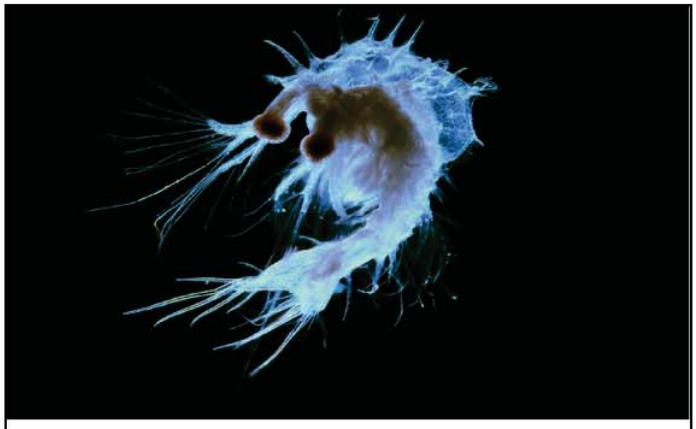

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Above :
Mud shrimp *Solenocera membranacea* larva, caught in the western Bay of Biscay. - Juan Bueno, Instituto Español de Oceanografía (IEO)

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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3.1 NEFSC Ecosystem Monitoring Program (Sites 1–4)

Jon Hare and Todd D. O'Brien

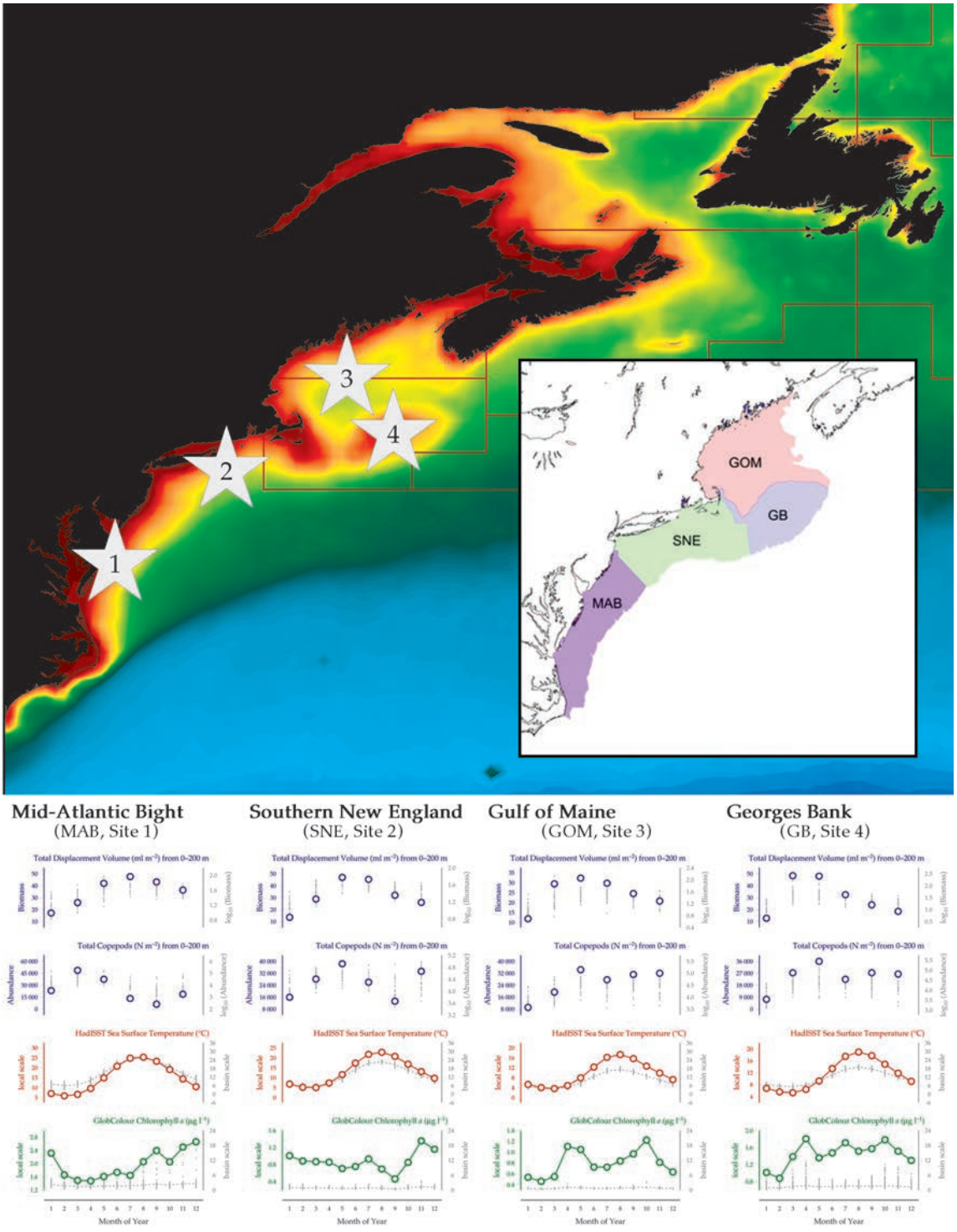


Figure 3.1.1
Locations of the NEFSC Ecosystem Monitoring Program areas (Sites 1–4) on a map of average chlorophyll concentration, and their corresponding seasonal summary plots (lower panels, see also Section 2.2.1).

The Northeast Fisheries Science Center (NEFSC) of the National Marine Fisheries Service (NMFS) has a long-standing Ecosystem Monitoring programme covering most of the northeast US continental shelf, which extends from approximately 35–45°N. The NEFSC sampling protocol divides the continental shelf into four regions (Figure 3.1.1), based on their different physical and biological characteristics. NEFSC surveys collect hydrographic and tow data using a randomized spatial sampling technique that samples approximately 30 stations per region per 2-month period. During these surveys, zooplankton are collected using a bongo net (60 cm diameter, 333 µm mesh) towed obliquely from 200 m (or near the bottom) to the surface. The zooplankton time-series in these four areas started in 1977 and continue to the present.

Seasonal and interannual trends (Figures 3.1.2–3.1.5)

Along the northeast US continental shelf, primary production is highest near the shore (Figure 3.1.1, map of chlorophyll, regions of red and yellow coloration). The distribution of zooplankton biomass is similar to that of primary production, with highest levels found during late spring and summer (Figure 3.1.1, lower panels of seasonal summary plots). High levels of primary productivity and zooplankton abundance are also found on Georges Bank. Changes in the northeast US continental shelf zooplankton community have been observed in all regions, with an overall increasing trend in total annual zooplankton biomass (measured as total displacement volume) since the early 1980s (Figure 