# Community structures and photosynthetic physiological conditions of phytoplankton in the NW subarctic Pacific during SEEDS and SEEDS-II

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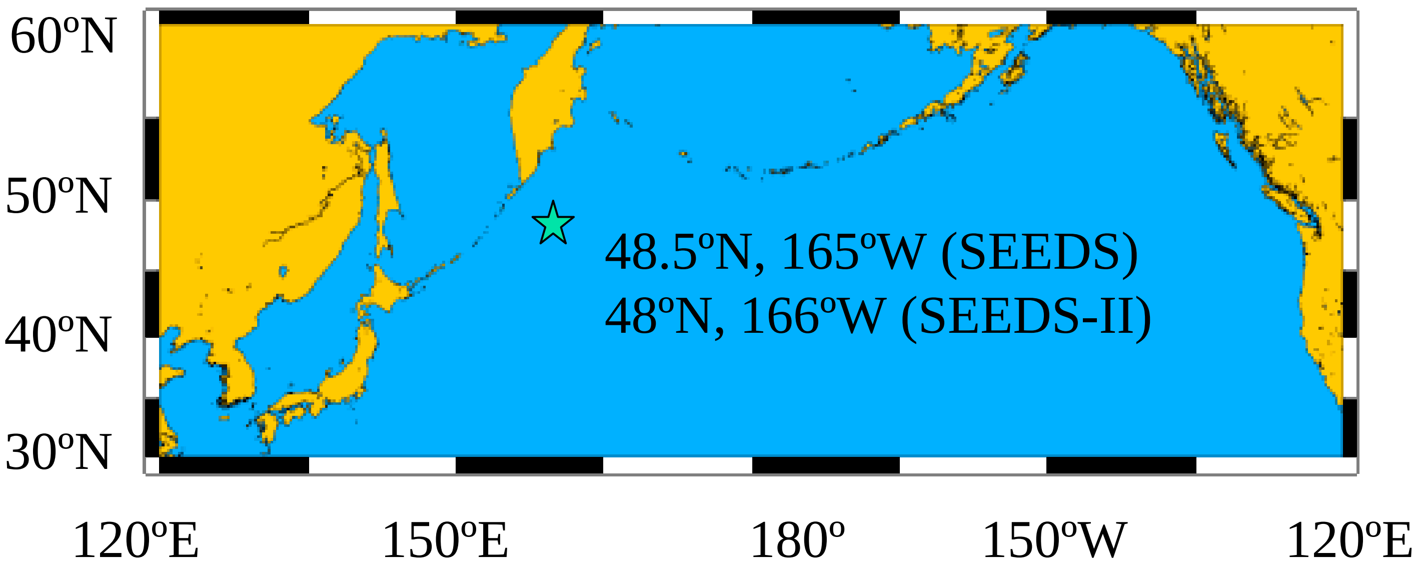
# Comparisons between SEEDS and SEEDS-II

- Phytoplankton community structure
- Photosynthetic physiology of phytoplankton

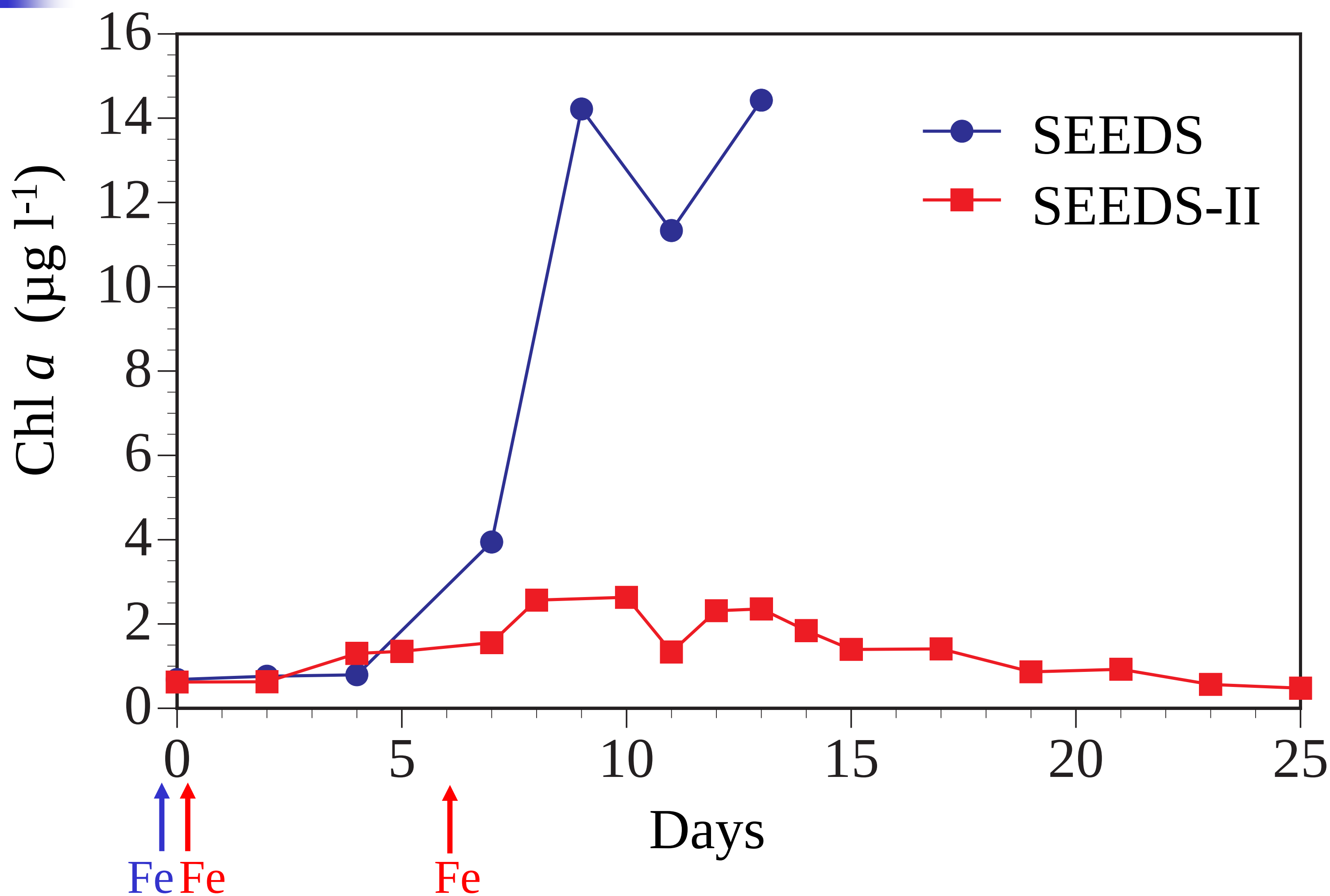
***Here we also briefly discuss why a diatom bloom did not occur during SEEDS-II.***

