The following supplements accompany the article

Functional trait variation and nitrogen use efficiency in temperate coastal phytoplankton

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Supplement 1

Table S1. List of the diatom species identified by inverted microscopy counts in coastal waters of the eastern English Channel (EEC) between 2011 and 2014, and their corresponding frequency (%), average biomass (µgC L^{-1}), and surface to cell volume ratio (S/V, µm).

	Frequency %	Average biomass µgC L^{-1}	S/V ratio $µm^{-1}$
Actinotychus spp.	15	0.04	0.22
Asterionellopsis glacialis	55	0.22	1.07
Bacillaria paxillifera	4	0.05	0.86
Biddulphia rhombus	15	0.27	0.12
Brockmaniella brockmanii	9	0.02	0.53
Cerataulina pelagica	19	0.48	0.77
Ceratoneis closterium	57	0.06	2.13
Chaetoceros compressus/tortissimus	30	0.23	0.79
C. curvisetus/pseudo-curvisetus/debilis	21	0.21	0.22
C. danicus	13	0.02	1.35
C. decipiens	15	0.79	0.29
C. densus/eibenii	9	0.08	0.30
C. diadema	11	0.17	0.31
C. didymus	2	0.01	1.61
C. lauderi/teres	9	0.03	0.30
C. simplex/tenuissimus	17	0.03	1.57
C. socialis	45	0.51	1.61
C. wighamii/perpusillus	21	0.13	1.57
Corethron criophilum	2	0.05	0.04
Coscinodiscus spp	4	0.13	0.02
C. radiatus	9	0.12	0.07
C. wailesii	4	2.10	0.02
Dactyliosolen fragillissimus	32	5.38	1.00
Delphineis surirella	11	0.04	0.33
Diploneis spp.	26	0.20	0.04
Ditylum brightwelli	45	5.34	0.28
Eucampia zodiacus/bicornata	4	0.02	0.07
Guinardia delicatula	70	14.90	1.25
G. flaccida	70	14.50	0.46
G. striata	51	5.91	1.08
Helicotheca tamesis	4	1.19	0.05
Lauderia annulata	13	1.33	0.86
Leptocylindrus danicus	51	26.46	2.13
L. minimus	19	0.08	3.16
Meuneria membranacea	26	0.14	0.09
Navicula sppp.	36	0.03	0.07
Nitzschia longissima	17	0.03	2.13
Odontella aurita	4	0.01	0.21

	Frequency %	Average biomass µgC L^{-1}	S/V ratio µm^{-1}
Pseudo-nitzschia americana	32	0.09	1.96
Pseudo-nitzschia spp.	40	0.05	3.94
P. delicatissima complex	70	1.07	4.63
P. fraudulenta	36	3.94	1.09
P. pungens	23	0.08	1.34
Paralia sulcata	62	0.19	0.30
Pleurosigma spp./Gyrosigma spp.	47	2.33	0.05
Podosira stelligera	2	0.01	0.20
Raphoneis amphiceros	30	0.07	0.09
Rhizosolenia imbricata var. shrubsolei	74	17.77	1.74
R. setigera	28	0.13	0.24
R. setigera f. pungens	9	0.26	0.54
Skeletonema spp.	26	0.16	1.63
Thalassionema nitzschoides	40	0.10	0.84
Thalassiosira angulata/curviseriata	15	0.49	1.00
T. fallax	2	0.01	1.30
T. gravida	19	0.39	1.24
T. levanderi	4	0.04	1.50
T. punctigera	9	0.05	0.18
Trigonium alternans	4	0.03	0.12

Supplement 2

Supplementary information related to photo-physiological parameters, and C/N and C/P cell content ratios.

Only published data on phytoplankton cultures grown in nutrient-replete media and at a temperature of or close to 20°C were selected. The photophysiological parameters were obtained by extracting raw data from published growth-irradiance curves using the ImageJ v.143u free software (Rasband 2006), and then by curve fitting according to the Monod equation (see Shwaderer et al. 2011) for the similarity in the photophysiological parameters values with the common Platt equation [Platt et al. 1980]:

$$\mu(I) = \frac{\mu_{\max} I}{I + \frac{\mu_{\max}}{\alpha_\mu}}$$

with I (μE m^{-2} s^{-1}) the irradiance, μmax (day^{-1}) the maximal growth rate, and α_μ (μE^{-1} m^2 s day^{-1}) the initial slope of the growth-irradiance curve. The onset of light saturation (E_k, (μE m^{-2} s^{-1}) was calculated as $\mu_{\max}/\alpha_\mu$.

Table S2. References for phytoplankton photo-physiological traits data ($\alpha\mu$, E_k, and μmax(Light)) and those related to nitrogen and phosphorus cell requirement (C/N and C/P cell content ratios). Each number corresponds to one publication, of which the list is given below.

