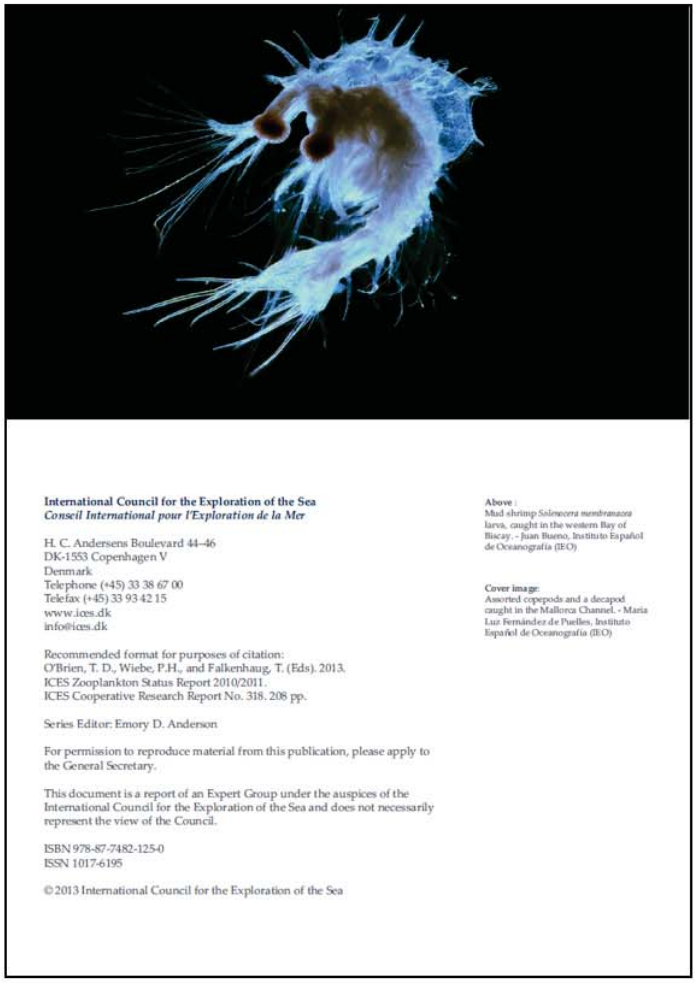

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Above :
Mud shrimp *Solenocera membranacea* larva, caught in the western Bay of Biscay. - Juan Bueno, Instituto Español de Oceanografía (IEO)

Cover image:
Assorted copepods and a decapod caught in the Mallorca Channel. - María Luz Fernández de Puelles, Instituto Español de Oceanografía (IEO)

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4.2 AR7W Section (Sites 10–14)