# SEEDS and SEEDS-II

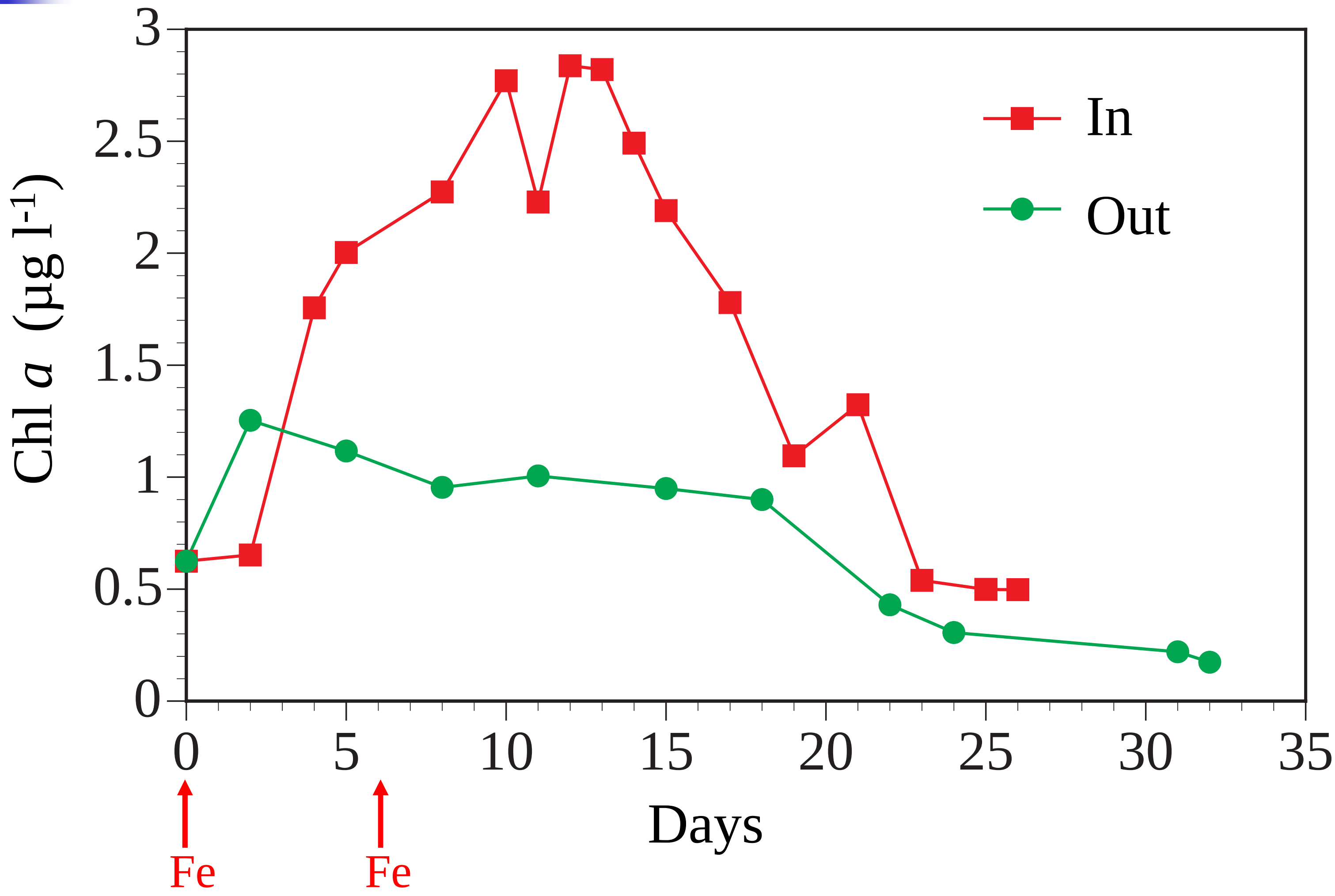



SEEDS : 18 July - 1 August 2001 (Days 0-13)
SEEDS-II : 19 July - 21 August 2004 (Day 0-32)

