Bedford Basin is Station Zero of the AZMP Halifax Line

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Annual average anomalies of sea surface temperature in Bedford Basin exhibit strong temporal coherence with anomalies at stations along the AZMP Halifax Line and also with anomalies in the eastern and western Scotian Shelf. Temperature anomalies at the Compass Buoy station in Bedford Basin are correlated with those on the Scotian Shelf. The strength of correlation decreases with distance from the Basin, from very strong (0.9) at HL2 off Chebucto Head, to moderate (0.5) at HL5 near the shelf edge, to very weak (0.2) at HL8 on the slope. The coherence of multiannual variations in temperature and picophytoplankton abundance observed in the Basin may likewise be expected to occur on the Scotian Shelf as a whole.

Long term trends (multidecadal) in seasonally adjusted values of environmental drivers (e.g. climate), pressures (e.g. temperature), and state (e.g. plankton) are best discerned from records of observation that are both extensive in duration and intensive in frequency. None of the stations on the AZMP Halifax Line provide data that meet these conditions. On the other hand, the Compass Buoy station in Bedford Basin has been monitored on a weekly basis for 20 years. Here, we show coherent long term temperature variations leading out from the Basin to the Shelf, indicating that the Compass Buoy station may be regarded as the inshore terminus of the Halifax Line, with implications for shelf-wide variations of picophytoplankton abundance related to temperature change.

The climatology and deseasonalised multiyear trend of surface temperature in Bedford Basin (Fig. S1) were calculated and displayed in standard ICES format employed by WGPME (Li et al. 2011). The 3-year running mean indicates that Basin temperature in the first decade of the 21st century was below normal in the first half of the decade, and above normal in the second half. The same pattern in the 3-year running mean of annual average temperature anomalies is seen in the Port of Halifax, at Halifax Line station 2, and across the western and eastern Scotian Shelf (Fig. S2). The anomalies at these locations are correlated significantly ($p<0.05$) with those in Bedford Basin (r = 0.89, 0.85, 0.86, 0.59 respectively).

Using SST measured by NOAA AVHRR instrument, we calculated climatology and annual average anomalies for a line of 119 virtual stations, starting at $63^0$26'45.6'', ending at 61^o23'49.2'', positioned apart by about 1.3 minutes longitude, thus creating a highly-resolved inshore-offshore gradient along the actual Halifax Line. For positions on the shelf but not on the slope, the time evolution of the 3-year running mean was similar to that in Bedford Basin (Fig. S3). Notably, the correlation coefficient relating anomalies in the Basin with those on the virtual line decreased in a striking manner along the inshore-offshore gradient, becoming statistically not significant ($p>0,05$) near the shelf break (Fig. 1).

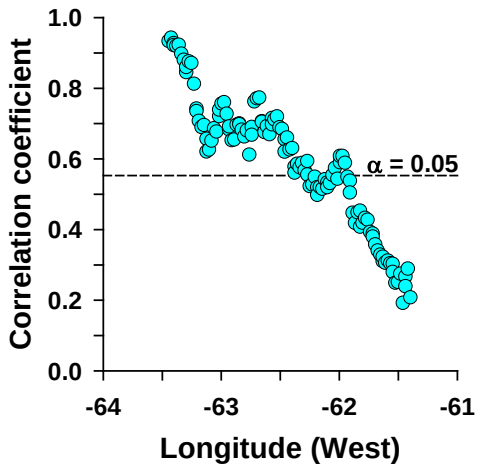

Fig. 1 Decreasing correlation of annual average temperature anomalies between Bedford Basin ($63^0$38'25"W) and positions along the Halifax Line.

In Bedford Basin, there is a strong relation between annual average anomalies of water temperature and picophytoplankton abundance (Fig. 2A), and thus also with mean phytoplankton assemblage size (Fig. 2B). These relationships were earlier noted (Li and Harrison 2008), but the present results of temperature coherence suggest that the picoplankton trend might also be a shelf-wide pattern.

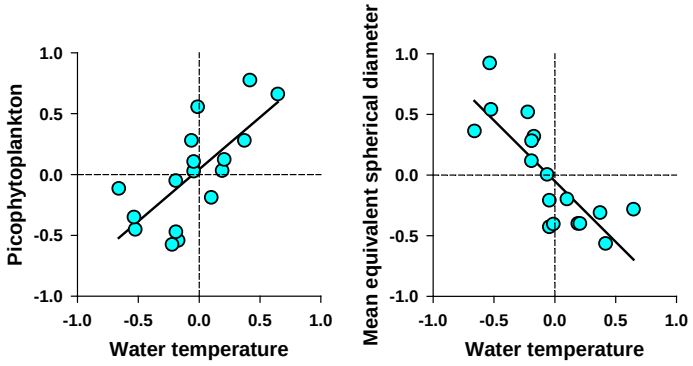

Fig. 2 Correlations between the annual average anomalies for temperature and (A) picophytoplankton abundance, and (B) mean cell size of the phytoplankton assemblage in the Bedford Basin.

