SUPPORTING INFORMATION

Table S1. Summary of environmental characteristics in the two Atlantic regions. Mean values and ranges (among parentheses) of temperature, total chlorophyll (Chl), nitrate and phosphate concentrations and the abundance of *Prochlorococcus* (Pro), *Synechococcus* (Syn) and picoeukaryotes (Euk). Significant differences are indicated with asterisk notation: *, p<0.05; **, p<0.01; ***, p<0.001; ns, not significant

Region	**Temp (ºC)**	**NO_3 (µmol L^{-1})**	**PO_4**	**Chl (µg L^{-1})**	**Pro**	**Syn (x 10^4 cells mL^{-1})**	**Euk**
NW	6.0	2.67	0.44	2.13	0	1.99	0.95
	(-0.6-16.1)	(0.01-11.0)	(0.15-0.94)	(0.08-14.1)		(0.001-19.9)	(0.02-6.87)
NE	15.7	1.67	0.18	0.71	1.26	2.56	1.24
	(11.6-22.1)	(0.07-7.4)	(0.01-0.88)	(0.19-3.76)	(0-12.1)	(0.03-13.9)	(0.25-5.44)
	***	*	***	***	***	ns	ns

Table S2. Linear regressions between phytoplankton variables and temperature. Statistical parameters for the OLS linear regressions between total phytoplankton and picophytoplankton abundance, cell-size and biomass and temperature for the two north Atlantic regions (NW and NE) and the whole data set (NE & NW).

Region	**Log-Y**	**X**	**Intercept**	**Slope**	r^2	***P*-value**	***n***
NE	Picophytoplankton abundance	Temperature	3.02 (0.20)	0.09 (0.01)	0.49	<0.0001	59
NW	Picophytoplankton abundance	Temperature	3.13 (0.05)	0.13 (0.01)	0.75	<0.0001	97
NE	Picophytoplankton cell-volume	Temperature	0.84 (0.12)	-0.06 (0.01)	0.56	<0.0001	59
NW	Picophytoplankton cell-volume	Temperature	0.08 (0.02)	-0.06 (0.01)	0.79	<0.0001	95
NE	Picophytoplankton abundance	Picophytoplankton cell-volume	4.31 (0.03)	-1.36 (0.12)	0.71	<0.0001	59
NW	Phytoplankton abundance	Picophytoplankton cell-volume	3.42 (0.06)	-1.90 (0.13)	0.68	<0.0001	98
NE	Picophytoplankton biomass	Temperature	0.28 (0.15)	0.03 (0.01)	0.16	0.0015	59
NW	Picophytoplankton biomass	Temperature	-0.40 (0.06)	0.07 (0.01)	0.48	<0.0001	95
NE & NW	Picophytoplankton biomass	Temperature	-0.38 (0.05)	0.07 (0.00)	0.66	<0.0001	154
NE	Phytoplankton biomass	Temperature	2.15 (0.19)	-0.05 (0.01)	0.20	0.0005	57
NW	Phytoplankton biomass	Temperature	2.11 (0.06)	-0.05 (0.01)	0.28	<0.0001	97
NE & NW	Phytoplankton biomass	Temperature	2.09 (0.05)	-0.04 (0.00)	0.39	<0.0001	154
NE	Picophytoplankton contribution	Temperature	0.08 (0.18)	0.09 (0.01)	0.47	<0.0001	57
NW	Picophytoplankton contribution	Temperature	-0.51 (0.09)	0.12 (0.01)	0.54	<0.0001	95
NE & NW	Picophytoplankton contribution	Temperature	-0.47 (0.06)	0.11 (0.01)	0.73	<0.0001	152