3.1.2–3.1.5). However, since 1990, zooplankton biomass has decreased somewhat and relatively low levels of zooplankton biomass were observed in 2010 in all four areas. Changes in species composition over this period have been observed in the Georges Bank region (Kane, 2007), with smaller-bodied taxa (e.g., *Centropages hamatus, Centropages typicus, Pseudocalanus* spp., and *Temora longicornis*) increasing in abundance in the 1990s and decreasing in the 2000s (Figure 3.1.5). There is also some evidence of a shift in seasonality for some zooplankton species (e.g. *T. longicornis*), with the peak abundance period beginning earlier in the season and lasting longer. These changes probably occurred in the Mid-Atlantic region as well.

Since 1960, water temperatures in all of the regions have been slowly increasing (Figure 3.1.6; see also Ecosystem Assessment Program, 2009). Water temperatures are influenced by the influx of cooler, fresher water from the north, and the occurrence of low-salinity events has also increased since the early 1990s (Mountain, 2004).

The 100+ year SST trends within each of the regions (Figure 3.1.7) illustrate that temperatures are currently above the 100-year climatological average, and are currently near or below the maximum seen in the 1950s (Figure 3.1.7, red dashed lines).

Stratification within the water column can also be influenced by surface winds, which have also been steadily increasing since the 1960s in all four regions (Figure 3.1.6). Hinder *et al.*(2012) found a strong correlation between increasing surface winds and the Continuous Plankton Recorder survey Plankton Colour Index, attributed to better wind-induced mixing within the water column. CPR Standard Area "F10" (see Figure 10.1 in Chapter 10) encompasses most of the NMFS Georges Bank and Gulf of Maine survey areas. Long-term data from this area (Figure 3.1.8) shows a strong increase in Phytoplankton Colour Index (PCI) and total diatoms, while a clear trend is not evident in the corresponding CPR total copepod data. As the CPR "total diatoms" category does not convey any cell size or species composition information, it is possible that the increasing (total) diatoms include species too small or less preferred within the local copepod diets.

