# Natural iron fertilization above the Kerguelen Plateau (Southern Ocean): Impact on carbon remineralization by the microbial food web

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Thanks to

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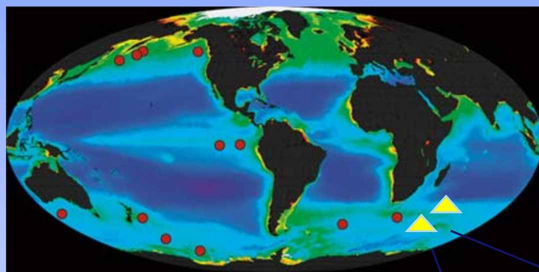
# Questions adressed

How does natural iron fertilization affect different components of the microbial food web ?

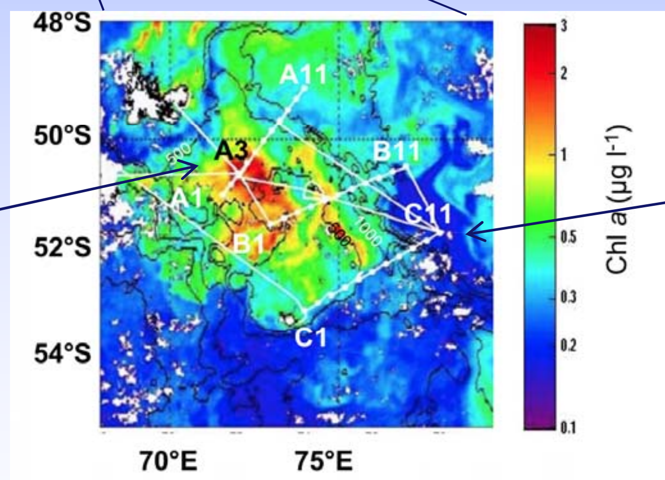
What are the consequences on the transfer of carbon through the microbial food web ?

