



Interactive comment on “Distribution of overwintering *Calanus* in the North Norwegian Sea” by A. Edvardsen et al.

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General comments

This paper builds on the reports of sampling in January 2000, 2001 and 2002 reported by Halvorsen et al (2003) by reporting on corresponding sampling in 2003 and 2004. The Introduction is a little confusing about this. Page 28, lines 1-4 refers to analysis of both summer and winter samples and trends in abundance in relation to climate indices, but this is not the subject of Halvorsen et al 2003. I think the Introduction could emphasise more clearly that this manuscript reports on an extension of the January sampling begun by Halvorsen et al.

Specific comments

Methods - the text says that *C. glacialis* was distinguished from *C. finmarchicus* during

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the sample analysis. How? As far as I know the only sure-fire way of doing this is by molecular methods. The only documented microscope based method I know of is that of Hirche, which depends on apportioning the population of a given stage based on prosome length - but this method has recently been shown to be unreliable - especially at the southern edge of the latitudinal range of *C. glacialis* (J. Plankton Res. 28: 221-238).

Documentation of the methodology for mapping abundance is extremely scant and should be extended. The manuscript merely says that geo-referenced abundance data were gridded using kriging. What data - the concentration $m-3$ in each layer - ie a separate grid for each layer, or the abundance $m-2$, or what? This needs to be elaborated because the methodology is not trivial. Horizontal gridding of point measurements of depth integrated abundance ($m-2$) can be very highly misleading over variable topography (as in this case) and is NOT to be recommended. Similarly, horizontal gridding of depth averaged concentration can be highly misleading when the averaging depth varies widely between point measurements and the vertical distribution is far from uniform (as in this case). Horizontal gridding of concentrations within each depth layer (where the layer thickness is essentially constant over the region) is legitimate and probably the way to proceed in this case. If you then want to visualise the spatial distribution of depth integrated abundance - you vertically integrate over the set of gridded maps for each layer. The authors really need to explain what they have done here. I suspect that they have committed a sin and gridded the vertically averaged data.

Results - section 3.4 - Horizontal distribution of copepods. The authors say that high concentrations occurred along the 1000m isobath (Fig 5), but patches of high abundance varied between years. Figure 5 shows the gridded maps of depth averaged concentration ($m-3$). I have trouble interpreting these since the seabed and maximum sampling depth is so variable - and see concerns above about the process of gridding depth averaged data. Most certainly it is hard to interpret abundance (normally the term used to refer to depth integrated numbers ($m-2$)) from these maps. I think the authors need to be VERY careful about the wording of this section, and I would VERY

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strongly recommend redoing the gridding much more carefully - eg - gridding concentrations layer by layer and then integrating the gridded data over all layers (being careful about where the seabed occurs at each grid node of course). Alternatively, use a more complicated 3-D gridding approach.

Discussion - in general, this lacks structure and is not comprehensive in its citation or relevant literature.

I don't understand the sentence on page 34, lines 13-14

The section from page 34 line 26 to page 35 line 22 seems to have a rather tenuous connection to the rest of the discussion. It does not add very much beyond the speculation of Halvorsen et al 2003 regarding the role of eddies in setting up the distribution of abundance. Then the track of the discussion reverts suddenly at page 35 line 23 back to a commentary on the biological data, sampling, and the temperatures experienced by the overwintering copepodites. I think that if the section on modelled flows at depth is to be included (and I am not sure that it helps that much), then it should be organised into a concluding section speculating on how the observed structures come to exist.

Page 37, lines 1-5 - also in the Faroe-Shetland Channel, males are found deeper than females in spring (Fish Oceanogr. 8 (Suppl 1), 84-99. (1999)) showed that the males form a layer at around 400m and the speculation was that they ambush and fertilise the females as they ascend through this layer on their way to the surface.

It would have been nice in the discussion to have seen some comparison (even pictures) of the results from these surveys in 2003 and 2004 with those reported by Halvorsen et al (2003) in 2000, 2001 and 2002. My impression from Figure 5 in Halvorsen et al is that the overall abundance was similar, but there were differences in distribution from year to year - but then again, I fear that the gridding of depth integrated abundance in Halvorsen et al may have generated artefacts at the slope.

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Also of interest (great interest) would be to blend the distribution of abundance in the Lofoten basin from the 5 surveys 2000-2004 reported here, onto the northern edge of the pan-Atlantic map in ICES J. mar. Sci. 61, 698-708 (2004). Then I think we will see that the bulk of the overwintering *C. finmarchicus* population in the Norwegian Sea is distributed in the east, all along the slope from 63N right up to 72N. the western side of the Norwegian Sea contains only a small overwintering population.

I also wonder if the authors would be able to comment on the existence or otherwise of overwintering concentrations of *C. finmarchicus* in the Barents Sea - as far as 45E or 50E. There seems to be considerable summer production in this area, but it must be too far east for the overwintering population to find its way back over the shelf edge into the Lofoten Basin. Are there any winter observations that far east to be able to say with any certainty if there are or are not any overwintering sites in the Barents Sea?

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