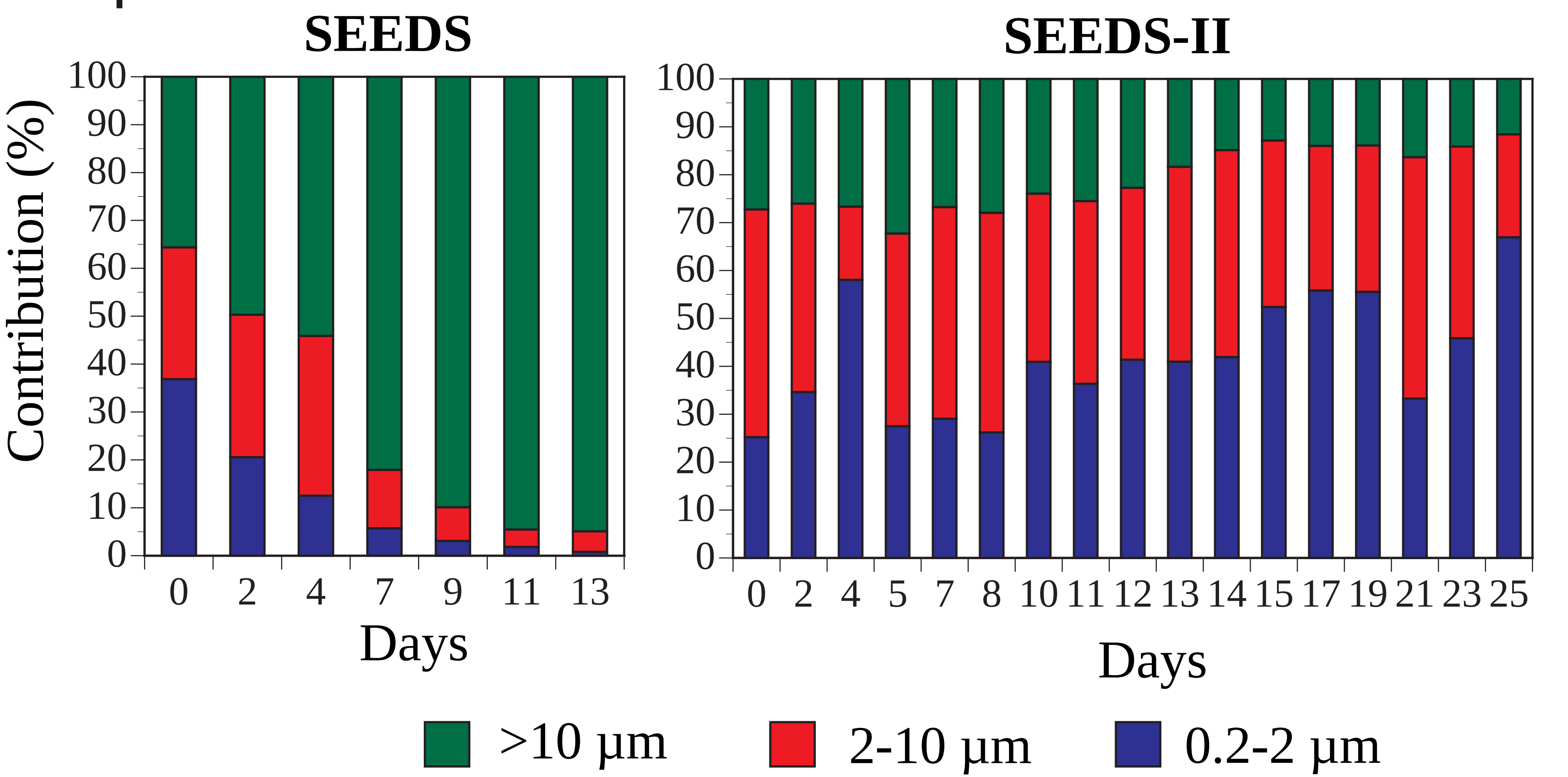
# Changes over time in chlorophyll *a* concentrations at 5 m inside the each Fe patch during SEEDS and SEEDS-II