# The natural iron fertilization experiment KEOPS (Kerguelen Ocean and Plateau compared Study)



From Boyd et al. 2008

**Bloom Station**

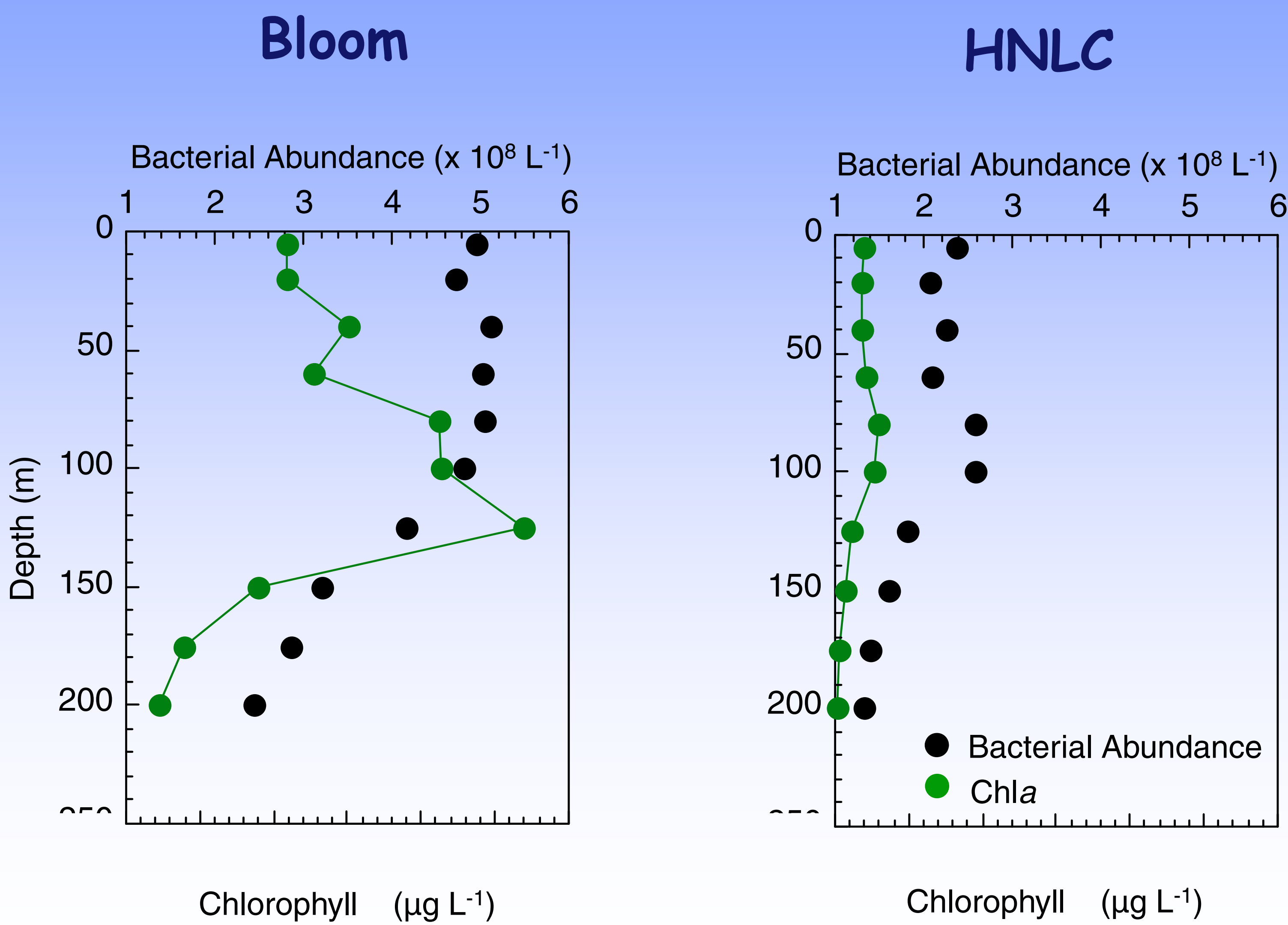



**HNLC Station**

**The Kerguelen Bloom**

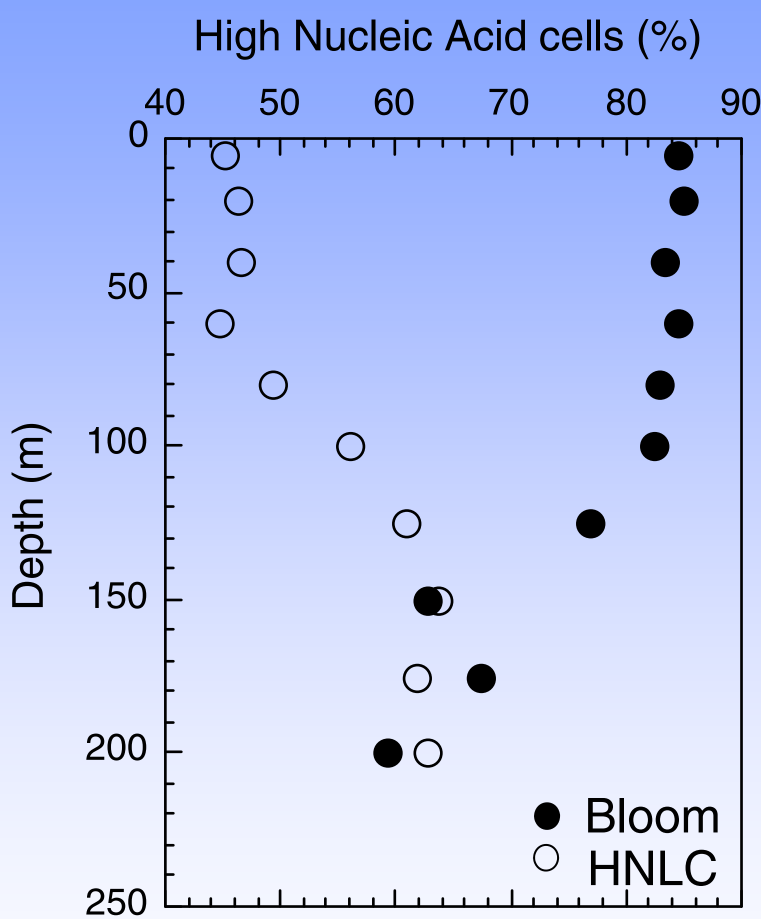
Blain et al. (2007)

# Marked response of heterotrophic bacteria




Obernosterer et al. (2008)

# Marked response of heterotrophic bacteria




| | | |
|---|---|---|
| Bacterial Production (μmol C $L^{-1}$ $d^{-1}$) | 0.25 | 0.042 |
| Bacterial Respiration (μmol C $L^{-1}$ $d^{-1}$) | 0.94 | 0.25 |
| Bacterial Growth Efficiency (%) | 21 | 14 |

All values are mean of upper 100 m.

