Calanus finmarchicus changes in the southern Norwegian Sea, 1990-2007

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Abstract
Since 2003 reproduction of overwintered Calanus finmarchicus has occurred earlier in spring In the cold East Icelandic Water (EIW) in the southern Norwegian Sea than during the period 1990-2002.

Introduction
Calanus finmarchicus overwinters in the cold deep waters of the Norwegian Sea and migrates towards the surface in spring to reproduce. The upper layers in the sourthern Norwegian Sea are dominated by two different water masses, the East Icelandic Water (EIW) flowing from the north, and the warmer Atlantic Water (AW) entering the area from southwest (Figure 1).

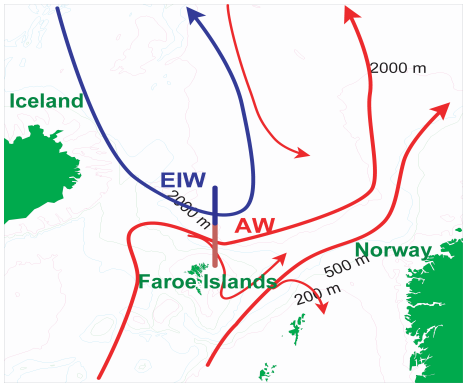

Figure 1. Water masses in the upper 500 m in the southern Norwegian Sea and the transect for monitoring of Calanus finmarchicus, chlorophyll a and hydrography.
EIW: East Icelandic Water, AW: Atlantic Water.

Changes in reproduction
Monitoring along a transect in the southern Norwegian Sea since 1990 have shown changes in the timing of C. finmarchicus reproduction in the cold East Icelandic Water (EIW). Prior to 2003 reproduction started significantly later in this water mass than in the warmer Atlantic Water (AW) of the transect, resulting in a dominance of overwintered individuals in the EIW and recruits in the AW in May (Figure 2). However, since 2003 this situation has changed. Young copepodite stages have during these last 5 years been observed in high abundances in both water masses in May, indicating a shift to an earlier

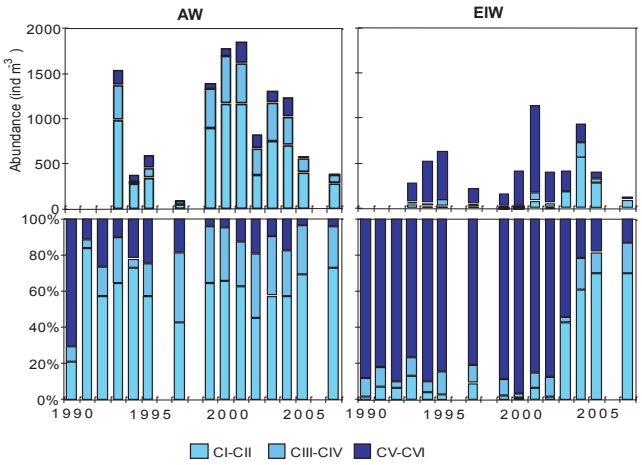

Figure 2. Mean stage composition and abundance of Calanus finmarchicus in the upper 50 m in the (AW) and (EIW) in May during the period 1990-2007

Phytoplankton biomass
The phytoplankton biomass in both EIW and AW has varied interannually during the period 1990-2007, usually with higher biomasses in the EIW. However, no apparent shift in the pattern of phytoplankton biomass has been observed the last 5 years that is able to explain the observed changes in timing of reproduction in the EIW (Figure 3)

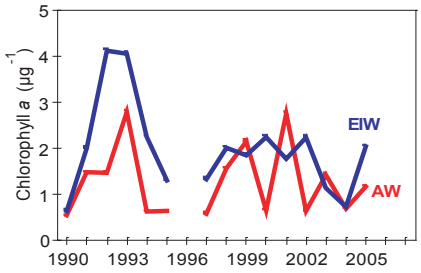

Figure 3. Average phyhtoplankton biomass (chl a) in the upper 50 m in the EIW and AW during the period 1990-2007.

Hydrography
The temperature and salinity of the EIW and AW have also been monitored since 1990 (Figure 4), but neither of these two parameters seem to explain the observed shift in Calanus finmarchicus reproduction in the EIW.

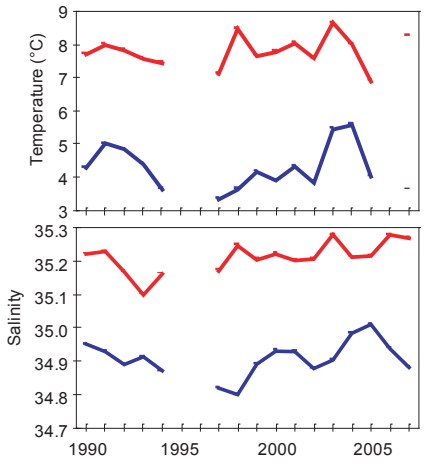

Figure 4. Average temperature and salinity in the upper 50 m in the EIW and AW during the period 1990-2007.

Conclusions and future perspectives

- The timing of reproduction of Calanus finmarchicus in EIW has occured earlier during spring during the period 2003-2007, than during the period 1990-2002.

- Local phytoplankton biomass and hydrography do not explain this observed shift in the reproductive pattern.

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- The changes in timing of spring reporduction in the EIW may have significant effects on annual secondary production and food potential for migratory pelagic fish in the area, and therefore merits further studies.