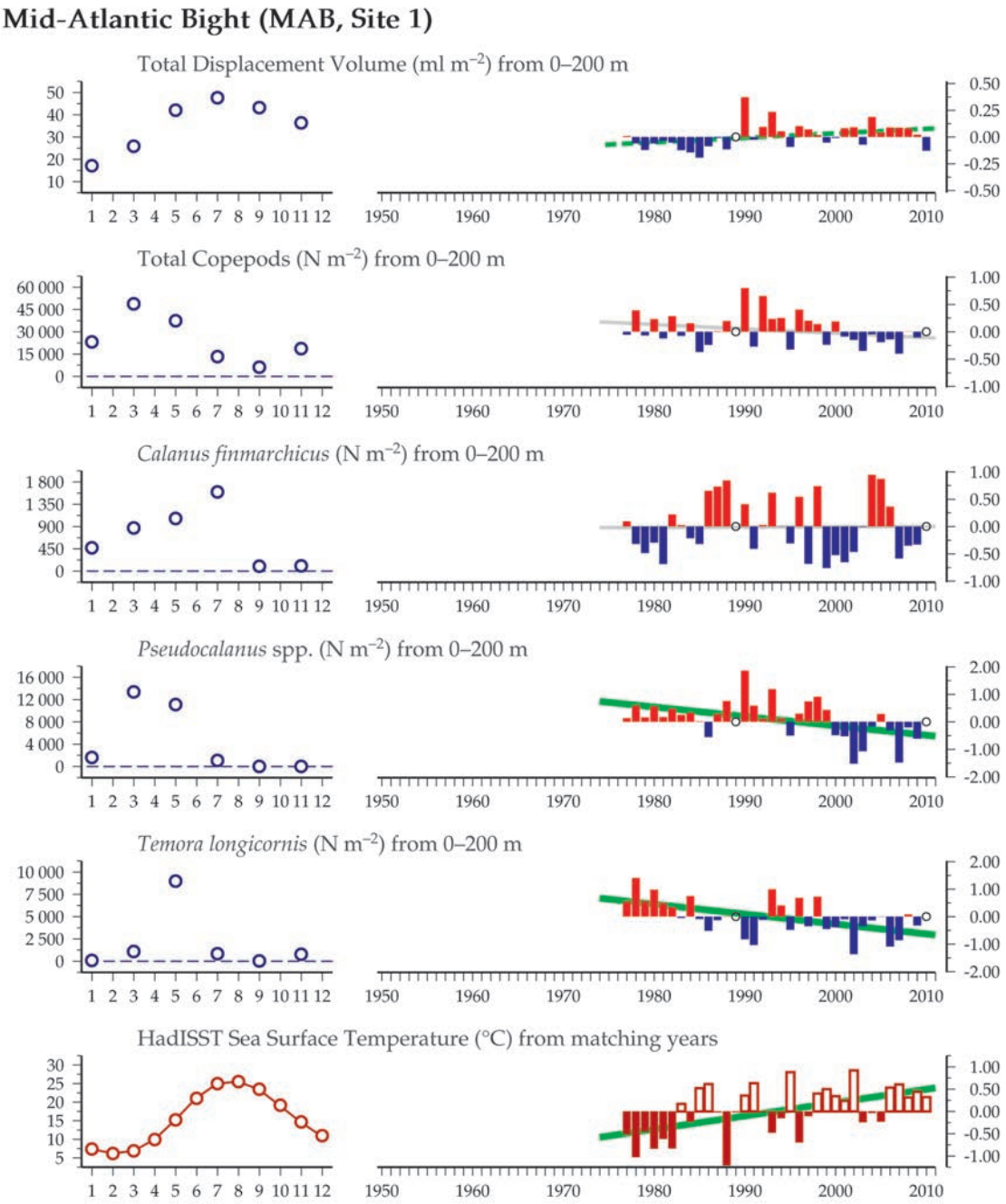


Figure 3.1.2
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables in the Mid-Atlantic Bight monitoring area.

