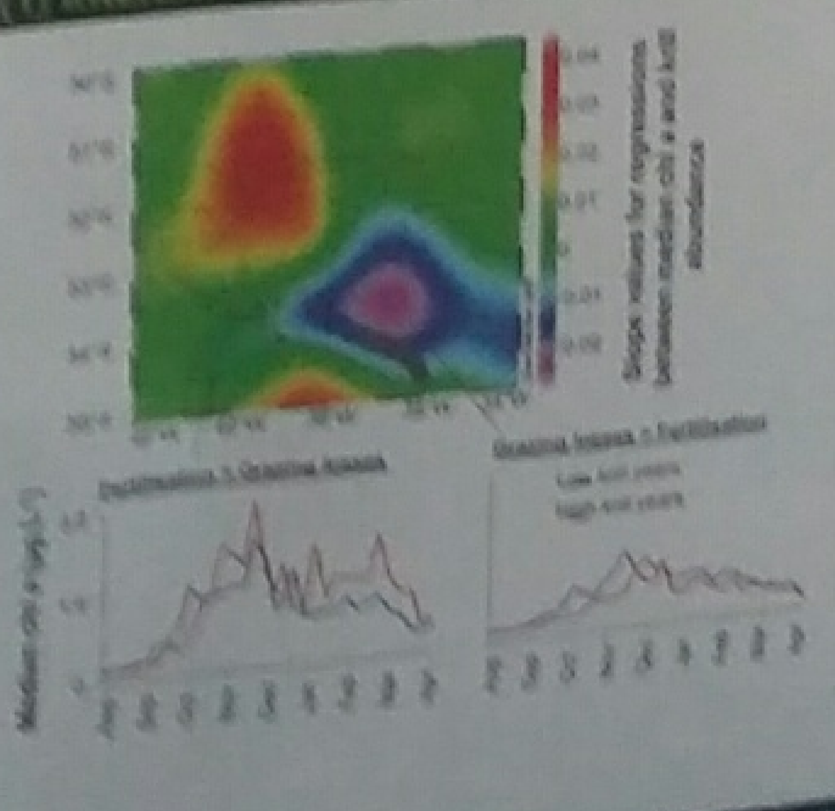
In UK shelf seas, the spring-summer primary producer community is often dominated by nanoplankton (2-20 µm), while microplankton (>20 µm) are rare (14±15% of total Chl a). In the SO, the micro-size fraction is much more prevalent, contributing 40±20% of total Chl a. These large diatoms are efficiently grazed by giant zooplankton - krill, salps and large copepods. The biomass of Antarctic krill is estimated to be similar to the global biomass of cattle (100-500 million tonnes). Key to these high krill abundances are their relatively low mortality rates and longevity, and their ability to migrate within seasons to search for feeding grounds. With the reduction of sea ice and other climate related changes in the Atlantic sector of the SO, krill abundances are in decline.

(2) Krill can recycle biogenic iron and mobilise lithogenic iron



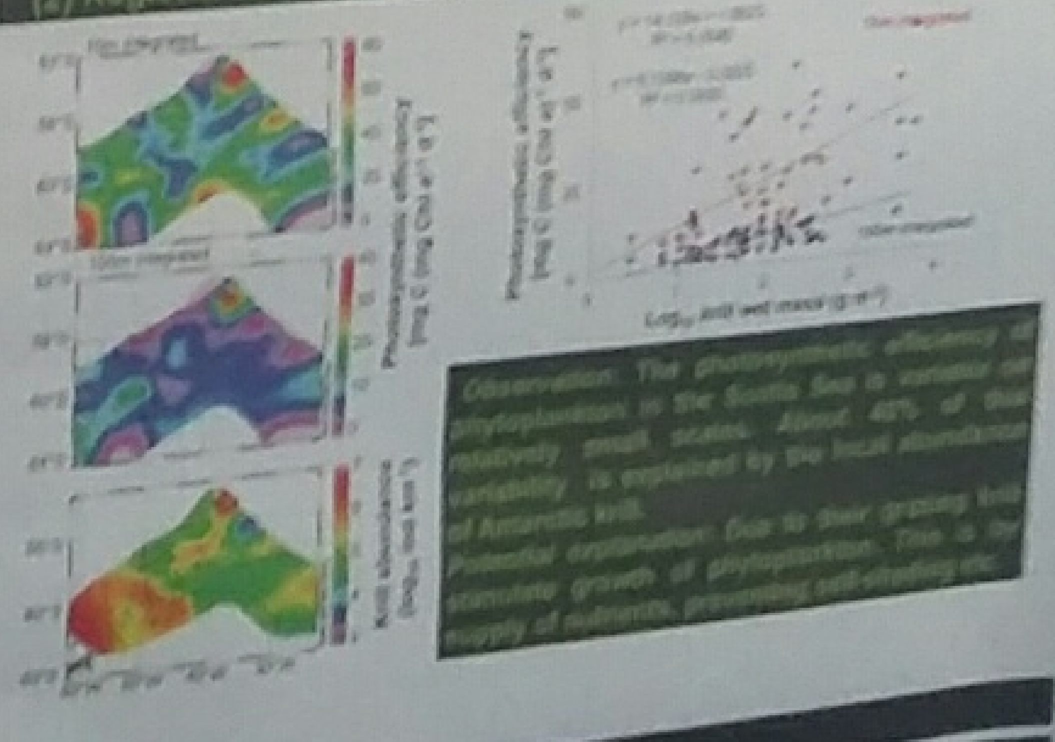
In situ indications of krill stimulating phytoplankton growth in the SO

(1) Interannual variability in the phytoplankton bloom downstream of S. Georgia



Observation: Years with high krill abundances on the South Georgia shelf coincide with lower chl a concentrations on the shelf (blue-purple area), but higher chl a concentrations downstream the island (yellow-red area).
Potential explanation: On the shelf, grazing losses by krill outweigh potential benefits of their phytoplankton fertilisation, but downstream fertilising effects outweigh grazing losses.
Potential processes involved:
Krill: recycling and mobilisation of iron & other trace elements, supply of ligands, DOM, NH_4 etc.
Microbes, other zooplankton: recycling of iron in krill fecal pellets and 'sloppy feeding' products
Krill predators: Release of iron from krill tissue
Pennate diatoms: luxury iron uptake on the shelf and transport to downstream bloom area with the current flow (black lines - drifter trajectories)

(2) Regional differences in photosynthetic efficiency of phytoplankton



Planned krill work during PICCOLO addressing Hypothesis 2 of WP3 (more details on WP3 on separate poster)

(1) Shipboard rate measurements of dissolved- and particulate iron release by key zooplankton grazers (Antarctic krill, ice krill, large copepods) along a potential iron-gradient from the Weddell Gyre to Weddell Sea shelf areas and the seasonally retreating ice edge (in cooperation with PICCOLO WP2)
(2) Estimation of nutrient stoichiometry (C:N:Fe) in zooplankton body tissue, fecal pellets and dissolved excretes (in cooperation with PICCOLO WP2)
(3) Relating photosynthetic efficiency and photophysiology of local phytoplankton communities to *in situ* NH_4 concentrations and abundance of Antarctic krill and other grazers (based on acoustic estimates)
(4) Testing the hypothesis that high iron concentrations in krill in the Weddell Sea are related to their grazing on the sea ice community (using the Antarctic sea ice proxy $IPSO_{25}$)

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