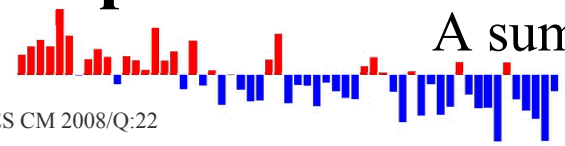
Zooplankton Monitoring in the ICES Area:

A summary of sampling sites and recent findings.



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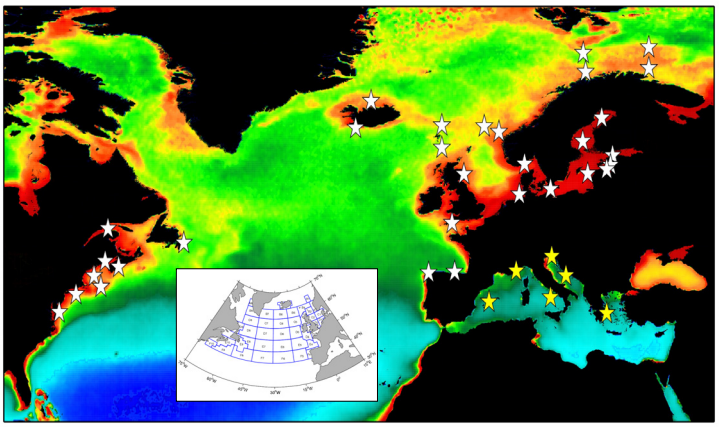
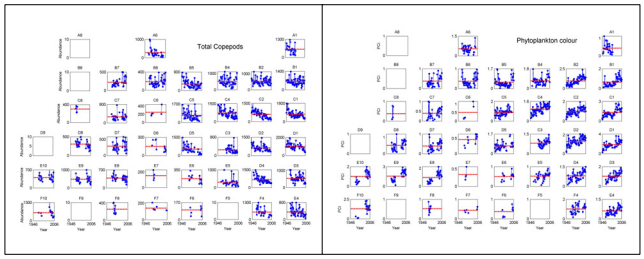
and members of the *ICES Working Group on Zooplankton Ecology* (WGZE)



Map of zooplankton samplings sites included in the 2006/2007 status report. Thirty-one sites in the ICES regions (white stars) were summarized, along with six Mediterranean sites (yellow stars) from zooplankton colleagues in the Mediterranean Science Commission (CIESM). Included in the analysis were forty standard areas from the Continuous Plankton Recorder (CPR) survey (figure inset), covering the entire central North Atlantic.

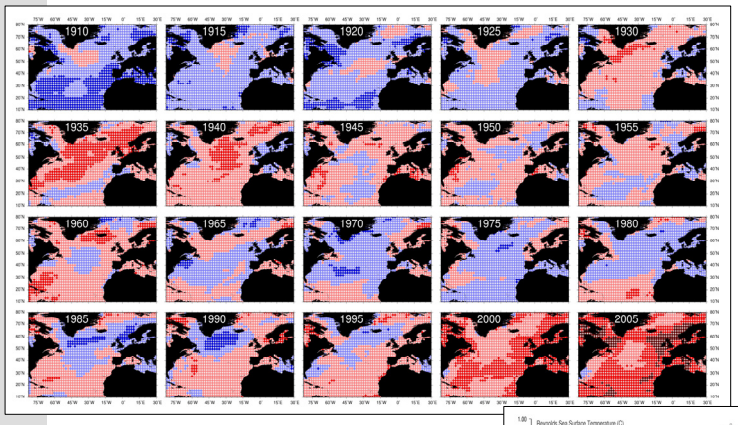
Every other year, the Working Group on Zooplankton Ecology (WGZE) produces a summary report on the status of zooplankton populations in the ICES area based on time-series obtained from national monitoring programs. Since its first report in 2000, this WGZE summary has been expanded to include over 32 monitoring sites, ranging from fixed stations to standard surveys and transects, each from 10 to 40+ years in length. These sites are distributed on the continental margins of both North America and Europe and cover an area from the temperate latitudes south of Portugal to the colder regions north of Norway, Iceland, and Canada. Data from several fixed CPR routes that cover coastal and oceanic waters in the North Atlantic are also included, as well as co-sampled phytoplankton and temperature data (when available). WGZE also maintains an online interactive map (http://WGZE.net) which summarizes the zooplankton monitoring sites and provides figures, data, and/or contact information for each site.

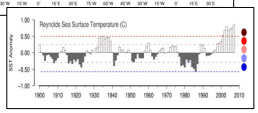
Zooplankton abundance and biomass vary substantially between years and decades, affected both directly and indirectly by the short and long-term hydrographic and physical conditions of their environment. Local water temperatures, for example, can greatly influence the community structure and production of zooplankton, which in turn can lead to large seasonal, annual, and decadal changes in population size and geographic distribution. One must also look at the phytoplankton, whose species composition and biomass determine both the amount and quality of food available to the zooplankton populations.



