Response of small grazers to an iron-induced diatom bloom in the Polar Frontal Zone of the Southern Ocean

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Results of the second *in situ* iron fertilization experiment (EisenEx) conducted in the HNLC (**H**igh **N**utrients **L**ow **C**hlorophyll) waters of the Southern Ocean in austral spring (November) 2000 are presented here. A 10 km diameter spiral was fertilized in the centre of an eddy with 4 tonnes of $FeSO_4$ on three occasions at weekly intervals. The response of the pelagic community and the processes within the food web were studied in detail and compared with processes in the surrounding water for over three weeks.

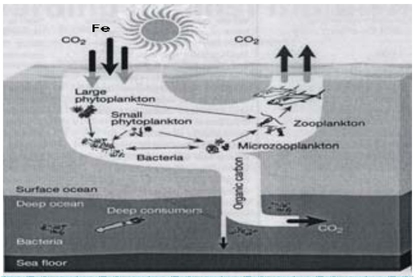

Fig. 1: The complex phytoplankton-based food web (Fig. modified after graph from Z. Johnson)

Although growth rates of all phytoplankton groups increased within days, only diatoms accumulated biomass which, because of heavy grazing, increased significantly (4-fold) only after 2 weeks. Acantharians, but not other protozooplankton, showed a marked increase in abundance by a factor of ~2.7 in the fertilized patch, but only slightly outside the patch (Fig. 2). This is of major interest, since acantharians are suggested to be responsible for the formation of barite found in sediments and which is a paleo-indicator of high productivity regimes.

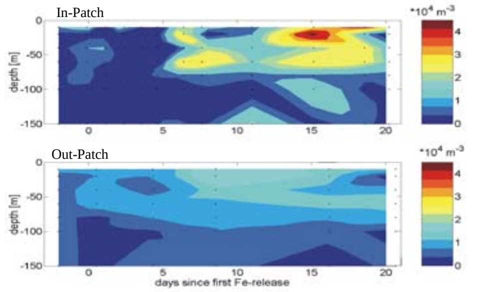

Fig. 2: Temporal development of acantharian abundance inside and outside the fertilized patch.

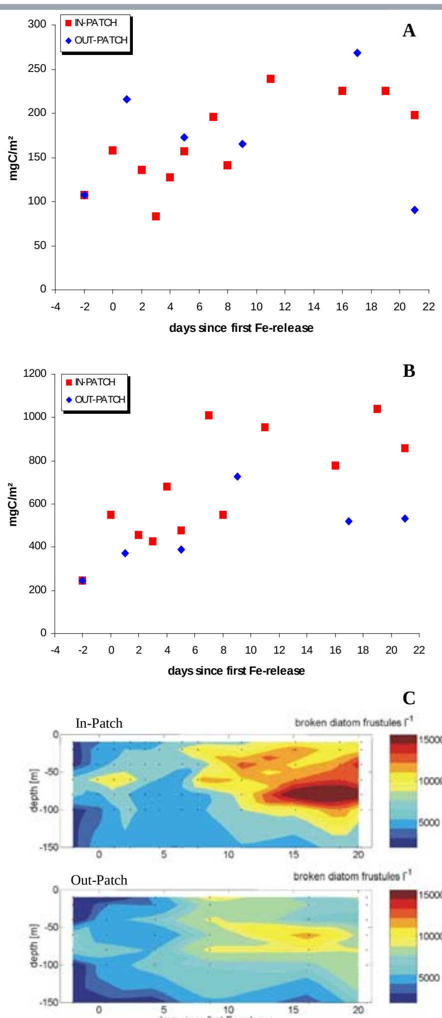

Fig. 3: Temporal development of (**A**) nauplii, (**B**) copepodite and small copepod (<1.5mm) biomass integrated over 150m depth and (**C**) broken diatom frustules abundance over the course of the experiment.

With regard to small mesozooplankton, copepod grazing pressure increased inside the patch as indicated by the numbers of broken diatom frustules and recognizable faecal pellets (Fig. 3C, 4 and 6). Nauplii and copepodites were extremely abundant (Fig. 5A and 5B) with *Oithona* spp. the dominant genus. Whereas nauplii numbers did not change significantly in patch, their increase in biomass is due to individual growth (Fig. 3B). Copepodite and small copepod (<1.5 mm) numbers and biomass increased by a factor of 3.1 and 3.5 inside the patch and 2.0 outside, respectively, suggesting that a significant portion of the fertilized phytoplankton biomass was channelled to higher trophic levels (Fig. 3B and 5B).

These results indicate that small copepods and their nauplii rapidly responded to increasing food supply due to iron addition in this Southern Ocean HNLC region. In unfertilized waters, the slight increase of grazing pressure by small grazers matched the seasonal increase in diatom biomass.

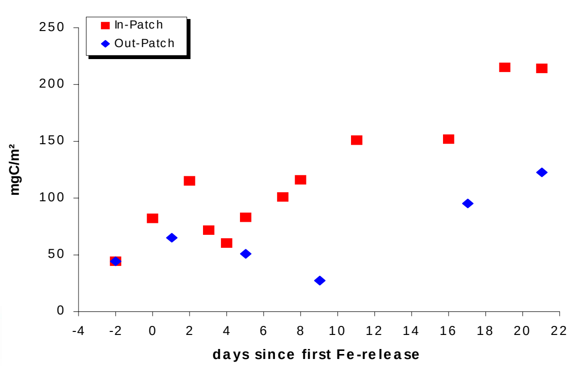

Fig. 4: Temporal development of copepod faecal pellet carbon integrated over 150m depth

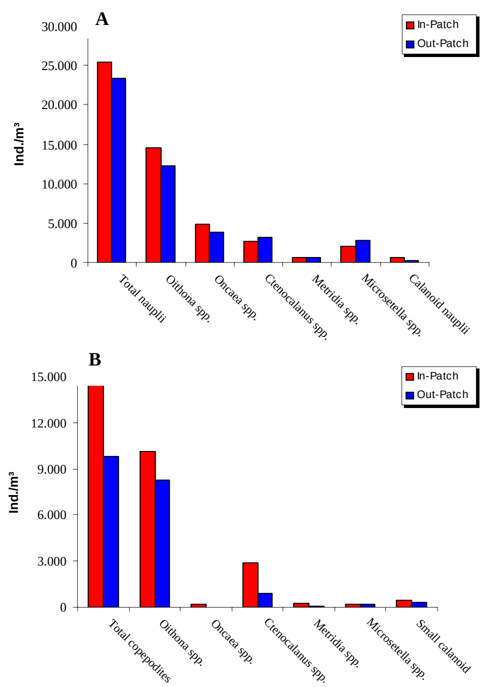

Fig. 5: Mean abundances of (**A**) nauplii, (**B**) copepodites and small copepods (<1.5mm) averaged over all in and out patch CTD-stations.

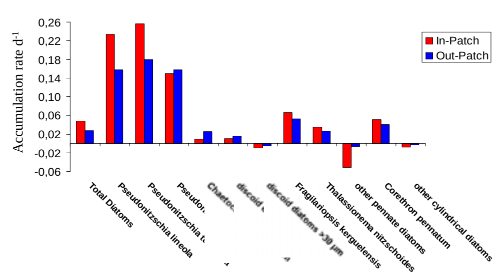

Fig. 6: Accumulation rate of broken diatom frustules over the course of the experiment.