Obernosterer et al. (2008)

# Comparison among iron fertilization experiments in the Southern Ocean

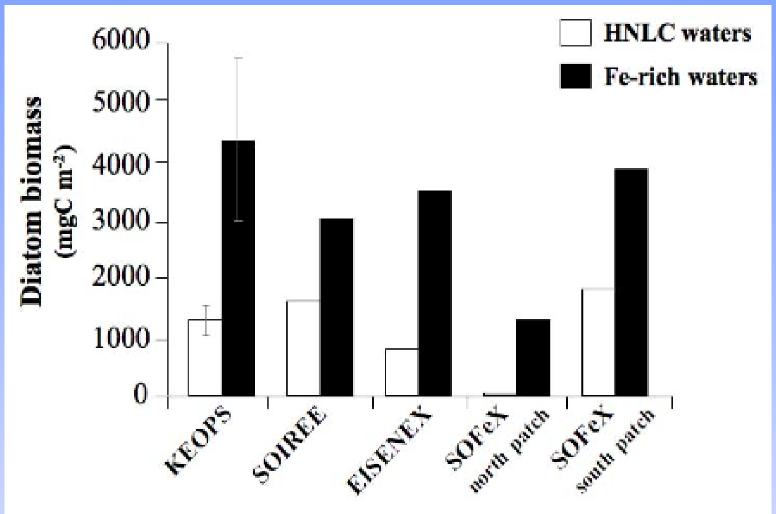
| | Bacterial heterotrophic production ($\mu g$ C $L^{-1}d^{-1}$) HNLC | HNLC + Fe | |
|---|---|---|---|
| KEOPS | 0.5 | 3 | X 6 |
| CROZEX<br>Zubkov et al. (2007) | 0.4 | 3.6 | X 9 |
| SOIREE, EisenEx, SOFEX<br>Hall and Safi (2001), Arrieta et al. (2004), Oliver et al. (2004) | 0.2-0.5 | 0.2-1.1 | X 2-3 |

**What stimulates bacterial heterotrophic activity?**

Direct or <u>indirect</u> response to iron addition?