# Temporal changes in Chl *a* levels at 5 m inside and outside the Fe patch during SEEDS-II

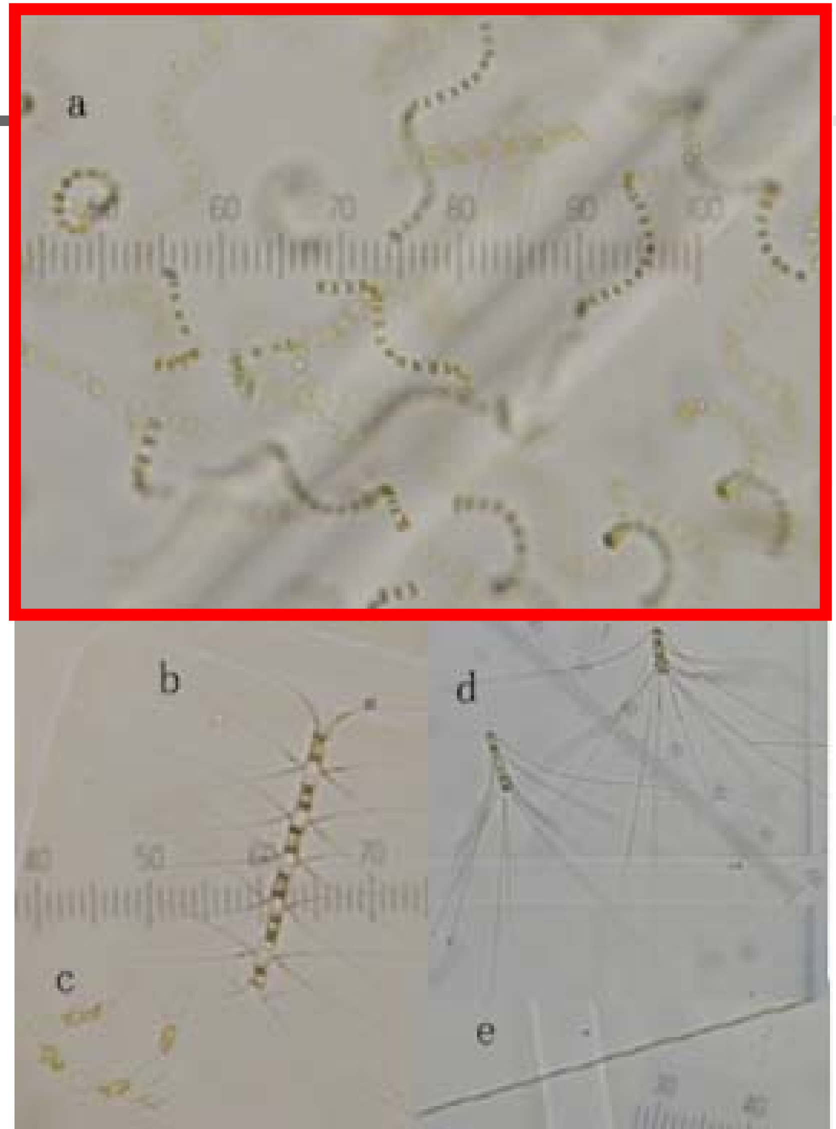


# Relative contributions of each size class of phytoplankton to Chl *a* levels at 5 m inside the each Fe patch



# Dominant diatom species during the bloom of SEEDS

***Chaetoceros debilis***




**Max. 1x10$^{4}$ cells ml$^{-1}$**

**Max. 1.8 d$^{-1}$**
**(= 