Erica Head

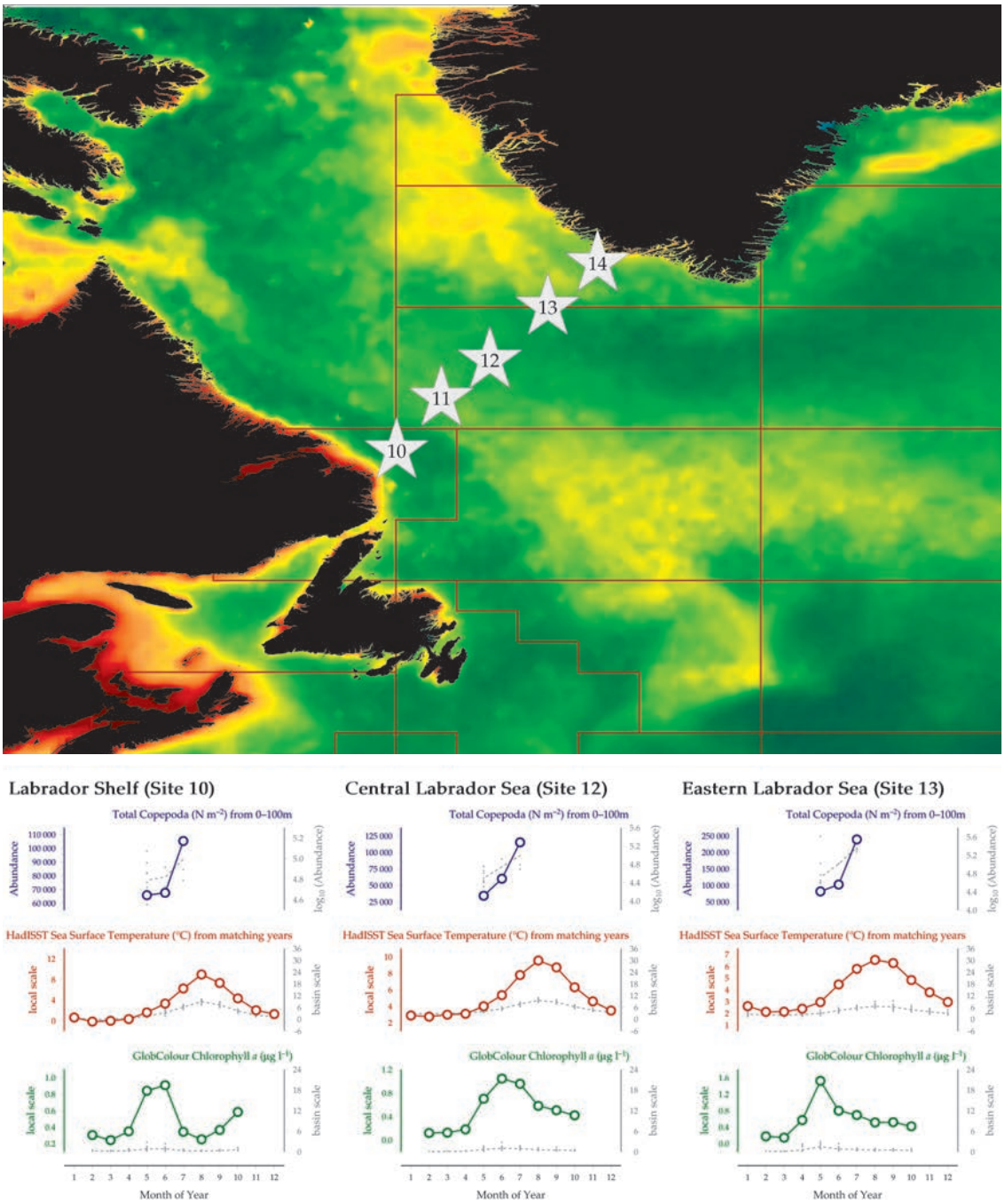


Figure 4.2.1
Location of the AR7W Section monitoring areas (Sites 10–14), plotted on a map of average chlorophyll concentration, with corresponding seasonal summary plots (only for sites 10, 12, and 13) shown in the lower panel (see also Section 2.2.1).

Zooplankton are sampled once a year during spring or early summer (May–July) at up to 28 stations along the AR7W section. Most of the occupations have been during late May (1996, 1997, 2000, 2004–2011), with others in June (1998, 2001) and July (1995, 1999, 2002, 2003). In some years, the Labrador Shelf is still covered with pack ice in late May, which prevents sampling at some or all of the stations there. Farther east, the section is ice-free, except for a few icebergs on or near the Greenland Shelf, which can also interfere with sampling at some stations.

Zooplankton sampling is by means of 202 µm mesh ringnets, towed vertically between 100 m and the surface. Zooplankton are preserved in formalin, identified, and enumerated, and the abundance data are analysed using a multidimensional scaling method that groups stations according to community structure. The stations generally fall into five zones (sites), which correspond geographically to the Labrador Shelf (Site 10), the Labrador Slope (Site 11), the western Central Labrador Sea (Site 12), the Eastern Labrador Sea (Site 13), and the Greenland Shelf (Site 14) (Head *et al.*, 2003). The boundaries between the three central regions are flexible, while the shelf stations are confined by bathymetry.

Zooplankton biomass is determined for groups of organisms that have been picked out and dried in an oven at 60°C for at least 24 h. These groups are for individual stages for three species of *Calanus* and of broader groupings for other taxa (e.g. genus, larvaceans), and the total sample biomass is calculated by summing the dry weights of the groups, using the abundance data where appropriate. Biomass is determined in this way because often the samples contain high concentrations of phytoplankton, which would lead to overestimation of zooplankton biomass, if bulk measurements were to be made.

Seasonal and interannual trends (Figures 4.2.2–4.2.8)