→ not Fe, but organic carbon first limiting factor

## Similar diatom biomass in Fe-fertilization studies

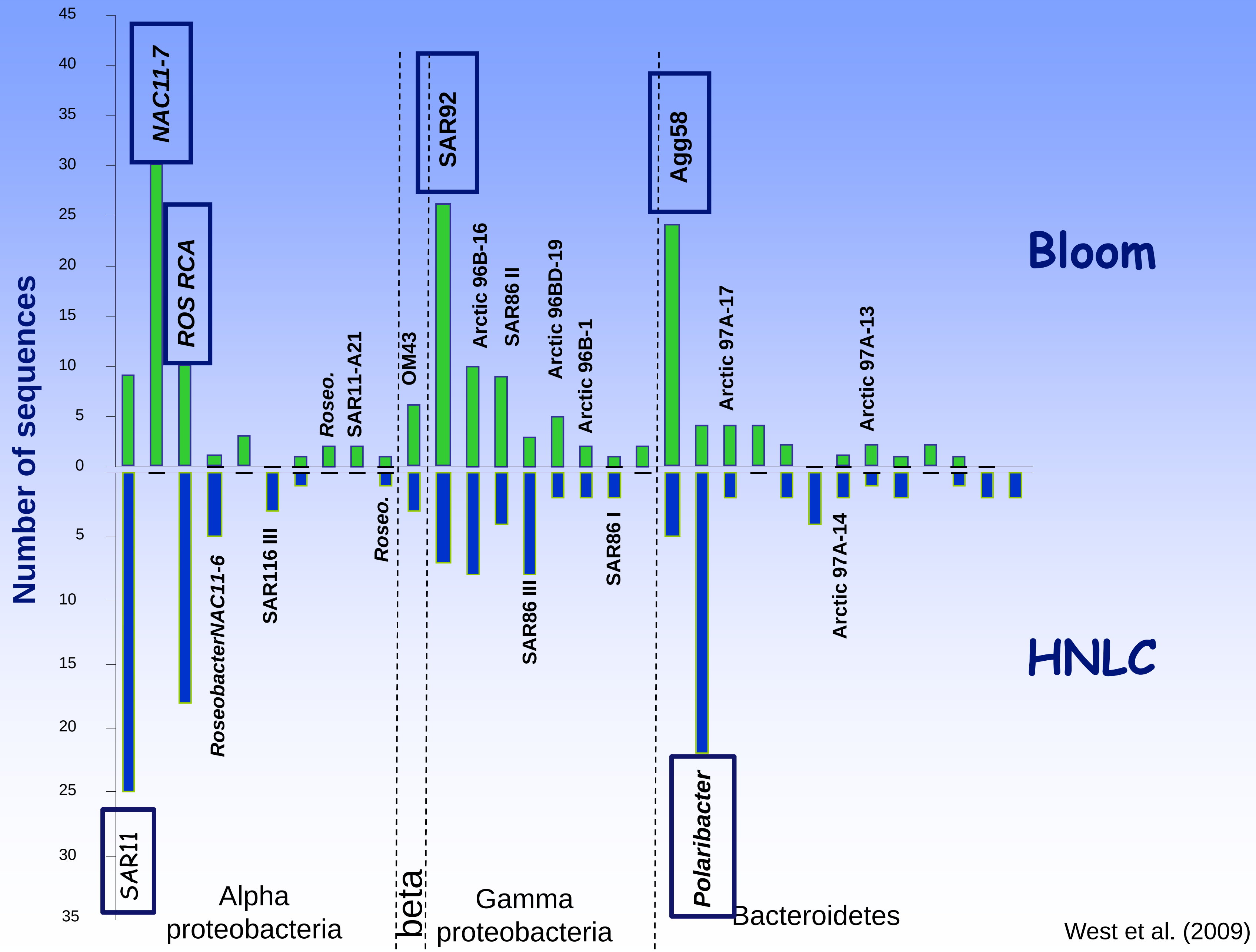



From Armand et al. (2008)

**….but differences in the duration of the blooms :**
**Mesoscale experiments: ≈ 1 to 40 days**
**Kerguelen bloom : ≈ 60  to 80 days**

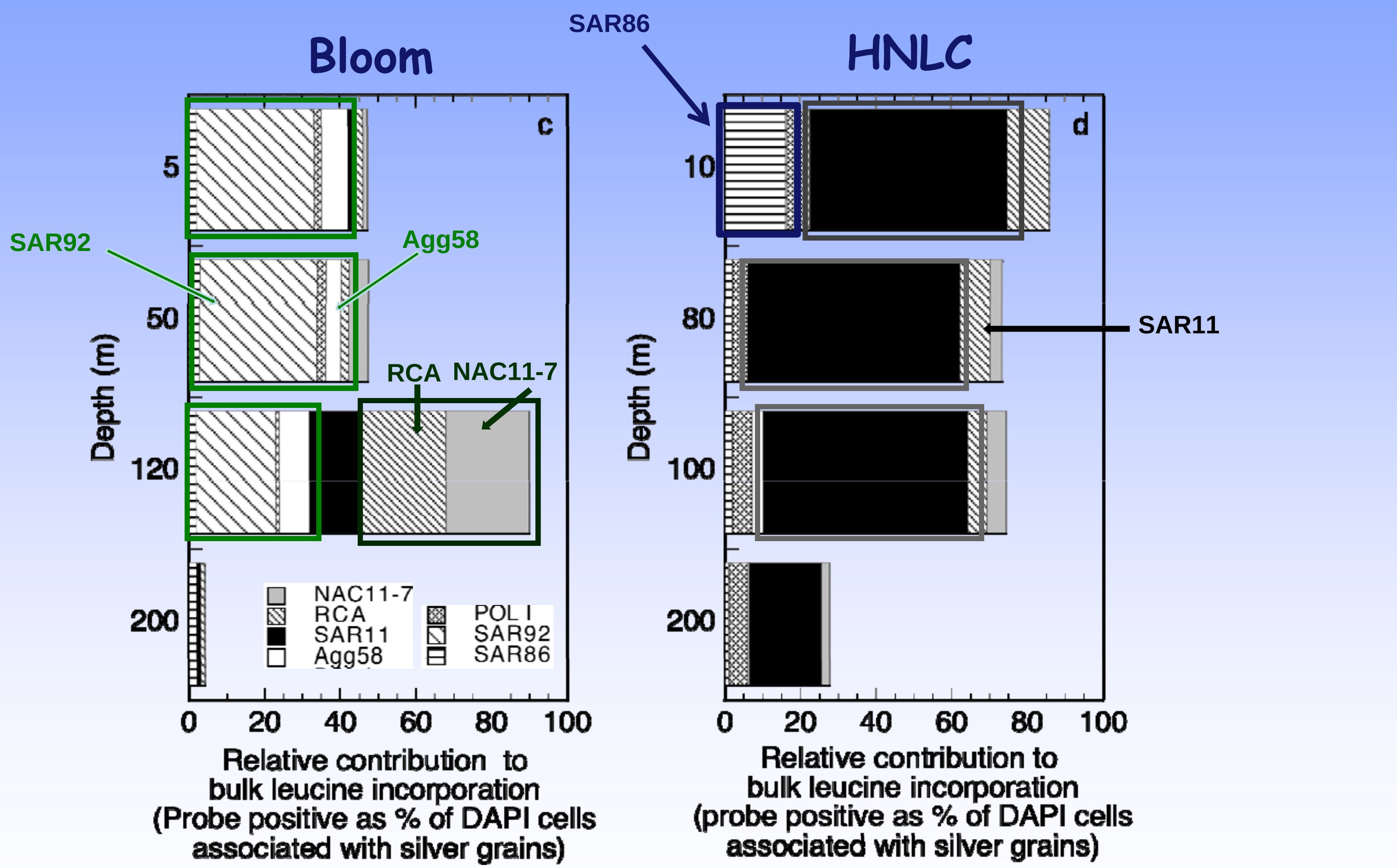
**The duration of the bloom and the mode of fertilization allows adaptation of the bacterial community.**