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References

Li WKW, Morán XAG, O'Brien TD, WGPME participants 2011. Towards an ecological status report for phytoplankton and microbial plankton in the North Atlantic. ICES-CM-2011/B02

Li, WKW, Harrison WG 2008. Propagation of an atmospheric climate signal to phytoplankton in a small marine basin. Limnology and Oceanography 53(5): 1734-1745

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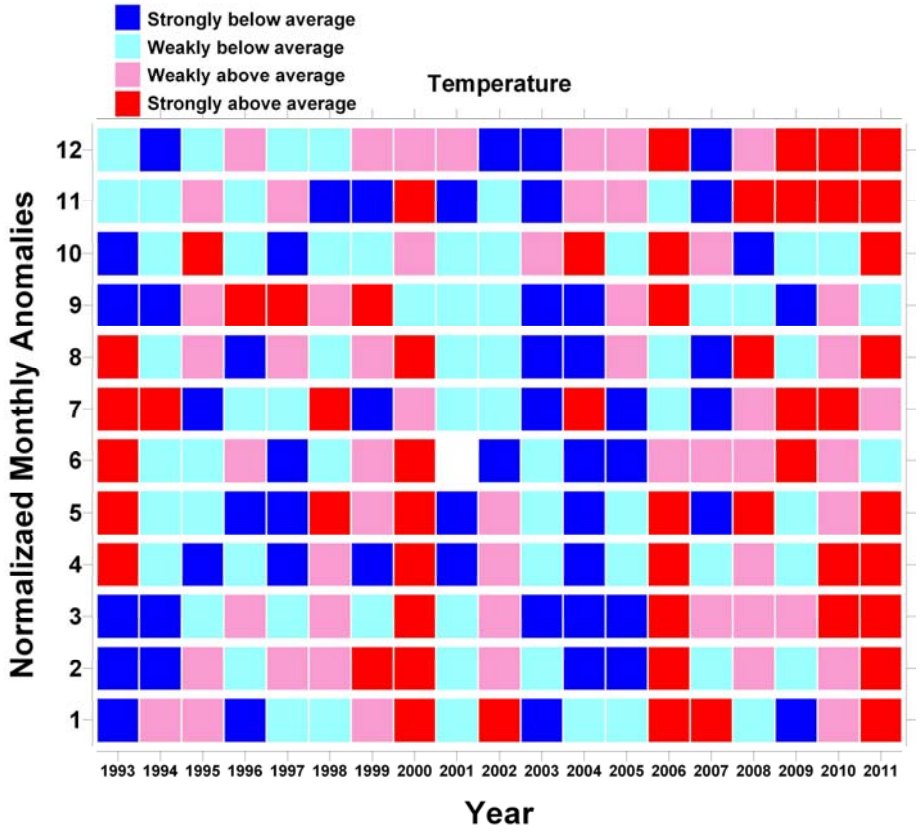
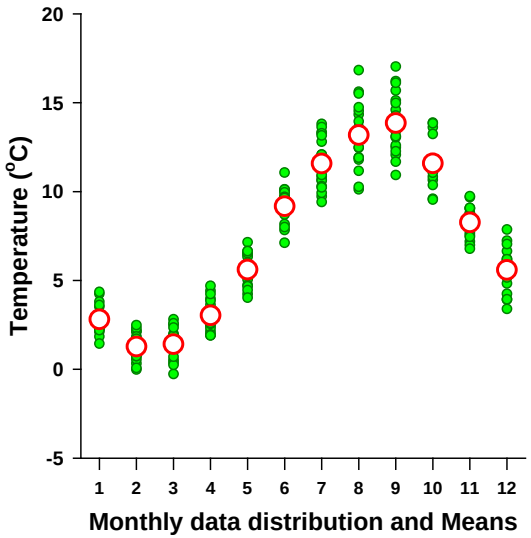
Figure S1 Bedford Basin temperature climatology and annual average anomalies.