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

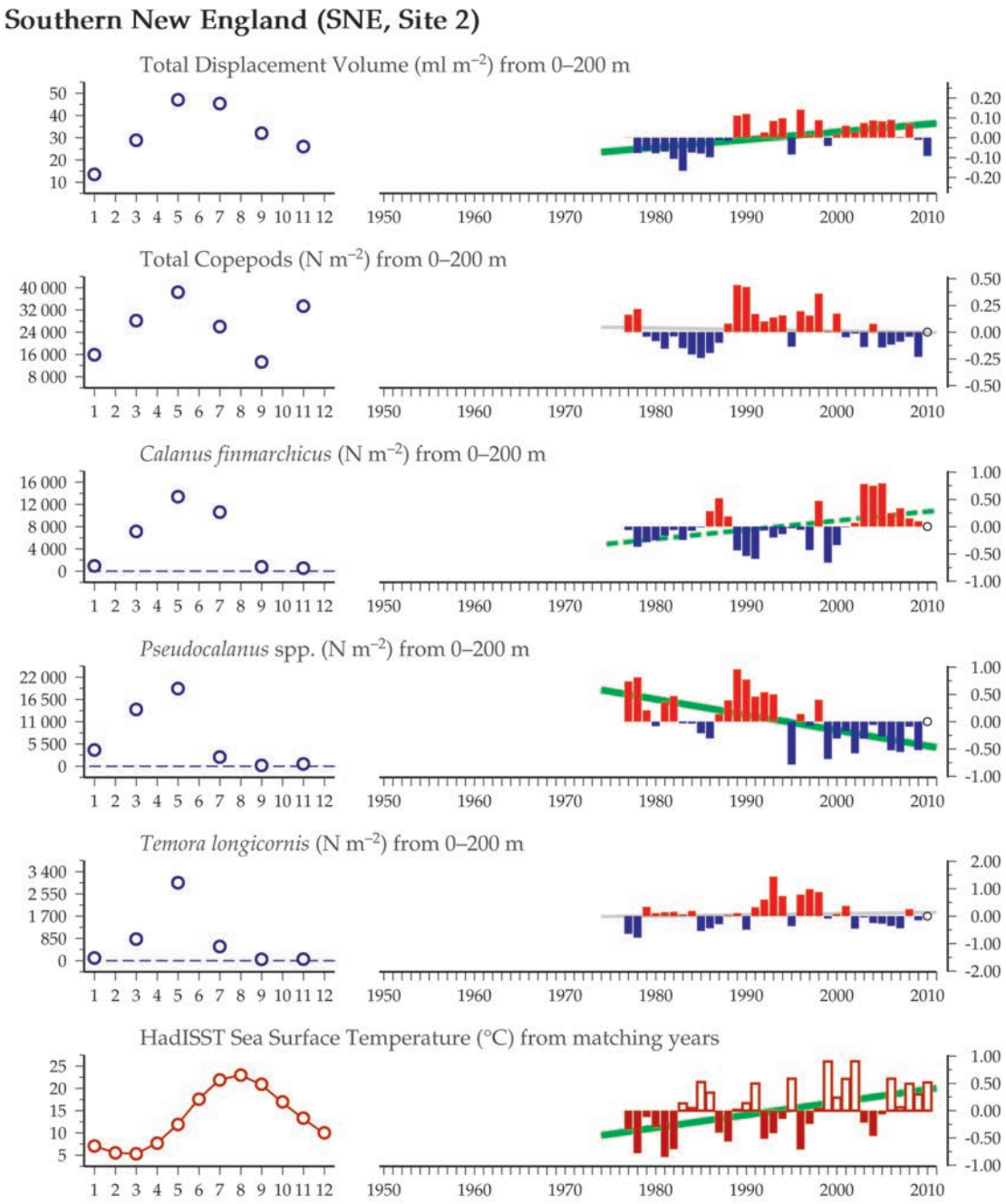


Figure 3.1.3
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables in the Mid-Atlantic Bight monitoring area.