2.6 doublings d$^{-1}$)**

**(Tsuda *et al*., 2005)**

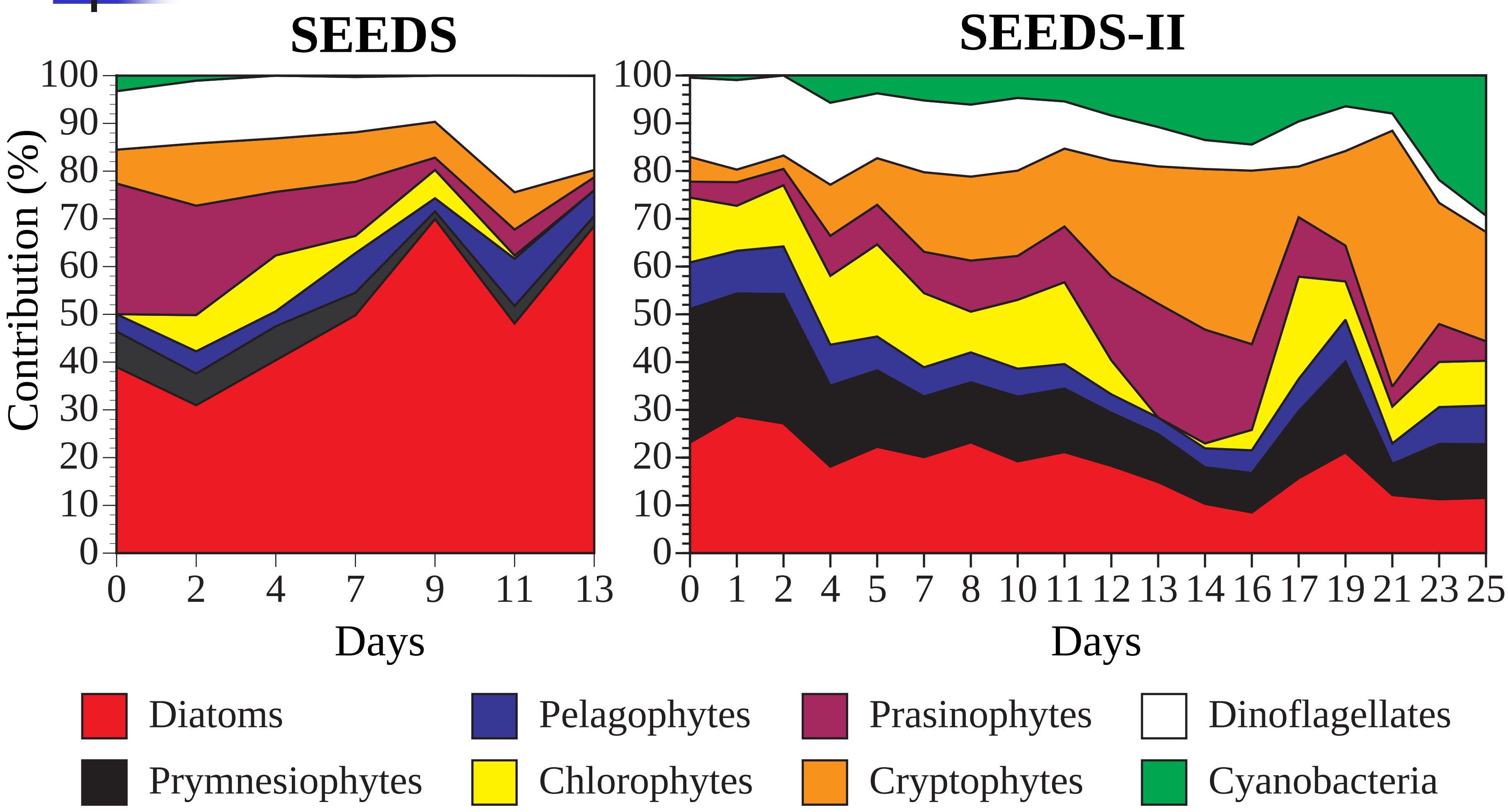
***Chaetoceros atlanticus***

***Chaetoceros concavicornis***

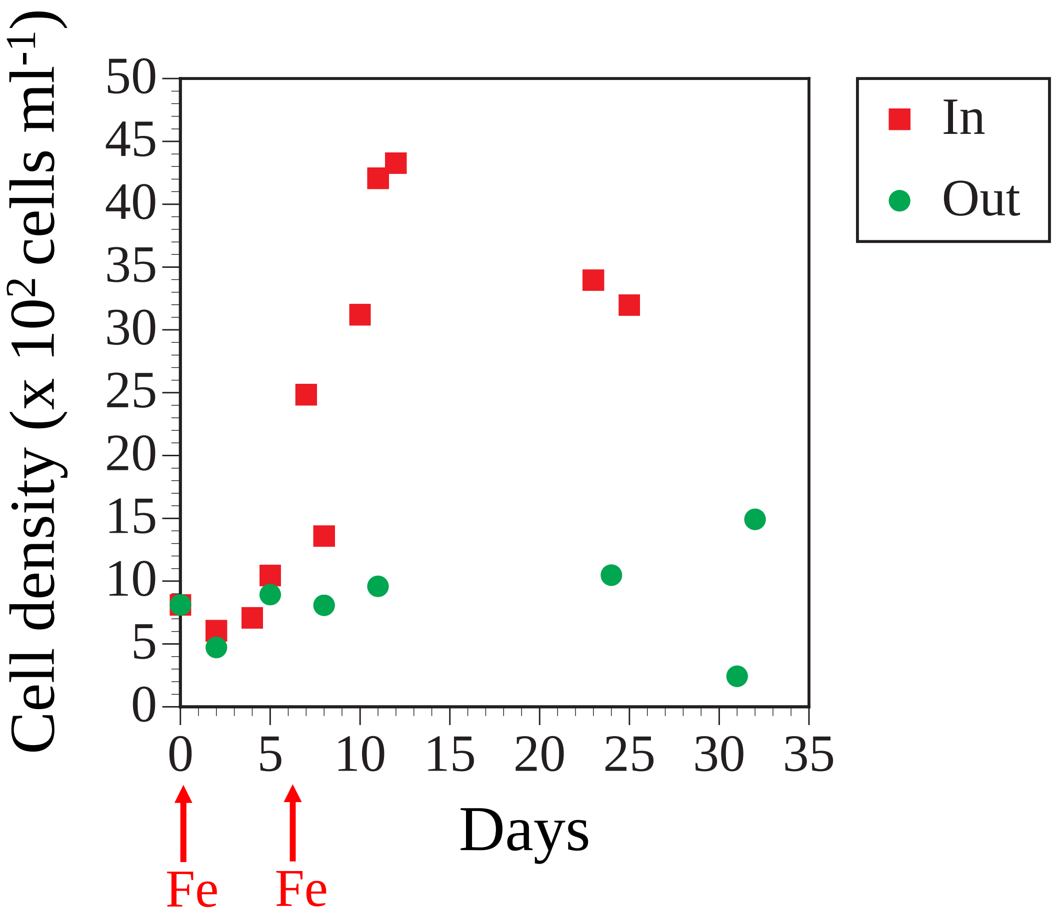
***Eucampia groenlandica***

***Pseudonitzschia turgidula***

# Contributions of each phytoplankton group to Chl *a* biomass at 5 m inside the Fe patch as estimated by CHEMTAX (HPLC pigment data)