# Strikingly different bacterial diversity at the two stations



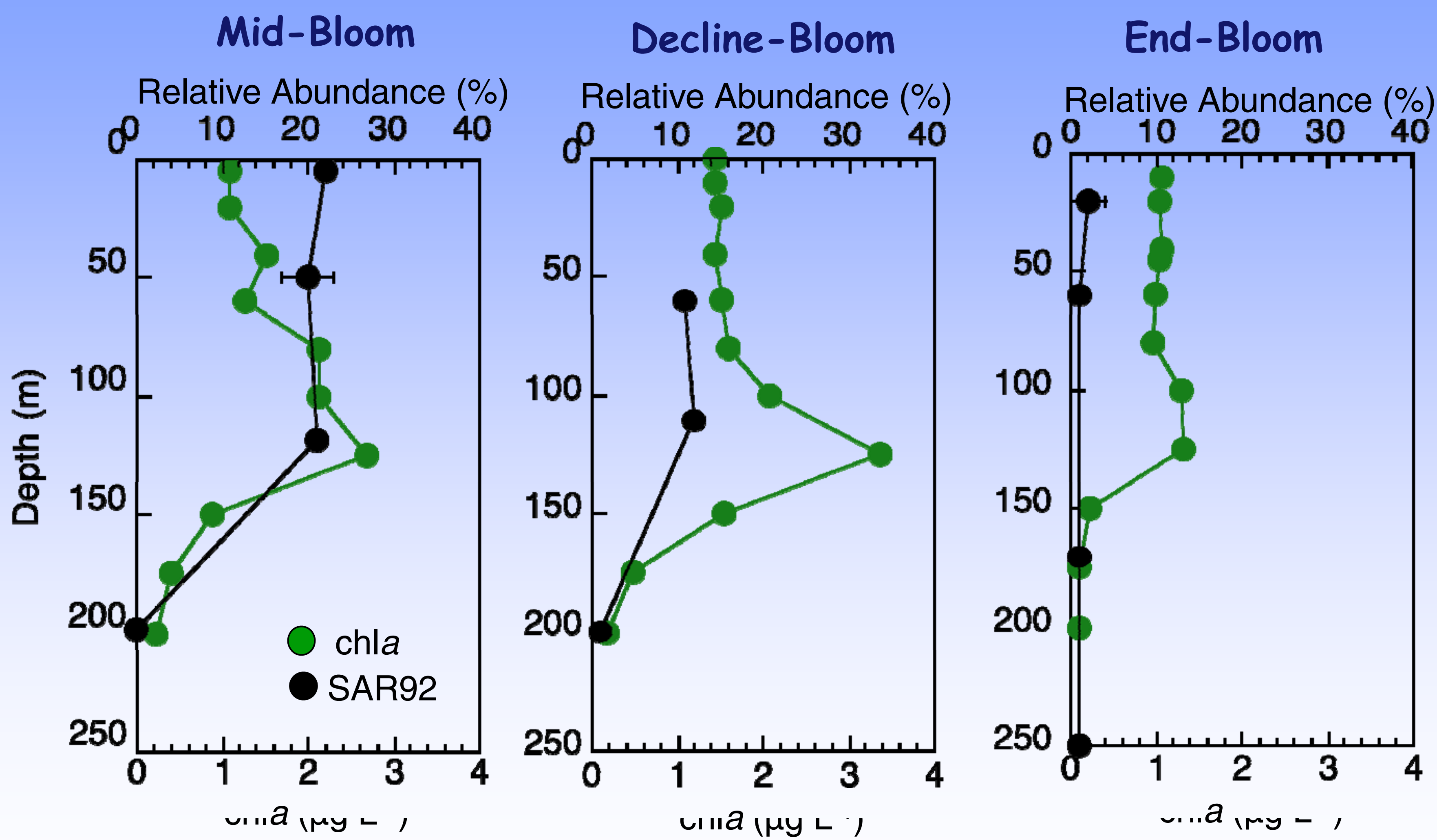

West et al. (2009)