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

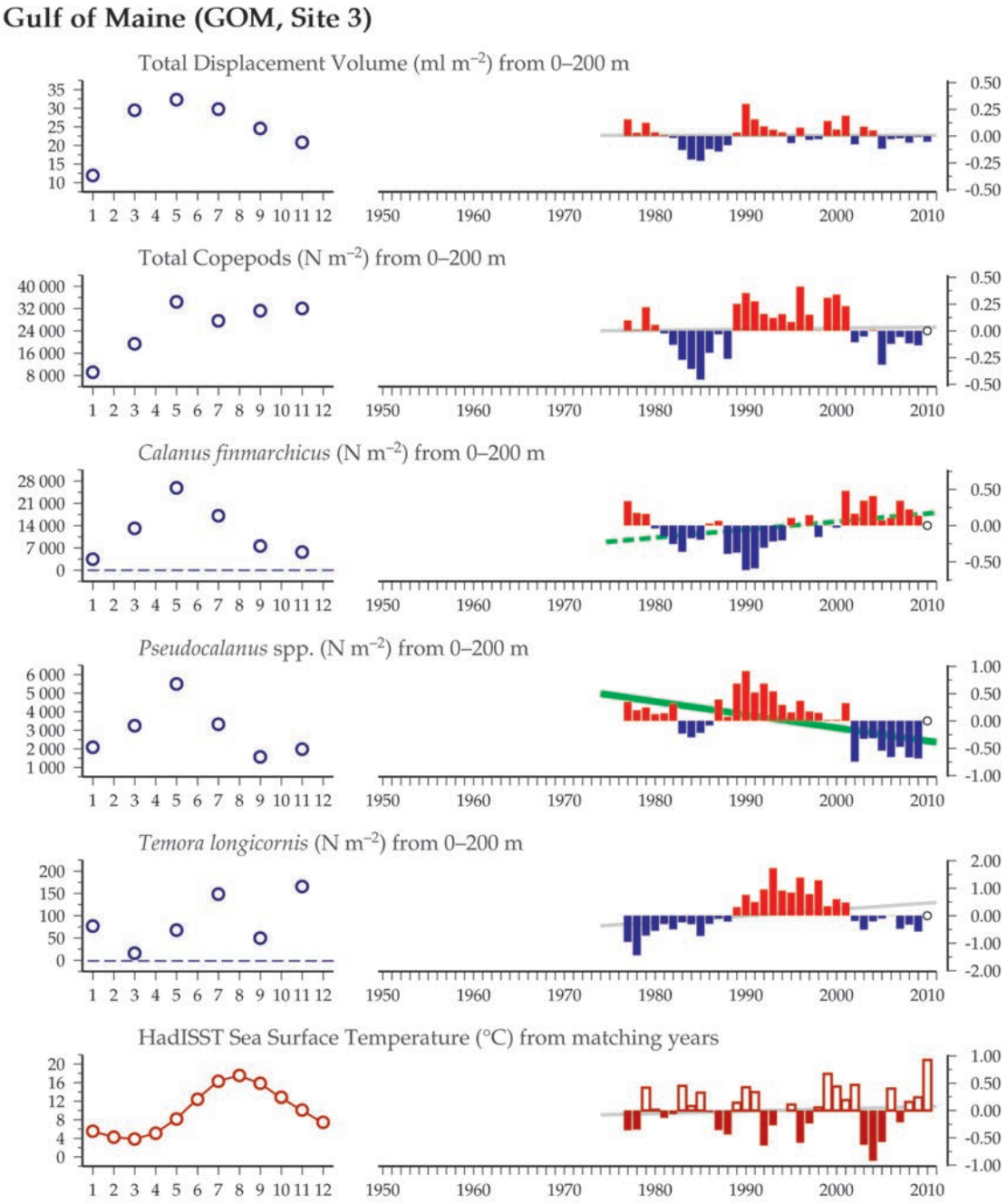


Figure 3.1.4
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables in the Gulf of Maine monitoring area.

