**Supplementary Information**

Definition of Abbreviations

NA: Not available

ND: Not detected

BChl e: bacteriochlorophyll *e*

Chl a: chlorophyll *a*

Chl b: chlorophyll *b*

Chl c1: chlorophyll *c*1

Chl c2: chlorophyll *c*2

Chl c3: chlorophyll *c*3

Chl-ide a: chlorophyllide *a*

MgDVP: magnesium-2,4-divinyl phaeoporphyrin *a*5 monomethyl ester

Phphy a: pheophytin *a*

Phphy b: pheophytin *b*

Pyroph a: pyrophytin *a*

Latitude and longitude refer to the spatial coordinates where the sampling was made. When they were not available, the spatial coordinates of the centre of the study site are indicated.

Ice thickness (cm): Measured generally at mid-lake sites in ice auger holes

Snow thickness (cm): Measured several metres around ice auger holes

Depth (m): Distance below the piezometric water level from which the sample was drawn

Concentrations of chl *a* and chl *b* include allomers and epimers that are produced from the chlorophylls during extraction.

The data are from one sample or from the mean of duplicates or triplicates (no more than 10 m apart).

For the data file of Ward Hunt Lake:

* Depth = surface, indicate that the sample was collected between 1 and 2.5 m below the water surface
* Location = Ward Hunt Lake - littoral: the sample was taken from the northwestern shore in shallow water
* Location = Ward Hunt Lake - pelagic: the sample was taken away from the shore, often close to the deepest point of the lake (83.08740°; -74.14805°) or the middle of the lake (83.33028°; -74.29611°)

**Pigment Analysis Methodology**

Water samples (0.35-1.05 L) were filtered onto 25-mm-diameter GF/F glass fibre filters (approximate pore size 0.7 µm) that were frozen immediately in the field in a Dry Shipper (‑80°C) and subsequently stored in a ‑80 °C freezer until analysis. Pigments were extracted from the frozen phytoplankton filters by sonication in 2.5 or 3 mL of 95% methanol, cleared by centrifugation, and filtered with PTFE syringe filters (pore size 0.2 µm) into HPLC vials. The extracts were then put under argon and kept at 4 °C in the dark in the HPLC autosampler to prevent pigment degradation. HPLC analyses from 2005 to 2010 were performed with a Varian ProStar HPLC system (LabX, Midland, Ontario, Canada) equipped with a Symmetry C8 column. Since 2011, HPLC analyses are performed using a Thermo Scientific Accela HPLC system (Thermo Scientific, West Palm Beach, Florida, USA) with a Hypersil Gold C8 HPLC column (3.0 µm pore size, 4.6 x 150 mm, Thermo Scientific) at 25 °C, with a C8 guard column. Shortly following extraction, 100 µL (or 40 µL with the Thermo Scientific Accela HPLC system) of phytoplankton pigment extracts were injected into the HPLC system. The solvent protocol followed that of Zapata, Rodriguez and Garrido (2000). The chlorophylls were detected by fluorescence (excitation, 440 nm; emission, 650 nm), and carotenoids were detected by photodiode-array (PDA) spectroscopy (350-750 nm) with a slit width of 2 nm. The absorbance chromatograms were obtained at 450 nm for carotenoids, 467 nm for bacteriochlorophylls *e*, 430 nm for bacteriochlorophylls *c* and *d*, and 384 nm for scytonemin.