# Distinct bacterial groups contribute to C-cycling within the Kerguelen bloom




Obernosterer et al. (in rev.)

# Temporal changes of SAR92



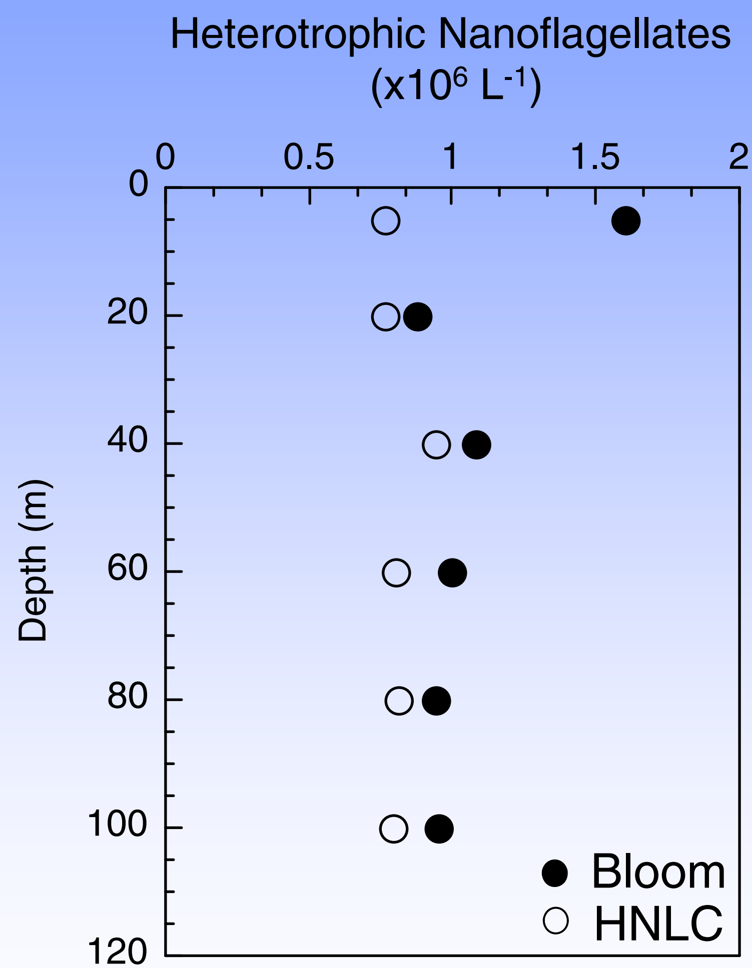

Obernosterer et al. (in rev.)

Pronounced response of heterotrophic bacteria to natural iron fertilization, in terms of activity and community composition.

Does it matter for biogeochemical cycling of elements?