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

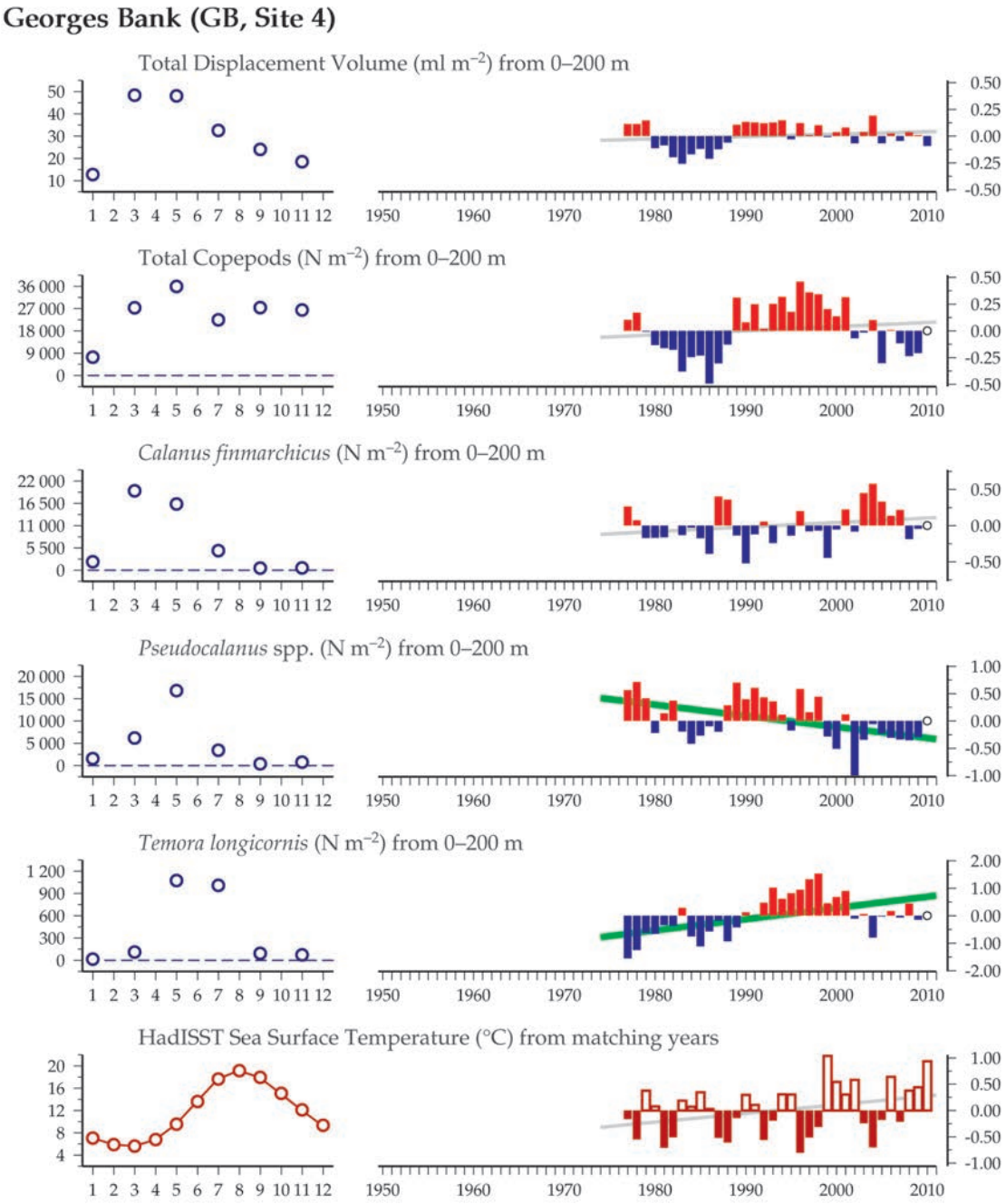
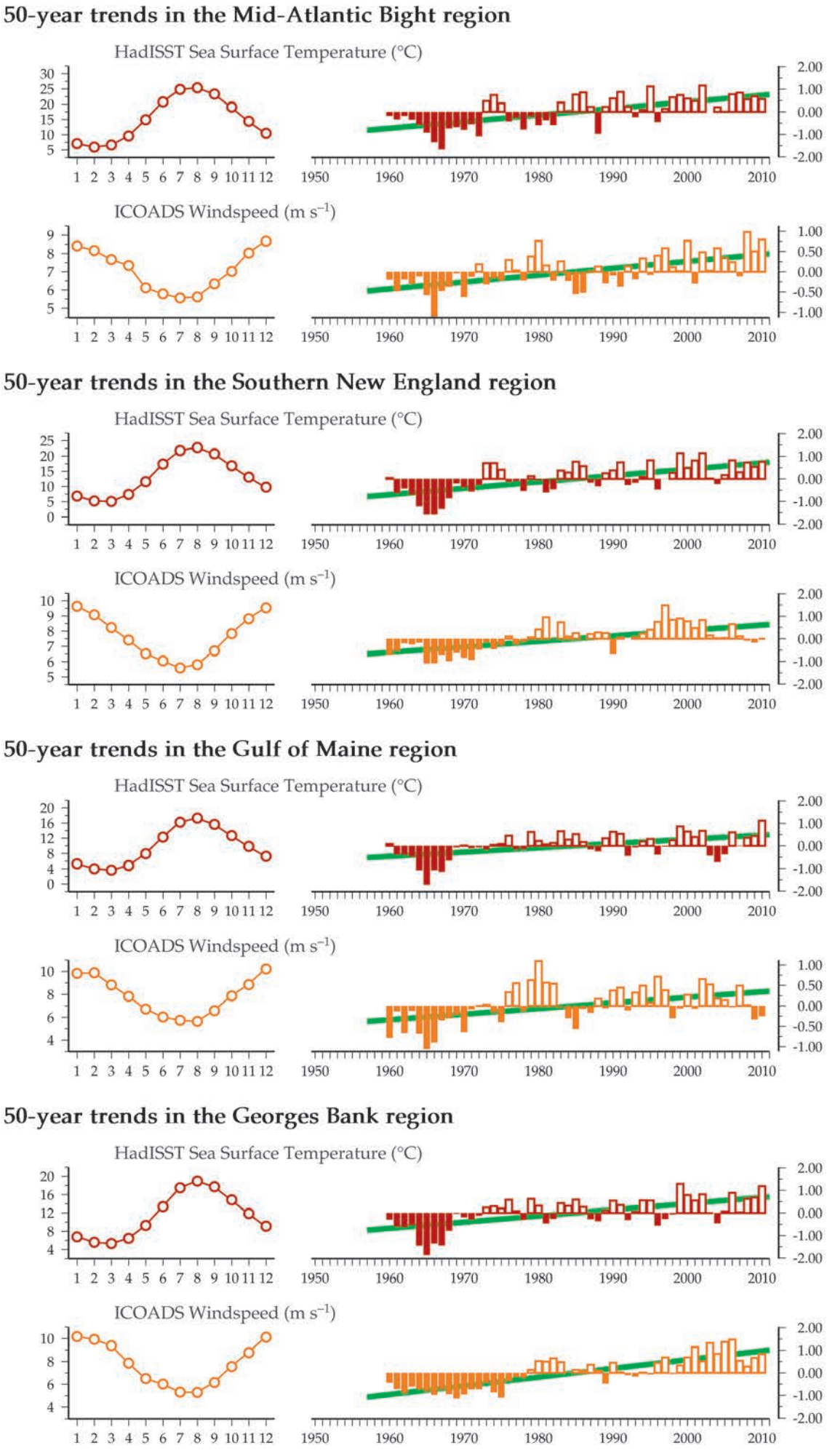