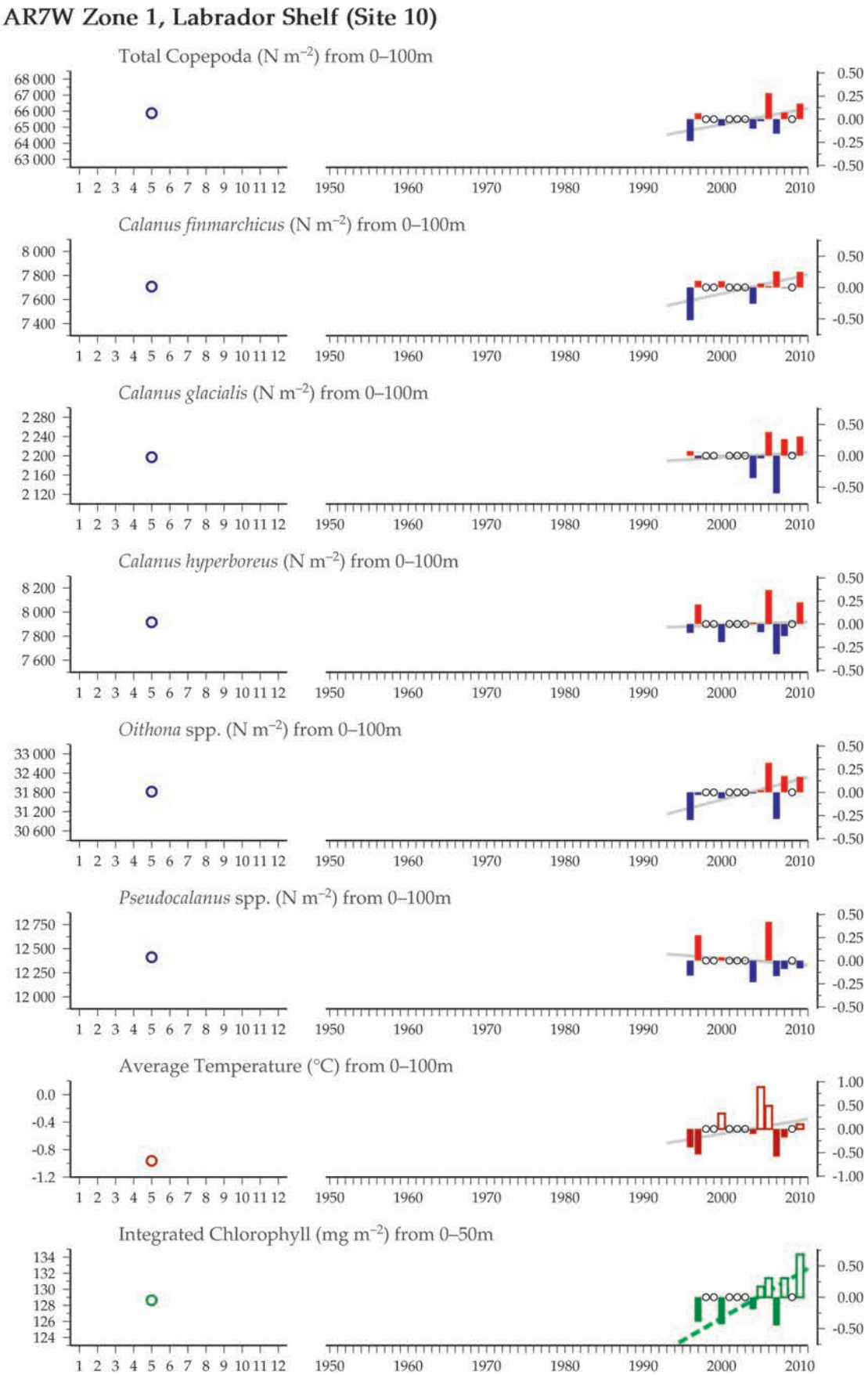
Seasonal cycles of abundance vary among species and regions in the Labrador Sea. For *Calanus finmarchicus*, regional differences in spring bloom dynamics lead to differences in the timing of reproduction. On the Labrador Shelf (LSh, Site 10) and in the Central Labrador Sea (CLS, Site 12), the bloom generally starts in May (see Figure 4.2.1), and populations are dominated by reproductively active adult females (>60%) in late May. In the Eastern Labrador Sea (ELS, Site 13), by contrast, the bloom starts in April, and by late May, young-stage copepodites are abundant and account for >90% of the population. The ELS population in July is more developed, but only slightly more abundant than the LSh and CLS populations. On the LSh, population size has increased by July and young stages (CI–IV) now make up >80% of the total. In the CLS, population size does not change between May and July, and in July, young stages still only make up about 40% of the total, suggesting high mortality and poor recruitment. A similar observation has been made in the central Irminger Sea (Heath *et al*., 2008). The two Arctic *Calanus* species contribute significantly to the total copepod abundance only on the LSh, with *C. hyperboreus* more abundant in May and June and *C. glacialis*, in July. *C. hyperboreus* reproduce in winter, without feeding (Conover, 1988) and the population is >75% CIV copepodites on the LSh by July and has started to return to depth to overwinter. *C. glacialis* reproduce in early spring, utilizing ice algae as an energy source, and by July, 90% of the population on the LSh are stage CI–CIII, which cannot overwinter and must continue to feed to reach a stage that can. *Oithona* spp. shows no May–July change in abundance on the LSh, but substantial increases in the CLS and ELS. *Oithona* spp. shows no spring–summer increase in abundance at Station 27 (Site 9, see Section 4.1) either, but by contrast, *Oithona* spp. in CPR samples collected in the subpolar gyre, between Flemish Cap and Iceland, are low in abundance in May, increasing to peak values in July (E. J. H. Head, pers. comm.). This regional difference in seasonal cycles could be due to differences in the seasonal cycle of food availability, or species composition, since the population on the shelf is mainly *O. similis*, while the offshore regions, which contain greater proportions of Atlantic water, also contain higher proportions of *O. atlantica*. *Pseudocalanus* spp. were only present in appreciable levels on the LSh, where they did not show the slight increased observed between May and July at Station 27 (see Figure 4.1.2, Section 4.1).

Within Figures 4.2.2–4.2.6, interannual trends in abundance were examined by including only data collected in late May. In general, there were no significant trends in abundance in any of the regions. The only statistically significant trend was an increasing trend for *C. glacialis* abundance in the Central Labrador Sea (CLS, Site 12). In general, the non-significant increasing abundance trends were consistent with increasing temperature trends, but not with the observed *in situ* trends in chlorophyll concentration.