→ Transfer of carbon through the microbial food web

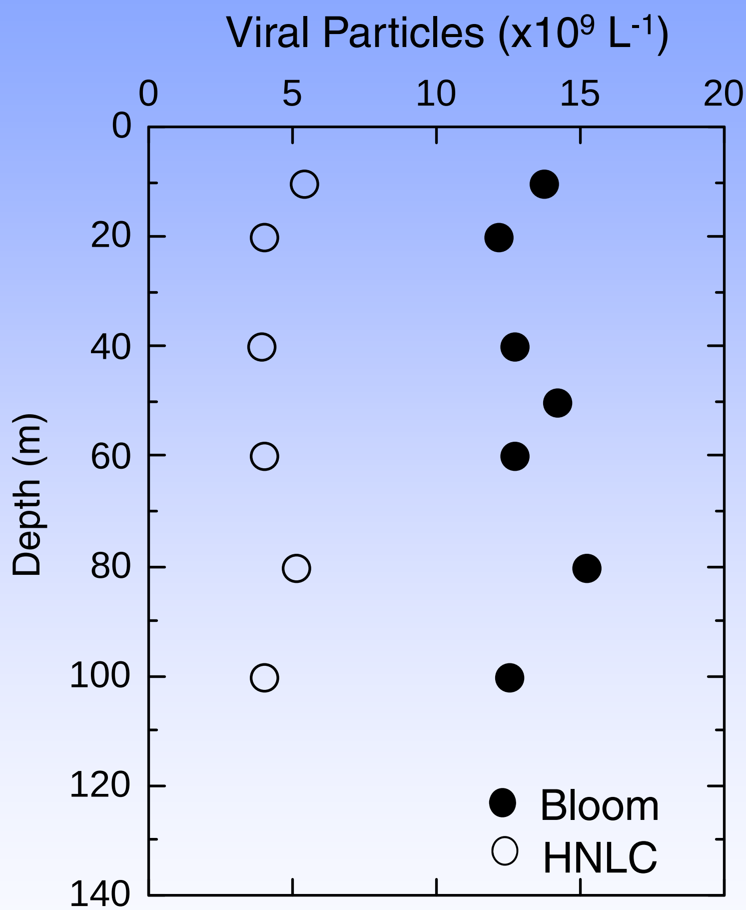
# Heterotrophic nanoflagellates - the first trophic link




| | | |
|---|---|---|
| Grazing loss of bacteria (in %, $d^{-1}$) | 35 | 95 |

Christaki et al. (2008)

# Viruses - a sink of bacterial heterotrophic production

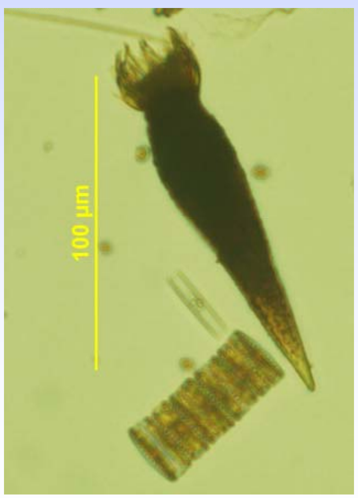



| | | |
|---|---|---|
| Lytic Viral Production (x 10$^{6}$ ml$^{-1}$ h$^{-1}$) | 1.2 | 0.3 |
| Frequency of infected cells (%) | 50 | 30 |

Malits et al. (in prep.)

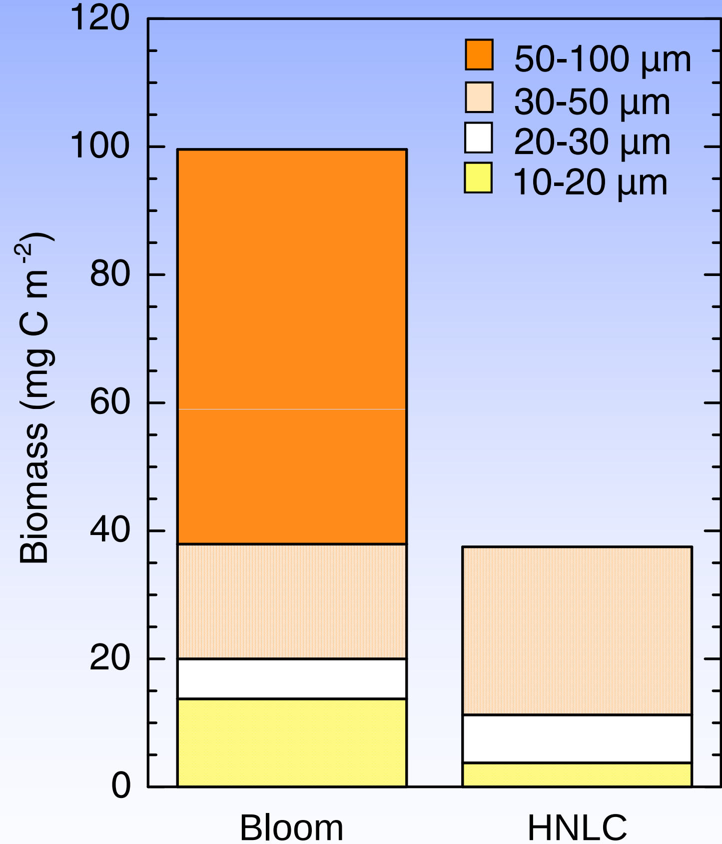
# Ciliates - the link between the microbial food web and the classical food web