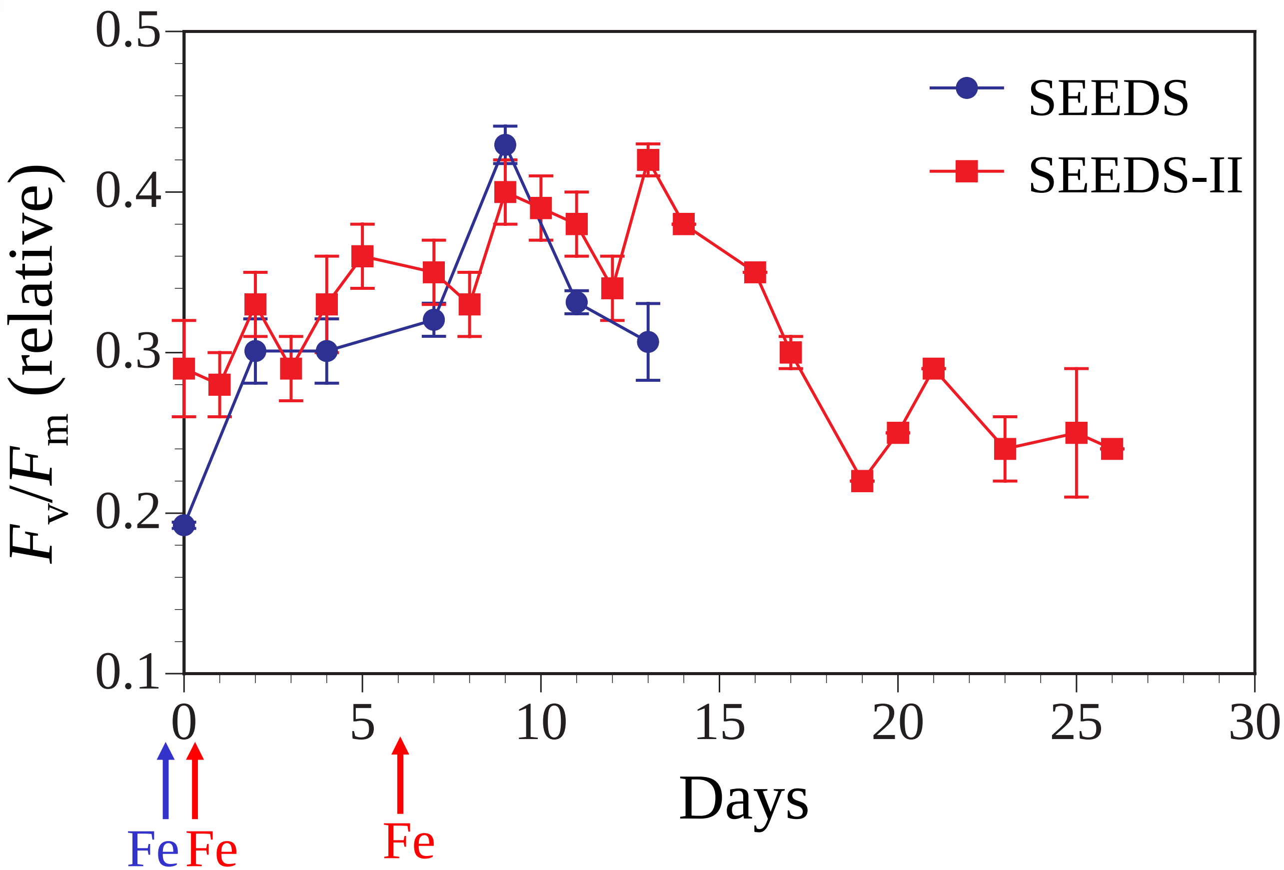
# Changes over time in the cell densities of cryptophytes at 5 m during SEEDS-II as measured by flow cytometry





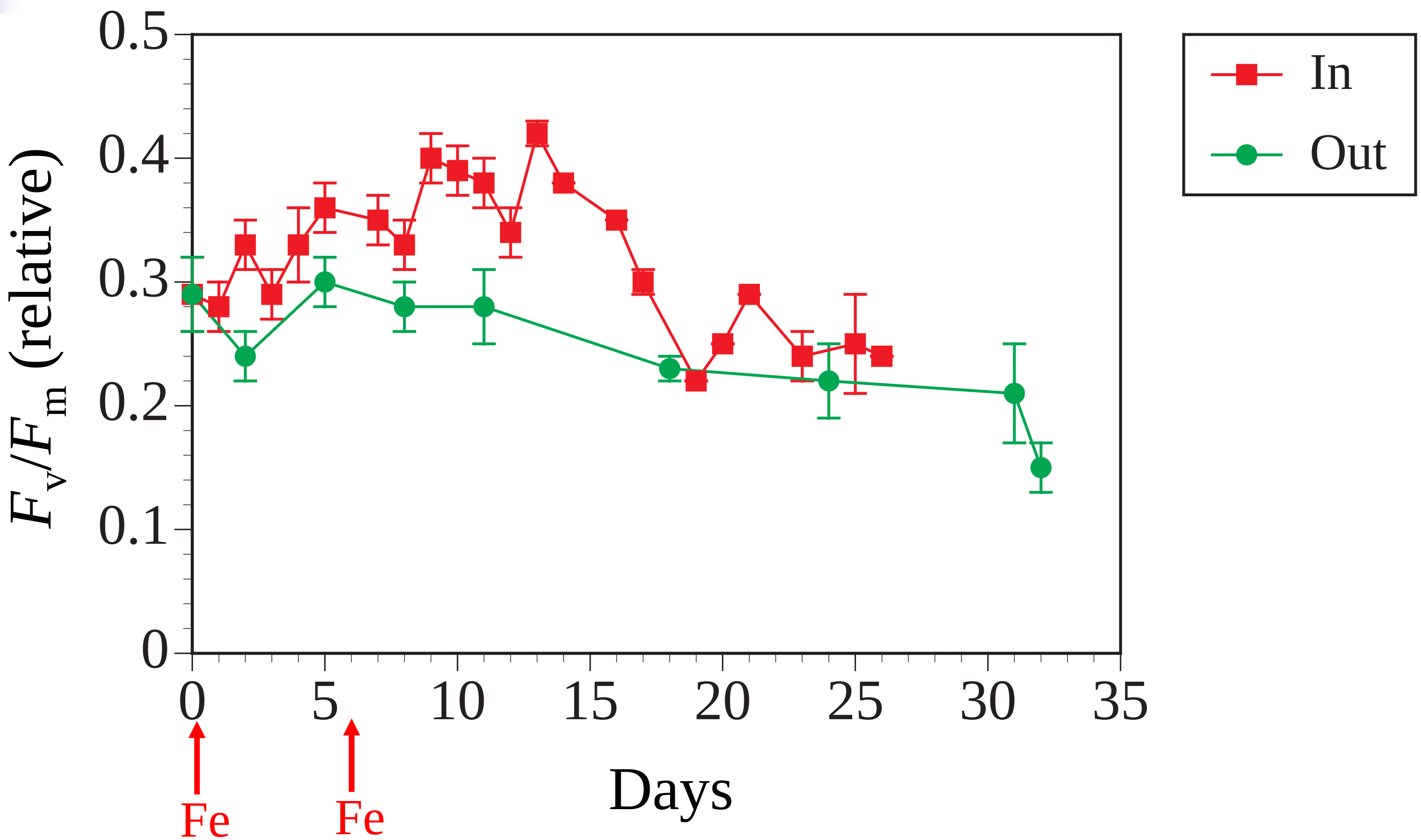
Cryptophyte
*Rhodomonas* sp.