Long-term temperature and windspeeds were increasing at all sites (Figure 4.2.7), with the exception of windspeeds in the Central Labrador Sea (CLS, Site 12). Recent (2005–present) sea surface temperatures in the Labrador Shelf, Labrador Slope, and Central Labrador Sea regions (Sites 10–12) have been near or above the warmest temperatures seen in the last 100 years (see Figure 4.2.8, red dashed lines).

Figure 4.2.2
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables at the AR7W Labrador Shelf zooplankton monitoring area (data collected in late May only).

Additional variables are available online at http://WGZE.net/time-series.



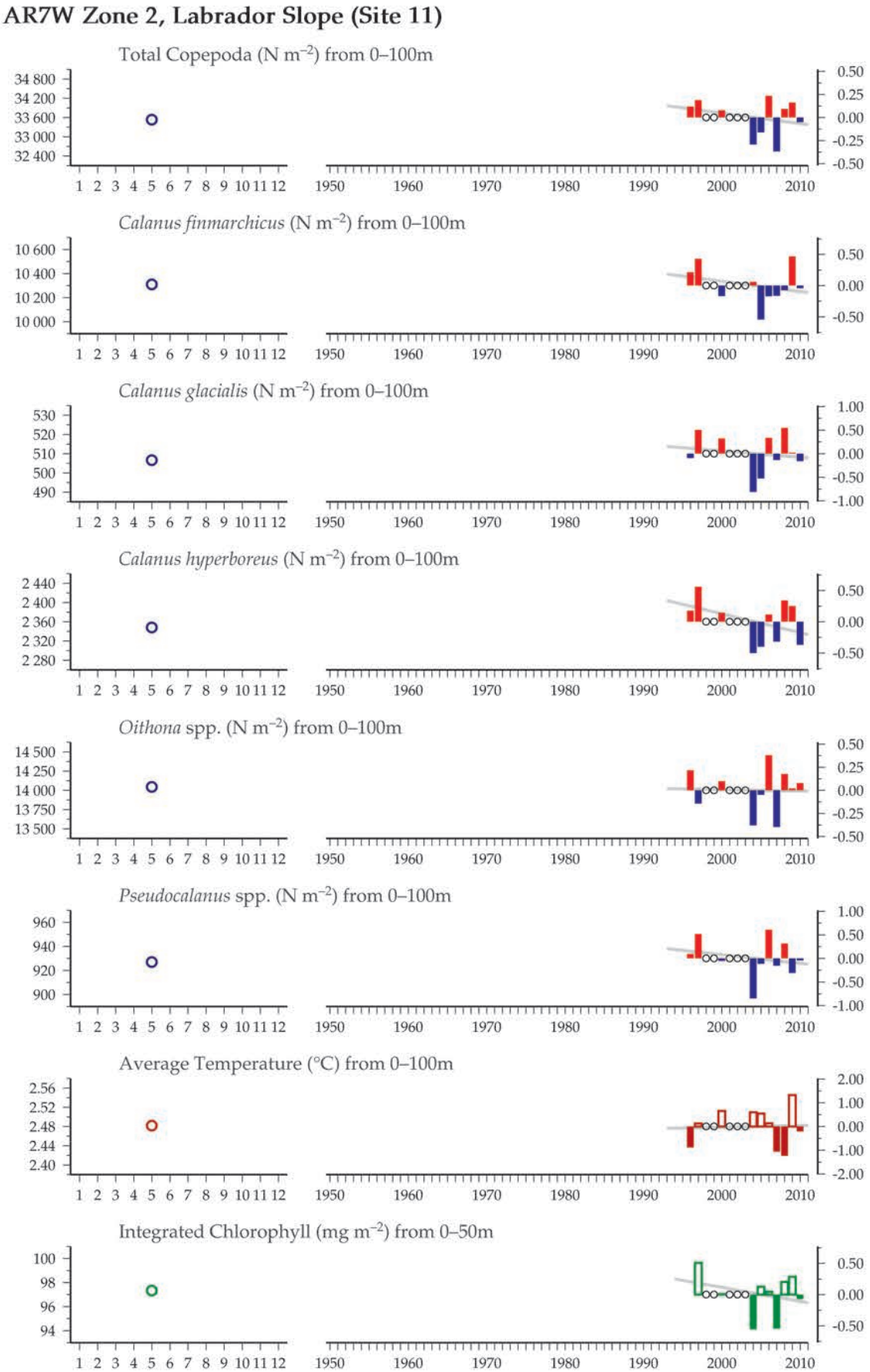
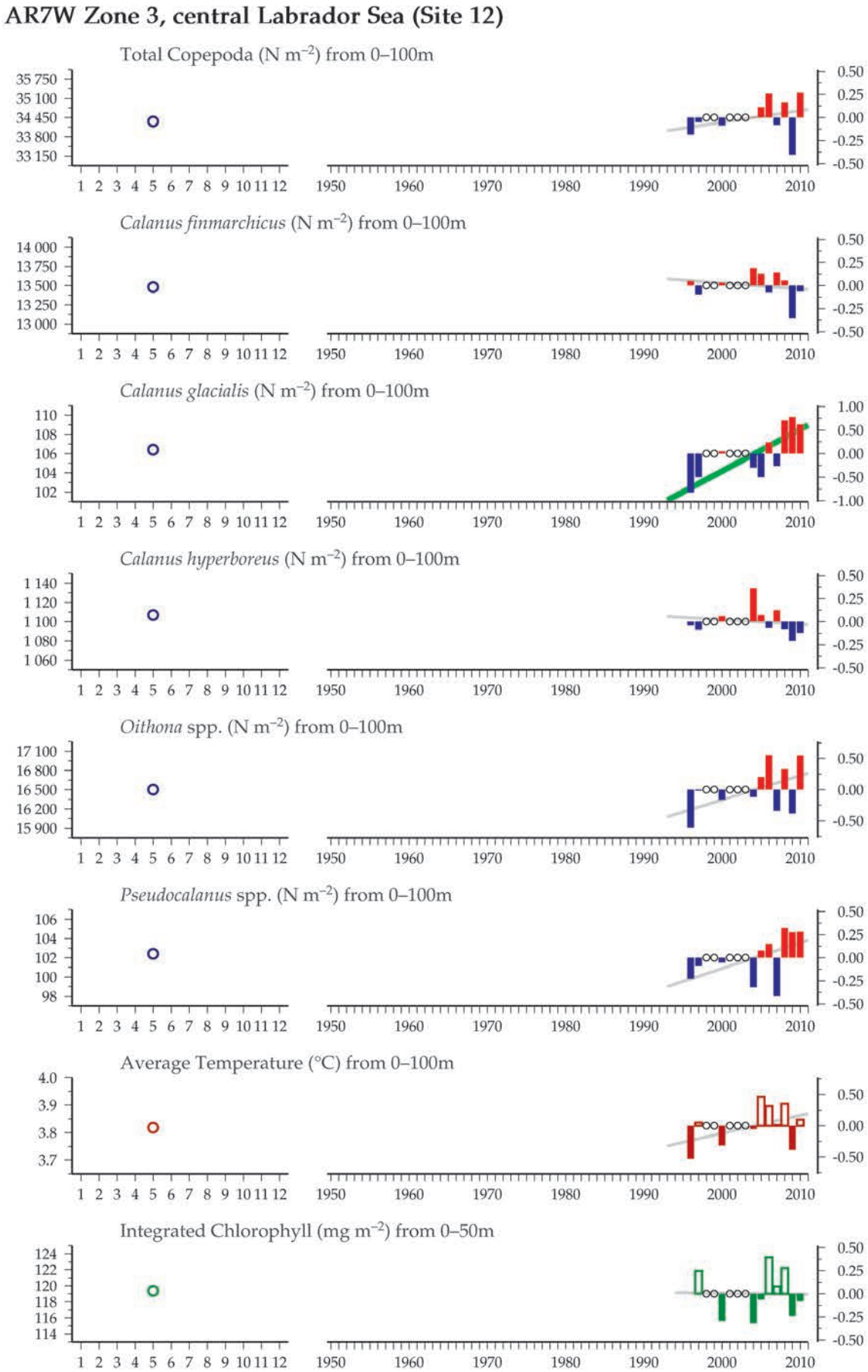