Tintinnid




Aloricated Ciliate

100-400 organisms $L^{-1}$

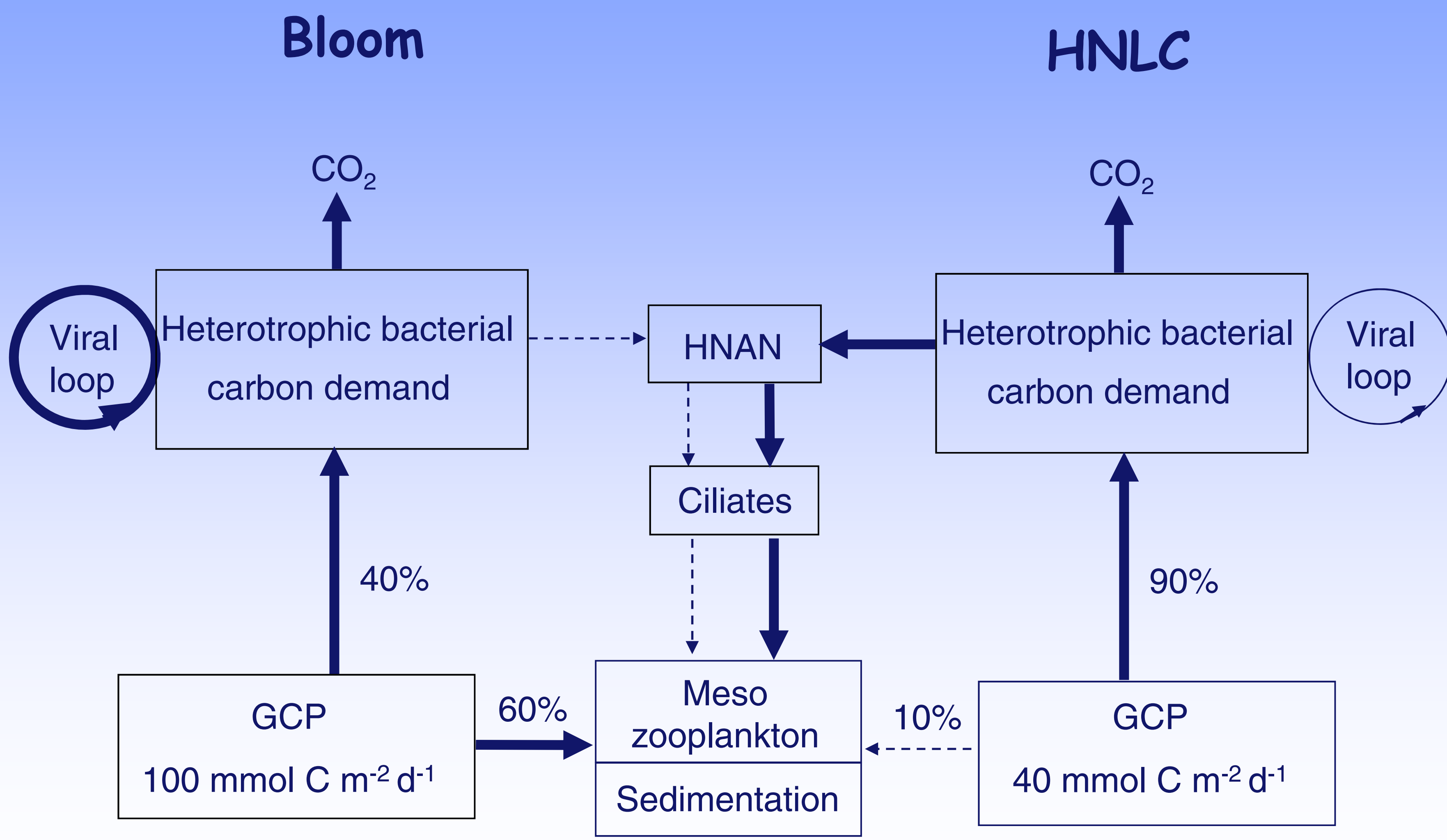





Aloricated Ciliate

Christaki et al. (2008)

# Carbon flow through the microbial food web



# Can the functioning of the microbial food web affect carbon export ?

Export efficiency*

| Bloom | HNLC |
| --- | --- |
| ≈ 28% | ≈ 58% |

*Export Production ($^{234}$Thorium, POC, PON) : Primary production (C-and N-uptake rates)

Savoye et al. (2008)

# Conclusions

-Pronounced response of heterotrophic bacteria to natural iron fertilization, in terms of activity and community composition.

- Rapid mineralization of organic carbon due to microbial food web processes.

**Merci de votre attention!**

Banyuls sur mer, March 2010