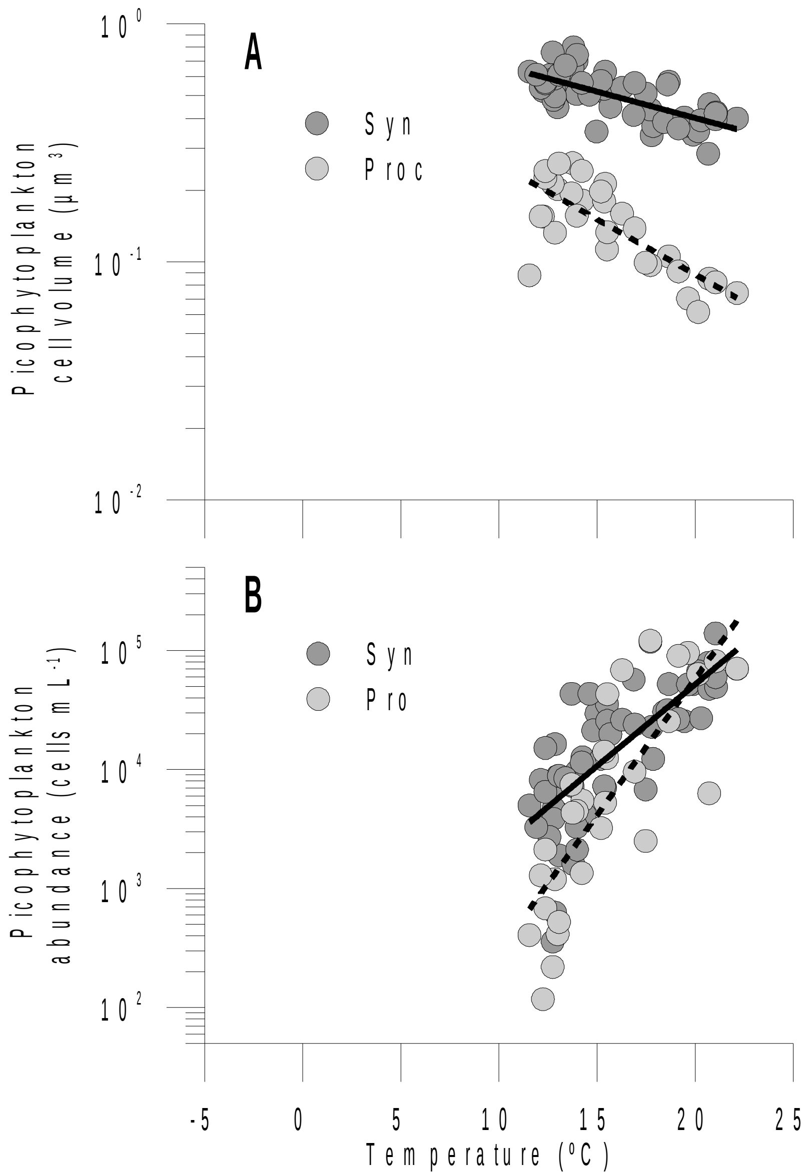

Fig. S1. The temperature-size and temperature-abundance rules for cyanobacteria. (**A**) Relationship between mean cell volume of *Synechococcus* (Syn) and *Prochlorococcus* (Proc) and temperature in the NE Atlantic region. (**B**) Relationship between *Synechococcus* and *Prochlorococcus* abundance and temperature in the NE Atlantic region. Fitted lines are OLS linear regressions for log-transformed data (continuous for *Synechococcus* and dashed for *Prochlorococcus*).

The temperature size-rule and the average size of a community: The temperature size-rule (TSR) explains how the average size of individuals in a population decreases with increasing temperature but we extend it to the relationship between average community size and temperature. If community composition holds constant then the temperature-related decrease in size in each of the component populations will unequivocally result in a smaller average size of the entire community. This is shown here for the two NE Atlantic picophytoplanktonic populations (*Synechococcus* and *Prochlorococcus*) for which we have size and abundance information. The average size of these two genera decreases with temperature as predicted by the TSR (Fig. S1A). Hence the change in average community size reported in Fig. 1B would likely result from the combination of these species-specific relationships into a community plot. The extension of the TSR from populations to communities is partially justified on the well known observation of latitudinal size variations. However shifts in phytoplankton community composition with temperature are well documented, driven by bottom-up processes associated with stratification, with warmer conditions favouring the predominance of smaller taxa within different functional groups (Karl *et al.* 2001; Finkel *et al.* 2005), thus enhancing the species-specific responses to temperature predicted by the TSR. An increase in temperature, stratification and nitrate limitation may also drive community composition to a relative increase in large sized nitrogen fixers such as *Trichodesmium*.

Fig. S1B above shows that population abundance increases with temperature for the two cyanobacteria. This is exactly the expected result from our argumentation detailed in the text for the temperature-picophytoplankton abundance relationship (Fig. 1). Interestingly, a stronger temperature-size relationship for *Prochlorococcus* than for *Synechococcus* (Fig. S1A) also results in a steeper slope of the abundance-temperature linear regression (0.23 vs 0.14, Figure S1B).

References

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Karl DM, Bidigare RR, Letelier RM (2001) Long-term changes in plankton community structure and productivity in the North Pacific Subtropical Gyre: The domain shift hypothesis. *Deep-Sea Research Part Ii-Topical Studies in Oceanography,* **48,** 1449-1470.