# Photosynthetic potentials of total algal assemblages at 5 m inside the Fe patch during SEEDS and SEEDS-II as estimated by FRRf




***No significant difference ($p > 0.05$) between SEEDS and SEEDS-II on surface $F_v/F_m$ ratios until Day 13.***

# Photosynthetic potentials of total algal assemblages at 5 m inside and outside the Fe patch during SEEDS-II as estimated by FRRf




***Overall, the photosynthetic physiological condition of phytoplankton was improved after the Fe enrichments.***

# Why didn't large-sized diatoms make a large bloom during SEEDS-II?

**Possibilities**

- *Zooplankton (especially, mesozooplankton) grazing might suppress diatom stocks?*

- *Seed populations of bloom-forming diatoms might not exist before the Fe additions?*
  - No, *Thalassiosira* spp. (ca. 20 μm in size) pre-dominated in the diatom population.

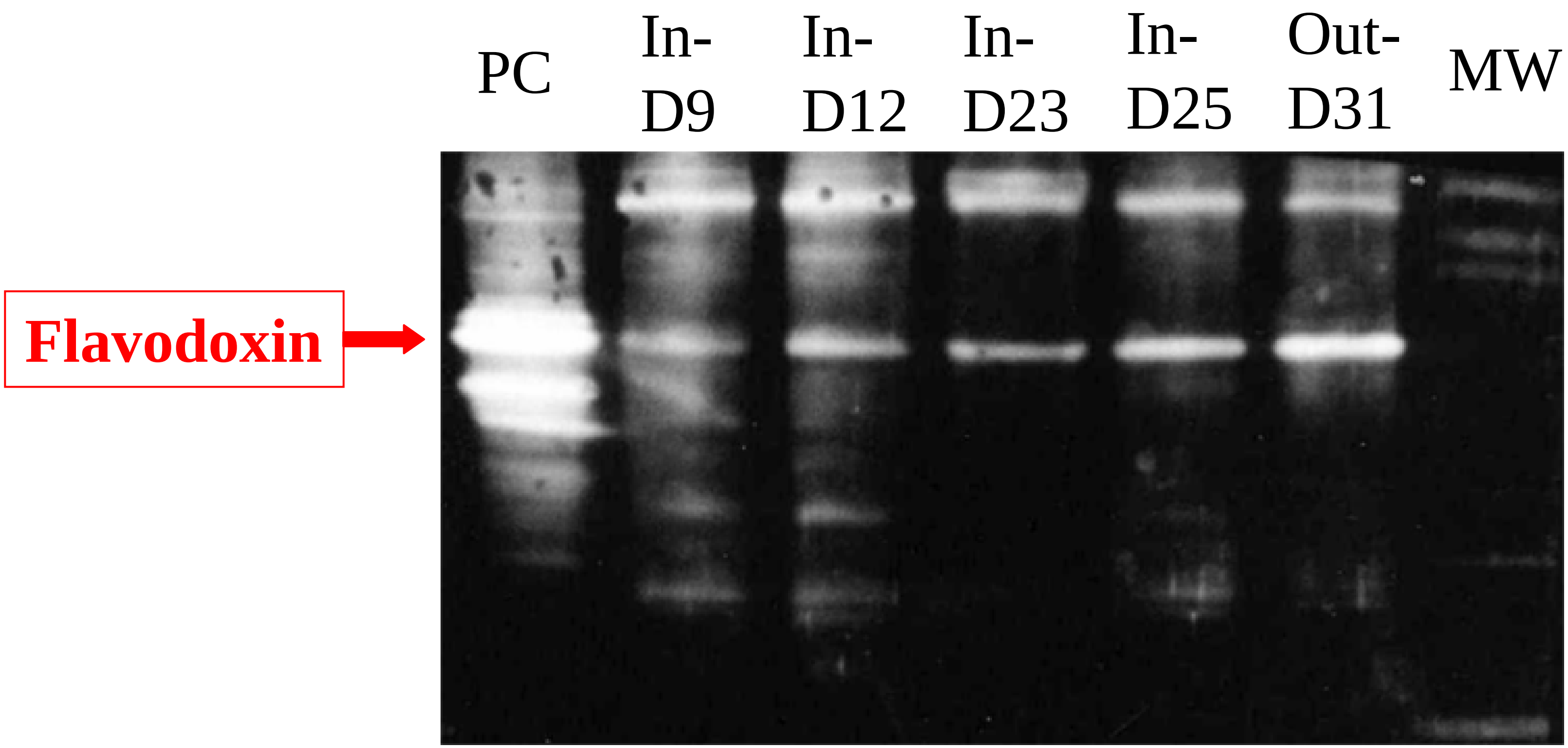
- *Sufficient amount of bioavailable Fe might not be supplied to the large-sized diatoms?*

# Ferredoxin/flavodoxin assays for micro-sized diatoms (20-200 μm in size) at 5 m during SEEDS-II

- For Fe-deficient algal cells, the Fe-containing protein "ferredoxin" can be replaced by the non-Fe-containing "flavodoxin" at the acceptor side of their photosystem I (La Roche *et al.*, 1996).