Standards for identification (based on PDA spectra and retention times) and quantification (using calibration coefficients) of pigments were obtained from Sigma Inc. (St. Louis, Missouri, USA) (chl *a*, chl *b*, astaxanthin, *beta*,*beta*-Carotene) and DHI Water & Environment (Hörsholm, Denmark) (chl *c*2, chl *c*3, chlorophyllide *a*, MgDVP, pheophorbide *a*, pheophytin *a*, alloxanthin, antheraxanthin, aphanizophyll, canthaxanthin, diadinoxanthin, diatoxanthin, echinenone, fucoxanthin, 19'but‑fucoxanthin, 19'hex-fucoxanthin, lutein, lycopene, myxoxanthophyll, neoxanthin, peridinin, prasinoxanthin, violaxanthin, zeaxanthin) to calibrate our HPLC (see note below). Prior to the purchase of standards from DHI Water & Environment, standards for identification of chl *c*3, MgDVP, neoxanthin, peridinin and prasinoxanthin were part of a mixed standard solution also obtained from DHI Water & Environment, and these pigments were quantified using extinction coefficients from the literature (Jeffrey, Mantoura and Wright, 1997; Latasa et al., 2004) since they were not available in a sufficient quantity to make calibration curves. Prasinophyte pigments (antheraxanthin (prior to 2013), micromonal, micromonol, uriolide) were identified from a culture of Arctic Micromonas sp. (strain CCMP2099; West Boothbay Harbor, Maine, USA; Lovejoy et al., 2007). Uriolide was quantified using the calibration coefficient of fucoxanthin, micromonol was quantified using the extinction coefficient of *beta*,*beta*-Carotene, while micromonal was quantified using extinction coefficients from the literature (Latasa et al., 2004). Prior to the purchase of standards for chlorophyllide *a* and pheophytin *a*, these pigments were identified based on their retention time in the fluorometer chromatogram (Zapata, Rodriguez and Garrido, 2000). No commercial standards for the photosynthetic bacterial pigments bacteriochlorophyll *c*, *d* and *e* and isorenieratene were available, and these were identified from published spectra (Borrego and Garcia-Gil, 1994). The concentrations of these pigments are calculated using the calibration coefficient of chl *a* at 430 nm for BChl *c* and *d*, and using the calibration coefficient of chl *b* at 467 nm for BChl *e* and using the calibration coefficient of *beta*,*beta*-Carotene at 450 nm for isorenieratene. Concentrations of unknown chlorophylls were calculated using the calibration coefficient for chl *a*, and concentrations of unknown carotenoids were calculated using the calibration coefficient for *beta*,*beta*-Carotene.

Borrego, C.M. & L.J. Garcia-Gil, 1994. Separation of bacteriochlorophyll homologs from green photosynthetic sulfur bacteria by reversed-phase HPLC. Photosynthesis Research, 41: 157-164.

Jeffrey, S.W., Mantoura, R.F.C. & S.W. Wright (eds), 1997. Phytoplankton pigments in oceanography. Paris, France: UNESCO.

Latasa, M., Scharek, R., Le Gall, F. & L. Guillou, 2004. Pigment suites and taxonomic groups in Prasinophyceae. Journal of Phycology, 40: 1149-1155.

Lovejoy, C., Vincent, W.F., Bonilla, S., Roy, S., Martineau, M.J., Terrado, R., Potvin, M., Massana, R. & C. Pedros-Alio, 2007. Distribution, phylogeny, and growth of cold-adapted picoprasinophytes in arctic seas. Journal of Phycology, 43: 78-89.

Zapata, M., Rodriguez, F. & J.L., Garrido, 2000. Separation of chlorophylls and carotenoids from marine phytoplankton: A new HPLC method using a reversed phase C8 column and pyridine-containing mobile phases. Marine Ecological Progress Series, 195: 29-45.

Date of the purchase of standards:

In 2003, from DHI Water & Environment: chl *c*2, alloxanthin, canthaxanthin, diadinoxanthin, echinenone, fucoxanthin, lutein, myxoxanthophyll, violaxanthin, zeaxanthin, and from Sigma Inc.: chl *a*, chl *b*, astaxanthin, *beta*,*beta*-Carotene.

In June 2009, from DHI Water & Environment: aphanizophyll, MgDVP, neoxanthin, prasinoxanthin.

In May 2013, from DHI Water & Environment: chl *c*3, chlorophyllide *a*, pheophorbide *a*, pheophythin *a*, 19'but-fucoxanthin, 19'hex-fucoxanthin, *alpha*-carotene, antheraxanthin, crocoxanthin, diatoxanthin, lycopene, peridinin.