	C/N ratio	**C/P ratio**	**aµ-Ek-µmax**
Coccolithophores	18,20,29,31,43,46,55 (5 species, 14 data values)	18,20,46 (4 species, 7 data values)	14,18 (3 species, 3 data values)
Cryptophytes	2,6,8,24,32,34,42,43,47,48,50,55 (10 species, 14 data values)	6,42 (3 species, 3 data values)	4,28 (2 species, 2 data values)
Diatoms	1,9,16,20,26,29,31,32,34,46,50 (27 species, 39 values)	9,16,20,26,42,44,46 (13 species, 18 data values)	3,7,11,12,13,17,23,25,27,35,36,37, 38,40,41,49,51,52,54 (16 species, 27 data values)
***P.globosa* diploid**	22,56 (2 data values)	22 (1 data value)	22,39 (2 data values)
***P.globosa* haploid**	21 (1 data value)	22 (2 data values)	55 (1 data value)
Picoeukaryotes	31,55 (4 species, 4 data values)	30 (1 species, 1 data value)	10,25,45,53 (5 species, 5 data values)
Synechococcus spp.	5,15,24,31,42,55 (6 data values)	5,19,42 (3 data values)	33 (1 data value)

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Supplement 3. Other traits (Nitrate scaled affinity, temperature dependent growth, and morphology)

The Nitrate scaled affinity (N_{saff}, L µmol^{-1} day^{-1}) was calculated according to the allometric equation established by Edwards et al. (2012), based on the compilation of literature data for 64 marine species cultivated at or near 20°C with sufficient light:

$$\log N_{saff} = -0.63 \log V + 2.9$$

where V (µm^3) corresponds to the mean cell biovolume of each species /functional group.

Growth rate for *Phaeocystis* (Schoemann et al. 2005) and the coccolithophore *Emiliania huxleyii* (Fielding 2013) were calculated from growth-temperature equations. Maximal growth rate calculated for *E. huxleyii* was compared with data from laboratory experiments with six other species of coccolithophores (Buitenhuis et al. 2008). For diatoms, we applied the equation established by Bissinger et al. (2008). Finally, maximal growth rates of *Synechococcus* spp. and picoeukaryotes were assessed from a worldwide field database compiled by Chen et al. (2014), using data where media was nutrient-enriched, complemented by data from Stawiarski (2014) and Pittera et al (2014). No value was found in the literature concerning marine cryptophytes.

Biovolume (V, µm^3) and surface area (S, µm^2) of each phytoplankton group were calculated using the geometrical formula given by Hillebrand et al. (1999), based on measurements by cytometry for *Synechococcus* spp., picoeukaryotes, *Phaeocystis* haploid cells, and coccolithophores; and by inverted microscopy according to the Utermohl method for *Phaeocystis* colonies, diatoms species, and cryptophytes. For microscopy, 20 specimens of each diatom species, 20 of each size category of cryptophytes, and all healthy *Phaeocystis* colonies were measured at each sampling date in a settled volume of 10 ml. The resulting V and surface to volume ratio (S/V ratio) of the diatoms and cryptophytes communities were obtained by weighting each of them to the abundance proportion of each species, and each size category, respectively. For cytometry, cell size was estimated using calibration beads according to the following equations:

(Correction Factor) = (Real beads size / Measured beads size) (1)

[Estimated Particles size (µm)] = (Measured Particles size * Correction Factor) (2)

Finally, the V and S/V ratio of each phytoplankton group used in this study corresponds to their median over the entire period. Presence or absence of flagella was based on the taxonomy of pico- and nanophytoplankters described in the EEC (Not et al. 2004, Genitsaris et al. 2015).

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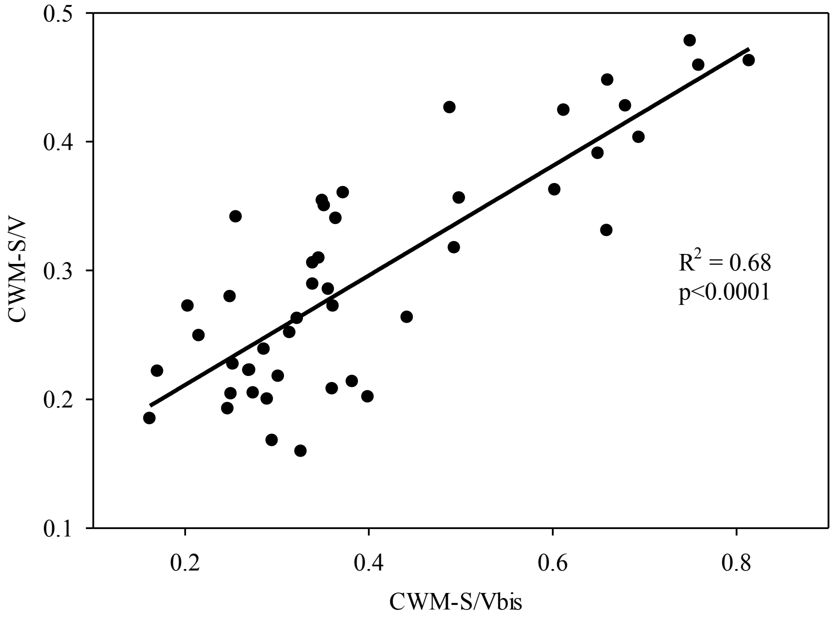
Supplement 4

Fig. S1. Relation between CWM-S/Vbis for each diatom species value (see Supplement 1) and CWM-S/V considering the median (see Table 1 in the main article). CWM-S/V: Phytoplankton community- weighted mean of the Surface area to cell Volume ratio.



Supplement 5

Fig. S2. Position of the observed (black circles) functional diversity values (A: functional evenness, FEve; B: functional divergence, RaoQ) in 999 null distributions along the resource gradient (RLQ axis). The grey zone and grey circles represent the range of the 999 randomized values and the individual mean, respectively. N: nutrient concentrations, L: light intensity for phytoplankton growth, +: high, -: low.