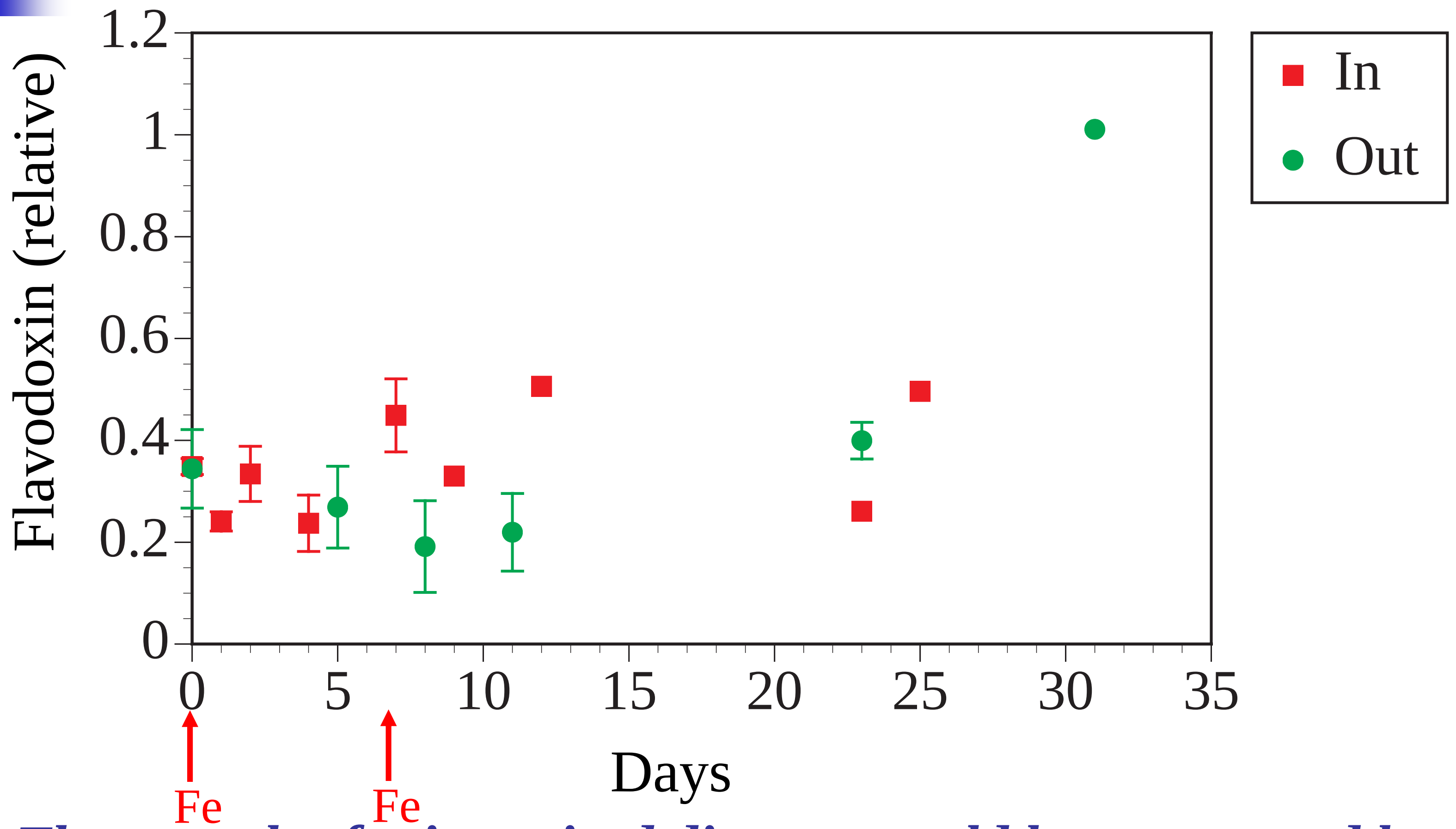
- Ferredoxin and flavodoxin were analyzed by SDS-PAGE plus western blotting using their diatom-specific antibodies, respectively.
  - anti-ferredoxin (Suzuki *et al.*, in prep.)
  - anti-flavodoxin (La Roche *et al.*,1995)

# An example of flavodoxin assay for micro-sized diatoms (20-200 µm in size) at 5 m during SEEDS-II




PC: positive control [Fe-limited diatom *T. pseudonana* (CCMP1335)]
MW: Molecular weight marker

# Changes over time in the relative abundance of flavodoxin in micro-sized diatoms (20-200 μm in size) at 5 m during SEEDS-II




***The growth of micro-sized diatoms could be suppressed by Fe availability even after the Fe additions.***

# Conclusions

- ***Fe supply had a crucial effect to improve the photosynthetic physiology of phytoplankton at the study site during summer.***

- ***In SEEDS-II, a diatom bloom did not occur. That could be partly due to the Fe limitation of large-sized diatoms throughout the experiment.***