Figure 4.2.3
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables at the AR7W Labrador Slope zooplankton monitoring area (data collected in late May only).

Additional variables are available online at http://WGZE.net/time-series.

Figure 4.2.4
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables at the AR7W Central Labrador Sea zooplankton monitoring area (data collected in late May only).

Additional variables are available online at http://WGZE.net/time-series.



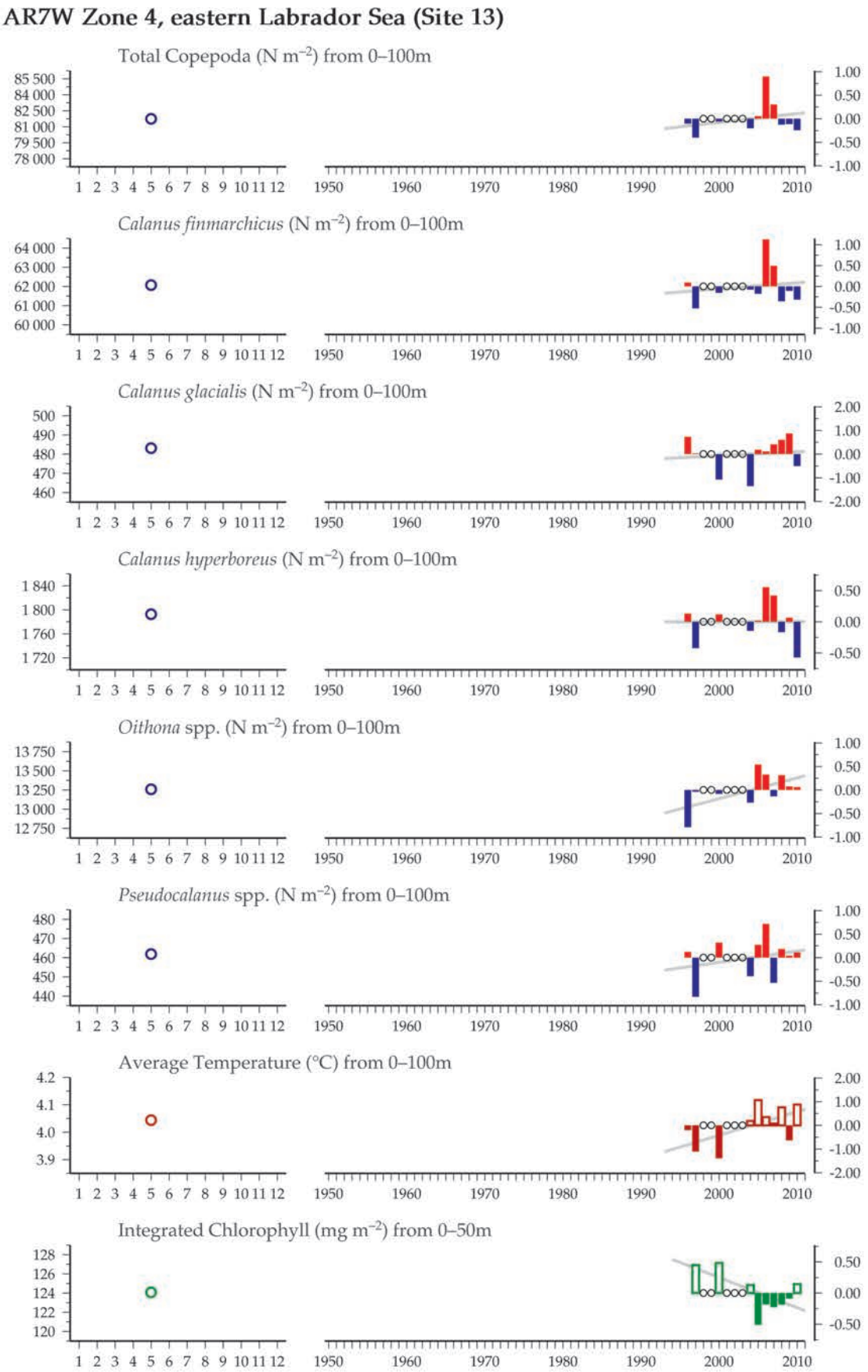
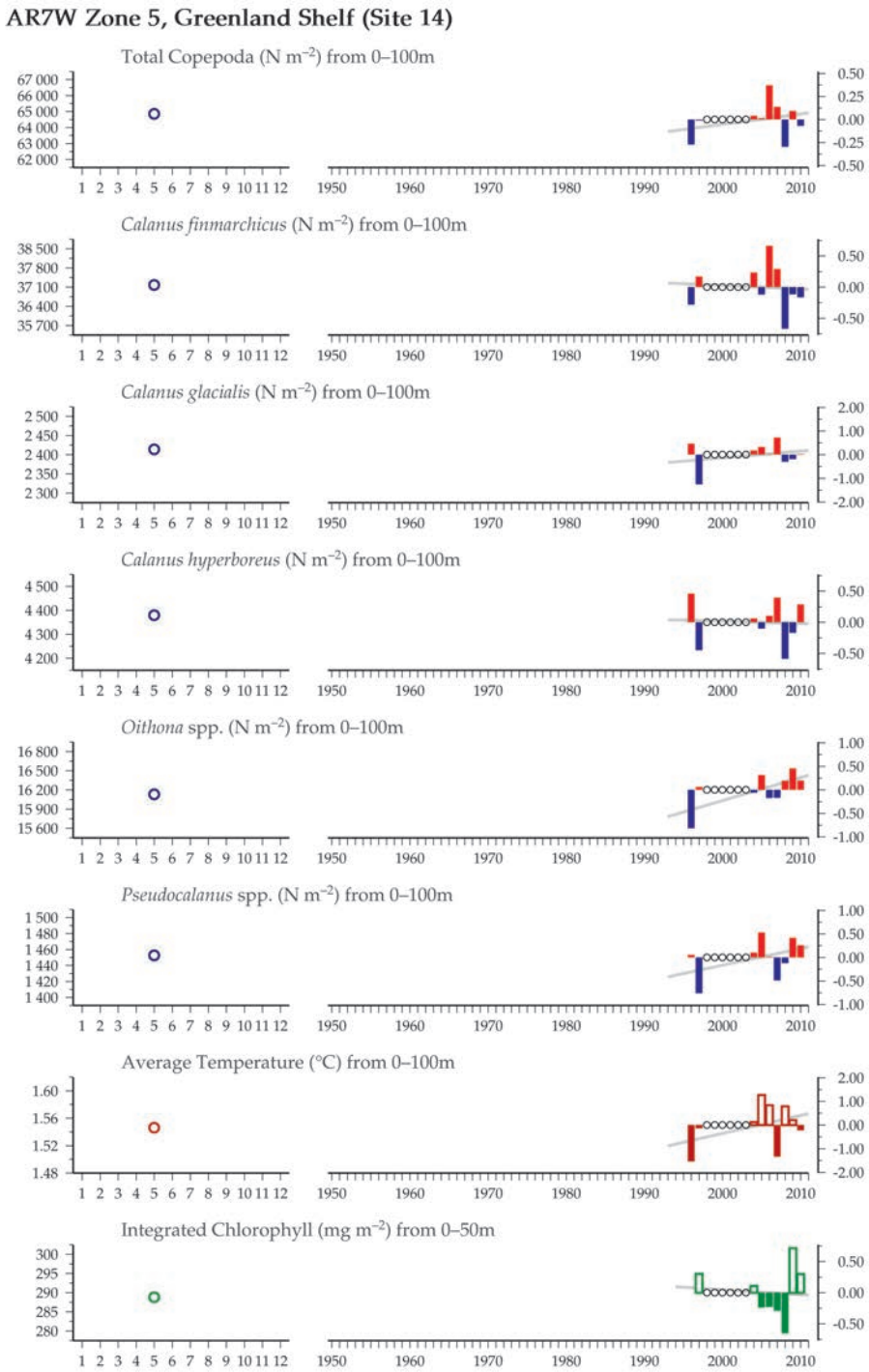