Figure 3.1.5
Multiple-variable comparison plot (see Section 2.2.2) showing the seasonal and interannual properties of select cosampled variables in the Georges Bank monitoring area.

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

Figure 3.1.6
Regional overview plot (see Section 2.2.3) showing long-term sea surface temperatures and wind speeds in the general region surrounding the Mid-Atlantic Bight, Southern New England, Gulf of Maine, and Georges Bank monitoring areas.



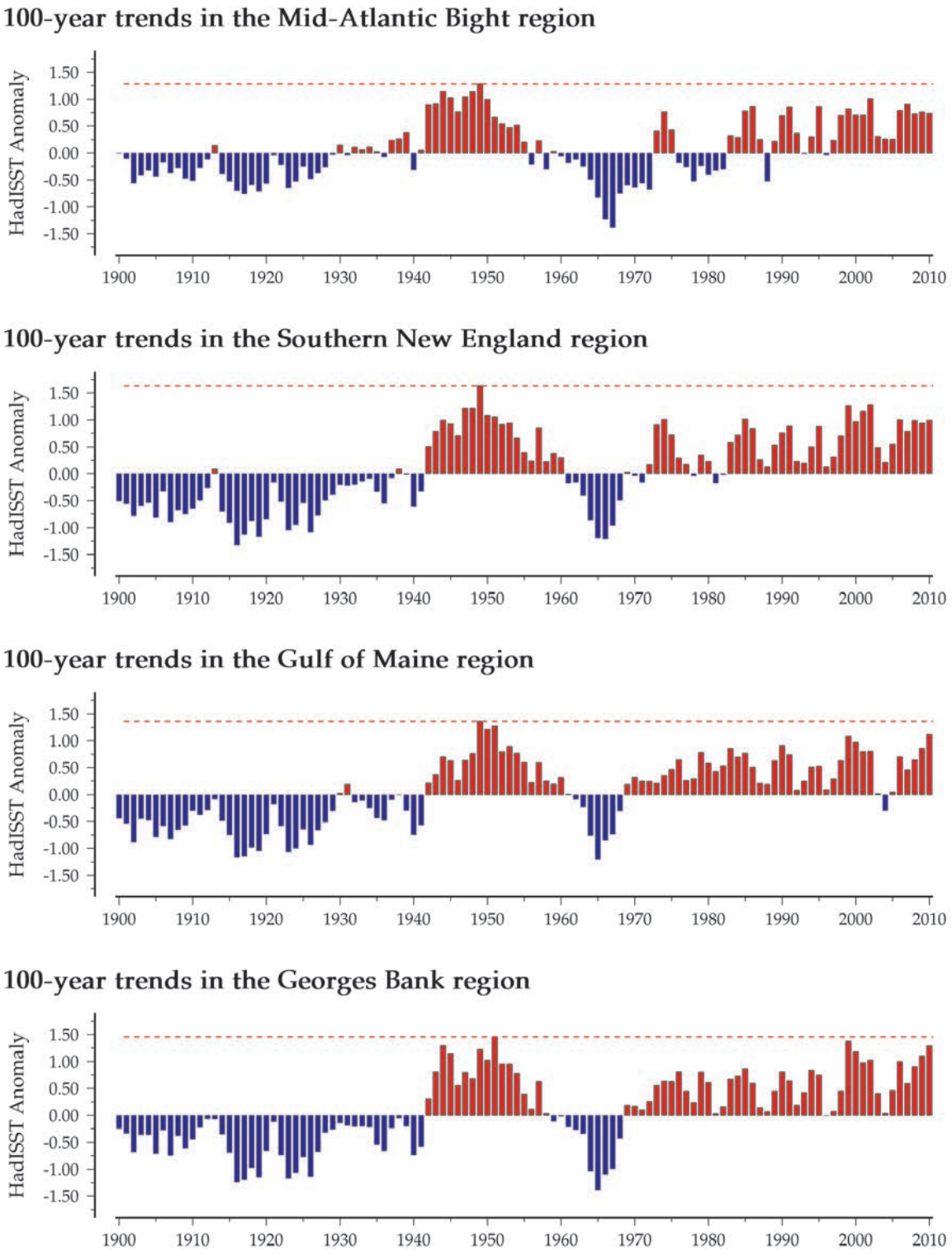


Figure 3.1.7
Regional overview plot (see Section 2.2.3) showing long-term sea surface temperatures in the general region surrounding the Mid-Atlantic Bight, Southern New England, Gulf of Maine, and Georges Bank monitoring areas.

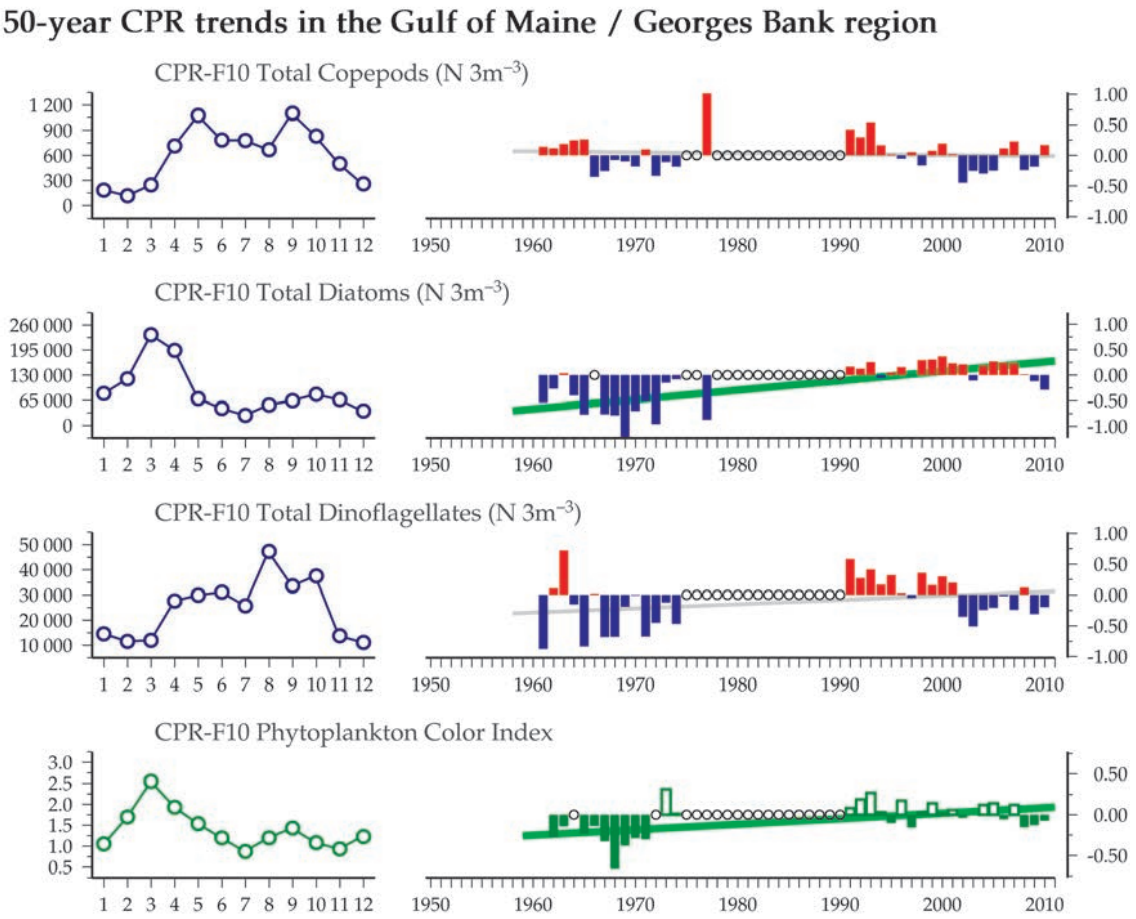


Figure 3.1.8
Regional overview plot (see Section 2.2.3) showing select variables from CPR Standard Area "F10" (see Section 10), covering the Gulf of Maine and Georges Bank monitoring areas.