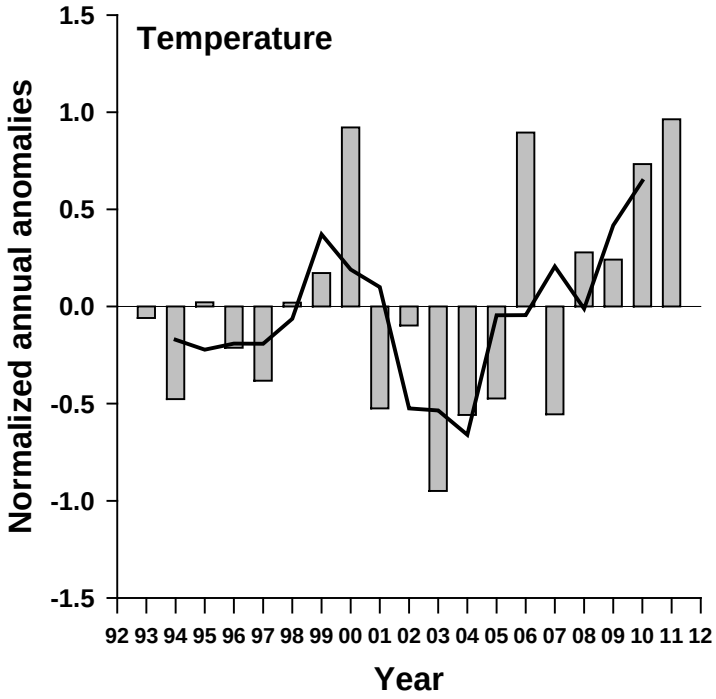


Figure S2. Shelf-wide pattern of coherent temperature change.

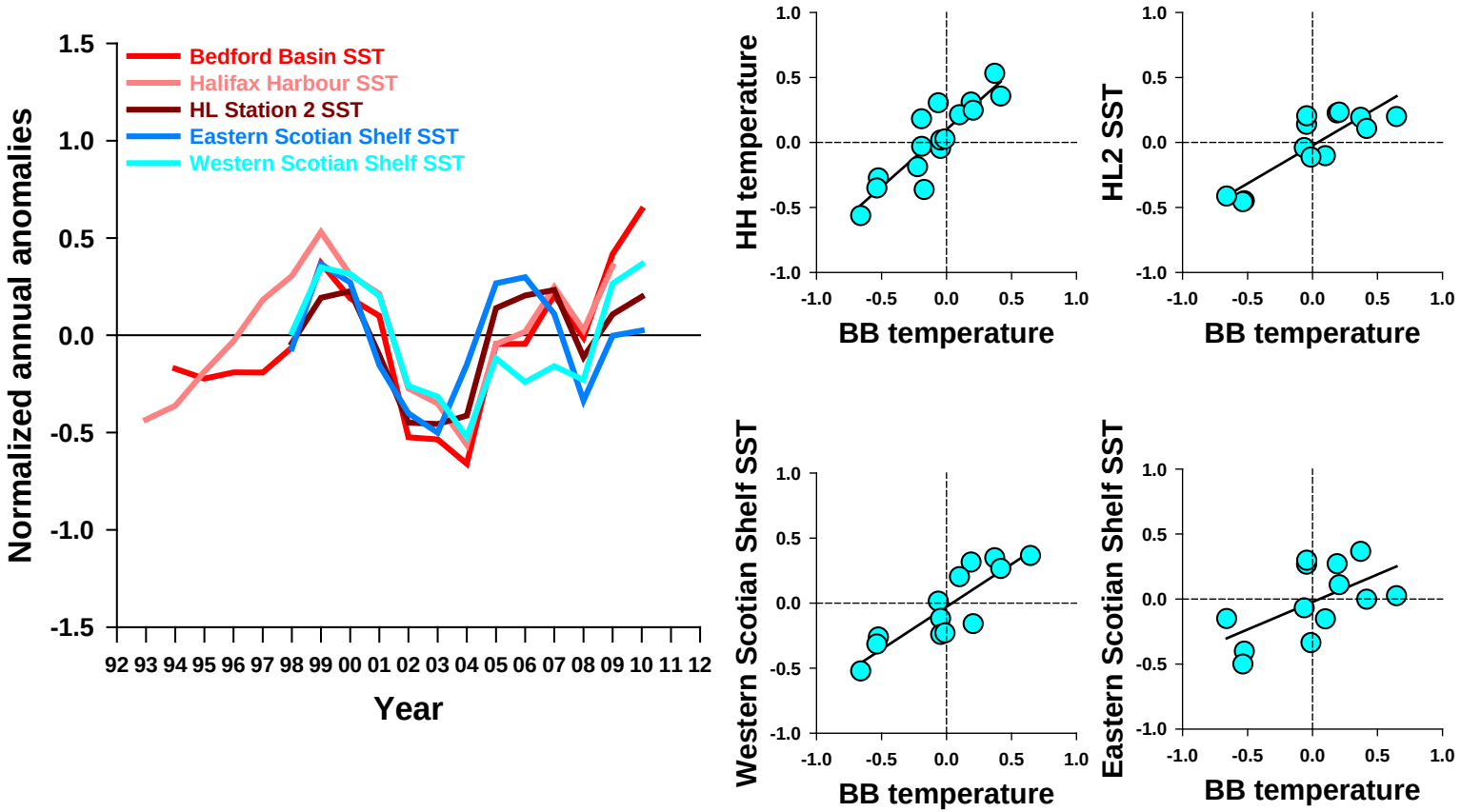


Figure S3. Coherent temperature change along the Halifax Line to the shelf break, but not beyond.