Figure 4.2.5
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables at the AR7W Eastern Labrador Sea zooplankton monitoring area (data collected in late May only).

Additional variables are available online at http://WGZE.net/time-series.

Figure 4.2.6
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables at the AR7W Greenland Shelf zooplankton monitoring area (data collected in late May only).

Additional variables are available online at: http://WGZE.net/time-series.



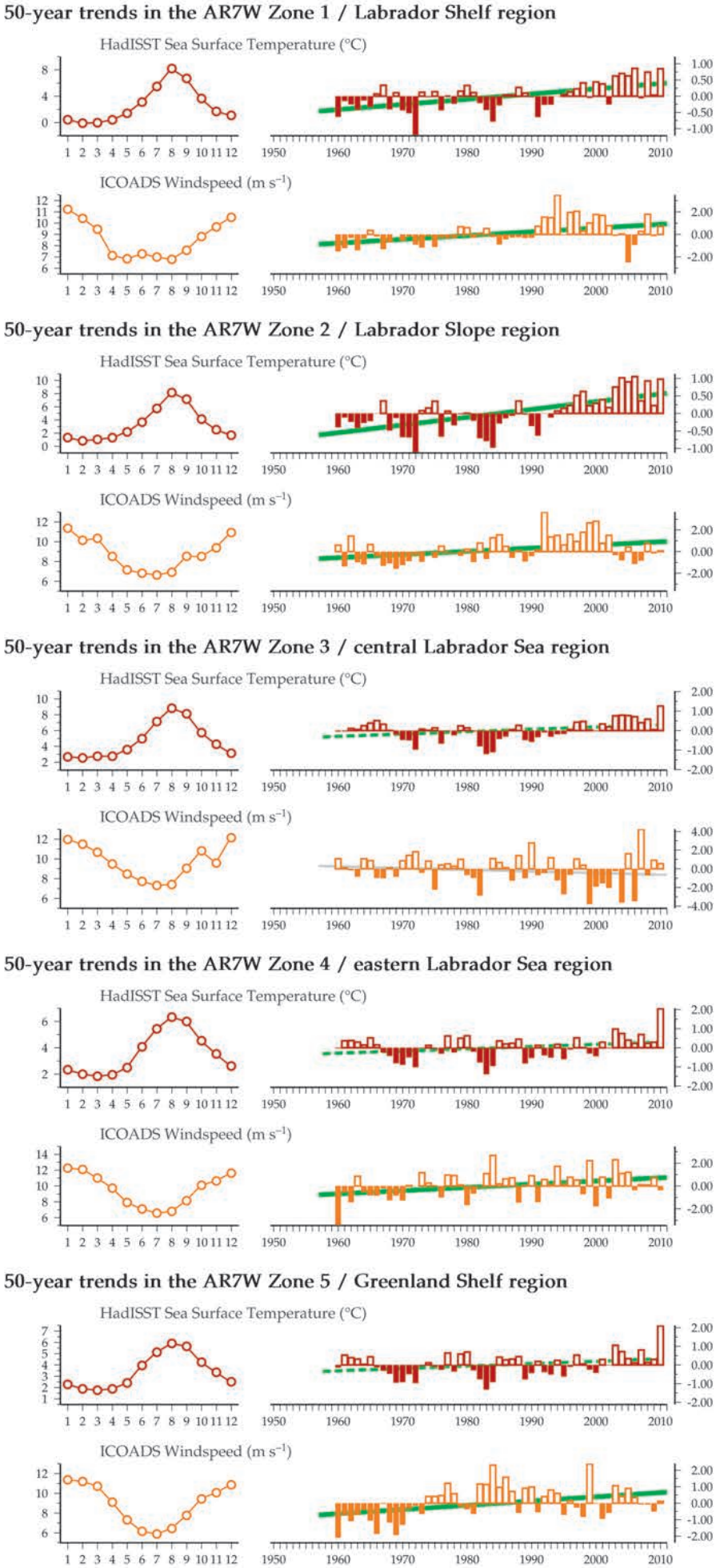


Figure 4.2.7
Regional overview plots (see Section 2.2.3) showing long-term sea surface temperatures and wind speeds in the general regions surrounding the AR7W monitoring areas.

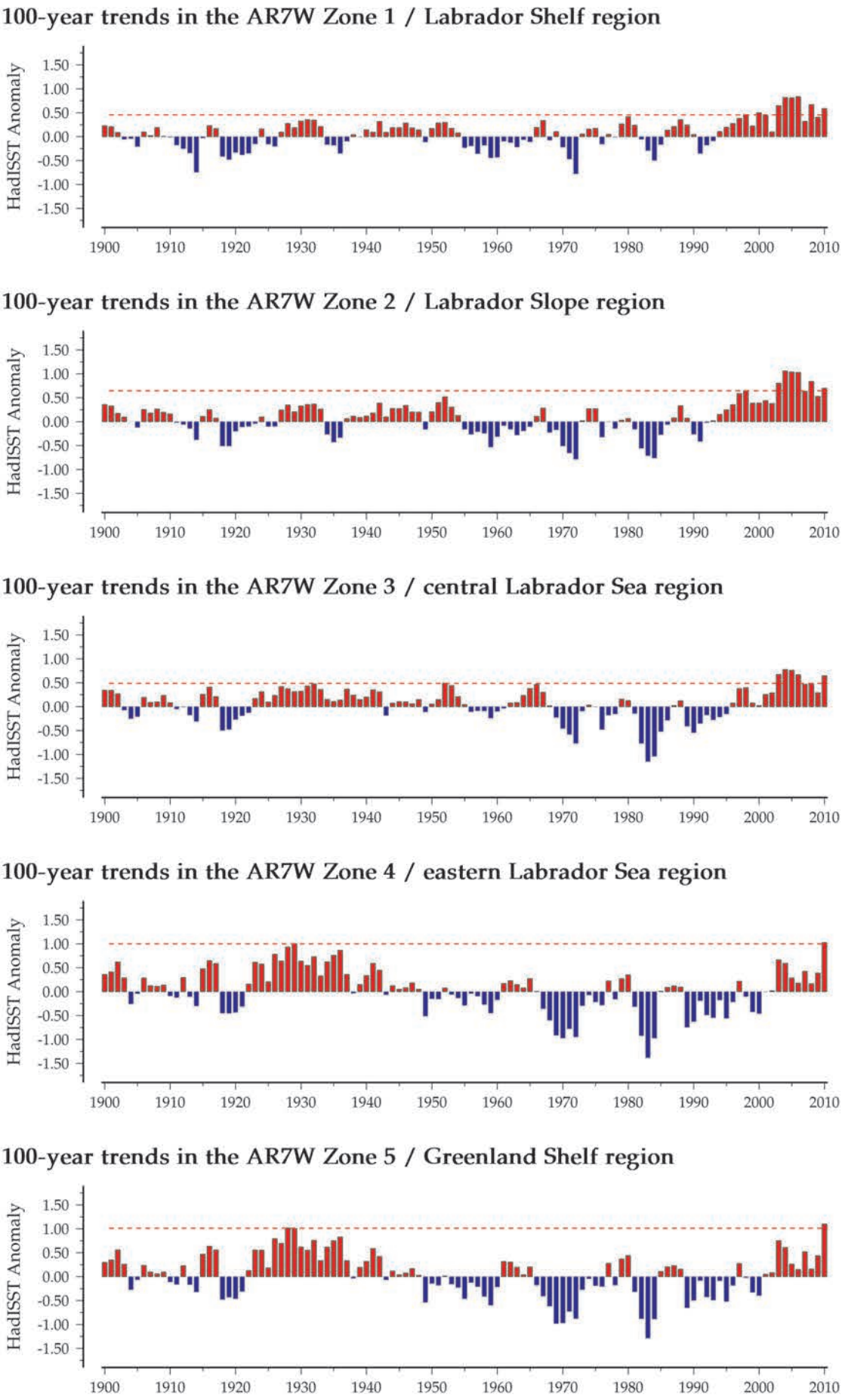



Figure 4.2.8
Seasonal and interannual trends of long-term surface water temperatures in the general region surrounding the zooplankton survey area (see Section 2.2.2 for an explanation of the data sources and figures).