Time-series from 1946 to 2006 of total copepod abundance, phytoplankton color, and sea surface temperature in CPR Standard Areas across the North Atlantic .

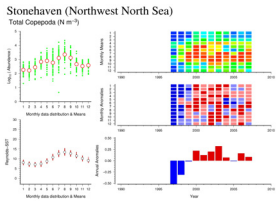
In this year's report, the trans-Atlantic CPR work of Edwards *et al.* (2006) was updated with new data, looking at long-term copepod abundance and phytoplankton biomass (via the CPR phytoplankton color index) across the North Atlantic. The most striking feature of these maps is the general long-term decline in copepod abundance in most of the northeast Atlantic, particularly in the southern North Sea, opposite of a large increase in phytoplankton color since the late 1980s in most regions (particularly the northeast Atlantic and the Newfoundland Shelf).



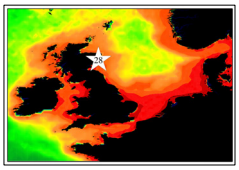


Relative sea surface temperature anomalies, plotted as five year averages from 1910 to 2005. Each figure represents the average annual anomaly for that year +/- 2 years (e.g., "1985" is the average of annual anomalies from 1983 to 1987). Blue dots represent regions of below average temperatures. Red dots indicate regions of above average temperatures. Dark red (brick) dots indicate regions in which temperatures are warmer than any recorded in the previous 100 years (1900-2000).

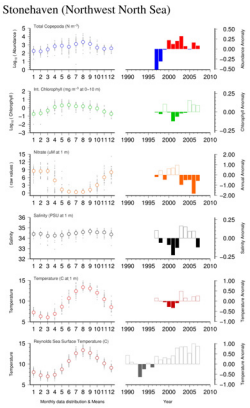
Site 28: Stonehaven (*northwest North Sea*)



Standardized WGZE time series summary plot for copepod abundance at the Stonehaven site.



Location of the Stonehaven site, plotted on a map of average chlorophyll (SeaWiFS).



Seasonal and interannual comparison of co-sampled variables at the Stonehaven site.

Rank	Taxa	% of Total Abundance 1984–2007	% of Total Zooplankton 2007	(Δ)	Mean Abundance (N m^{-3}) 1984–2007	Abundance (N m^{-3}) 2007	(Δ)
1	*Pseudocalanus spp.*	13.2	12.3	(-0.9)	411.4	369.9	(-10%)
2	*Oncaea spp.*	11.5	12.2	(0.7)	358.9	366.5	(2%)
3	*Oithona spp.*	11.1	11.3	(0.2)	346.5	339.8	(-2%)
4	*Paracalanus spp.*	10.4	10.7	(0.3)	322.8	319.0	(-1%)
5	*Cirripedia larvae*	9.8	10.3	(0.6)	304.0	309.3	(2%)
6	*Temora spp.*	8.8	8.6	(-0.1)	272.9	257.9	(-5%)
7	*Acartia spp.*	5.8	5.4	(-0.5)	182.2	160.9	(-12%)
8	*Evadne spp.*	5.2	4.8	(-0.4)	163.2	144.7	(-11%)
9	*Corycaeus spp.*	2.7	2.8	(0.2)	82.6	84.1	(2%)
10	*Appendicularia*	2.5	2.4	(-0.1)	78.1	71.0	(-9%)
	"Top Ten" Totals	**80.9**	**80.9**	(-0.0)	**2522.5**	**2422.9**	(-4%)
	Total Abundance of all zooplankton (N m^{-3})				**3119.0**	**2996.5**	(-4%)

Average abundance and relative dominance (percentage of the total zooplankton collected) of the top ten most abundant zooplankton taxa collected at Stonehaven in previous years (1999–2007) in comparison to that collected in 2007. Colors in the "Δ" and "Δ%" column indicate either an increase (red) or a decrease (blue) in relative dominance from previous years.

The Reynolds' Extended Reconstructed Sea Surface Temperatures product (ERSST.v3) was used to add standardized temperature data to every site. The ERSST.v3 uses *in situ* data, along with satellite validation and statistical reconstruction (for data sparse time periods or regions), to create a continuous global monthly temperature time series back to 1854. We used data from 1900 onward to provide a 100 year summary of water temperatures in and around the zooplankton sampling sites. Looking at water temperatures at each site, and spatially across the North Atlantic, we found that many regions were now experiencing temperatures higher than any previously recorded in the last 100 years.

The basin-wide CPR analysis has already noted a general downward trend in copepod abundance in many of the regions of high temperatures. Individual sites within these same regions, however, show a mixed response, with some sites showing a decrease in abundance or biomass while others show a slight increase. Zooplankton response to these conditions may be lagged or take multiple seasons to become clearly evident. Near shore hydrographic features can also play a role in altering or lagging the effects seen in the open water CPR data. Within this year's report, a visual and descriptive summary of trends and status is provided for each of the thirty-seven sites used in this analysis.

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