

Estimates of cell biovolume and carbon of protistan plankton taxa from inshore waters of the United Kingdom

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Data to be cited as:

“Atkinson A, Widdicombe, CE, Best M, Ostle C (2025) Estimates of cell biovolume and carbon of protistan plankton taxa from inshore waters around the United Kingdom. The Archive for Marine Species and Habitats Data (DASSH) (dataset). <https://doi.org/10.17031/67b461de9bef1.1>”

Abstract

This datasets describes the estimated values of biovolume and carbon mass per cell of inshore, single-celled autotrophic, mixotrophic and heterotrophic plankton, based on combined datasets from Plymouth Marine Laboratory and the Environment Agency. It contains 644 rows in total, each with a taxon-specific determination of mean cell volume and carbon per cell. This is based on two component datasets from the Plymouth Marine Laboratory's L4 monitoring site 6 miles south of Plymouth and Phytoplankton monitoring data review from the Environment Agency's (and predecessor organizations) inshore UK waters sampling program. Both are based on Lugol's-preserved settled water samples (and separate formalin-preserved samples for L4 coccolithophores), enumerated by light microscopy. It includes determinations for diatoms, dinoflagellates, ciliates, coccolithophores, flagellates and various other single-celled eukaryotic plankton. The two datasets provide independent estimates of cell biovolume, from which the commonly-used conversion factors of Menden-Deuer and Lessard (2000) have been used to further estimate carbon. We stress that both the size and the elemental content of protists is highly variable, and we assessed the congruence of the two datasets for 98 of the taxa that were common to both. Determinations for diatoms agreed well, whereas those for the intermediate size (i.e. 100-10,000 pg C) non-diatom did not, with PML values often over an order of magnitude greater than those from the EA. This spreadsheet gives a first approximation of the sizes and carbon contents of over 600 UK taxa, but users of the data need to be aware of uncertainties in these estimates, both of size and of body composition of these highly variable cells. Please use the data citation above when using these data.

Description of the data set.

For the Defra-funded mNCEA PelCap project, we provided spreadsheets for the individual carbon values of UK plankton. The zooplankton one can be found at <https://doi.org/10.17031/6733204cc545e.1> and here we provide a parallel spreadsheet for phytoplankton. This spreadsheet is a compilation of two files, with columns summarized in **Table 1**. The first is from Plymouth Marine Laboratory (PML) from Claire Widdicombe and is obtainable directly from BODC: [Phytoplankton taxonomic abundance and biomass time-series, WCO L4, 1992-2020](#). This pertains to PML's standard, weekly resolution water bottle sampling at 10 m depth since 1992 and contains 293 rows of data (i.e. taxonomic units) all with biovolume and estimated carbon. The other dataset is from the Environment Agency's review of all the estuarine and near coastal phytoplankton data collected by the National Rivers Authority and Environment Agency between 1993 and 2017 (mainly monthly data from 100-300 sites) to “normalise” the taxonomy and elucidate key traits. The latter was based and key published literature and particularly WORMS, Marine Species.Org, and Diatom base. This contains a further 401 taxa. Surprisingly,

only 98 of these taxa are common between the source datasets, based on complete matches in the taxon column, although due to changing latin names, the best comparison of the two datasets will be by matching their Aphia Ids.

Biovolumes values were provided by the data originators. For PML's L4 time series, cell biovolumes were initially calculated according to Kovala and Larrence (1966) and since 2006 new taxa have been aligned with Olenina et al (2006). From these biovolumes, cell size-specific equations specific to diatoms and all remaining taxa were used to convert cell biovolumes (V , μm^3) to carbon C (pg) , based on the equations of Menden-Deuer and Lessard (2000) provided in their paper Abstract:

$$\begin{array}{ll} \text{Diatoms:} & C = 0.288 * V^{0.811} \\ \text{Other cells:} & C = 0.216 * V^{0.939} \end{array}$$

The exception was the large dinoflagellate *Noctiluca scintillans*, an outlier with low carbon content for its volume, For this, a value of 20375 pg carbon was used by PML, whereas Atkinson assigned a value of 35,340 pg carbon for the EA data, based on Table 2 of Menden-Deuer and Lessard (2000).

Table 1. Summary of the spreadsheet with description of columns and methods used.

Column No.	Column heading	Column Description
A	Taxon	Name of taxon provided by data originator (these may change subsequently but should be traceable via the doi). Taxa are listed alphabetically within source institute and within major group
B	Major Group	For L4 taxa the data originator coded these into diatoms, dinoflagellates, ciliates, coccolithophores, flagellates, <i>Phaeocystis</i> and other. For the EA data, traits were provided also for this species set in the original spreadsheets, and Atkinson differentiated diatoms and "non-diatoms" from these, solely on the basis of diatoms having the traits of containing silica, being non-motile and being autotrophic.
C	Aphia ID	Provided by the data originator. None of these were checked or changed from the source files
D	Volume per cell (μm^3)	Likewise, none of these were checked or changed from the source files provided. The EA data were provided on a natural log scale but only to 1 decimal place, so some of the taxa have identical estimated biovolumes. The source data file (provided by Mike Best) also lists the number of measurements, and the standard deviation of the measurements used to derive biovolume, but this information is not available for the PML data so these columns are not added to this spreadsheet.
E	Carbon per cell (pg C)	These were derived from the two equations listed above pertaining to diatoms and all other taxa, in the Abstract of Menden-Deuer and Lessard (2000). The only exception was <i>Noctiluca scintillans</i> , and outlier with low carbon content. For this a value of 20375 pg was used by PML, whereas Atkinson assigned a value of 35,340 pg C for the EA data, based on Table 2 of Menden-Deuer and Lessard (2000).
F	Source Institute for dataset	Self-explanatory
G	Details of data source	For the PML data from L4, this is the weblink for BODC landing page which contains the latest time

		series data and metadata. For the EA data it is the name of the file provided by Mike Best from the EA. Based on routine monitoring data collected between 1993 and 2017 from estuarine and near coastal sites around England and Wales.
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The 98 taxa with independent biovolume estimates are compared in **Figure 1** between the L4 determination (x-axis) and the EA determination (y-axis). While the results are expressed in carbon, all values except for *Noctiluca* are based on the same conversion factors from volume, so differences relate to biovolume.

The diatoms agree reasonably well between the two sources, although the smallest diatoms generally lie above the 1:1 equality line, meaning that their biovolumes are rather higher in EA data. For the various non-diatom taxa, the agreement is poorer, reflected in much lower R^2 values, with some intermediate size cells having over tenfold lower biovolumes in the EA data as compared to those from PML. Whether this is a real regional differences or reflective of differences in biovolume estimation method is not clear, but it underlines the uncertainty in these estimates.

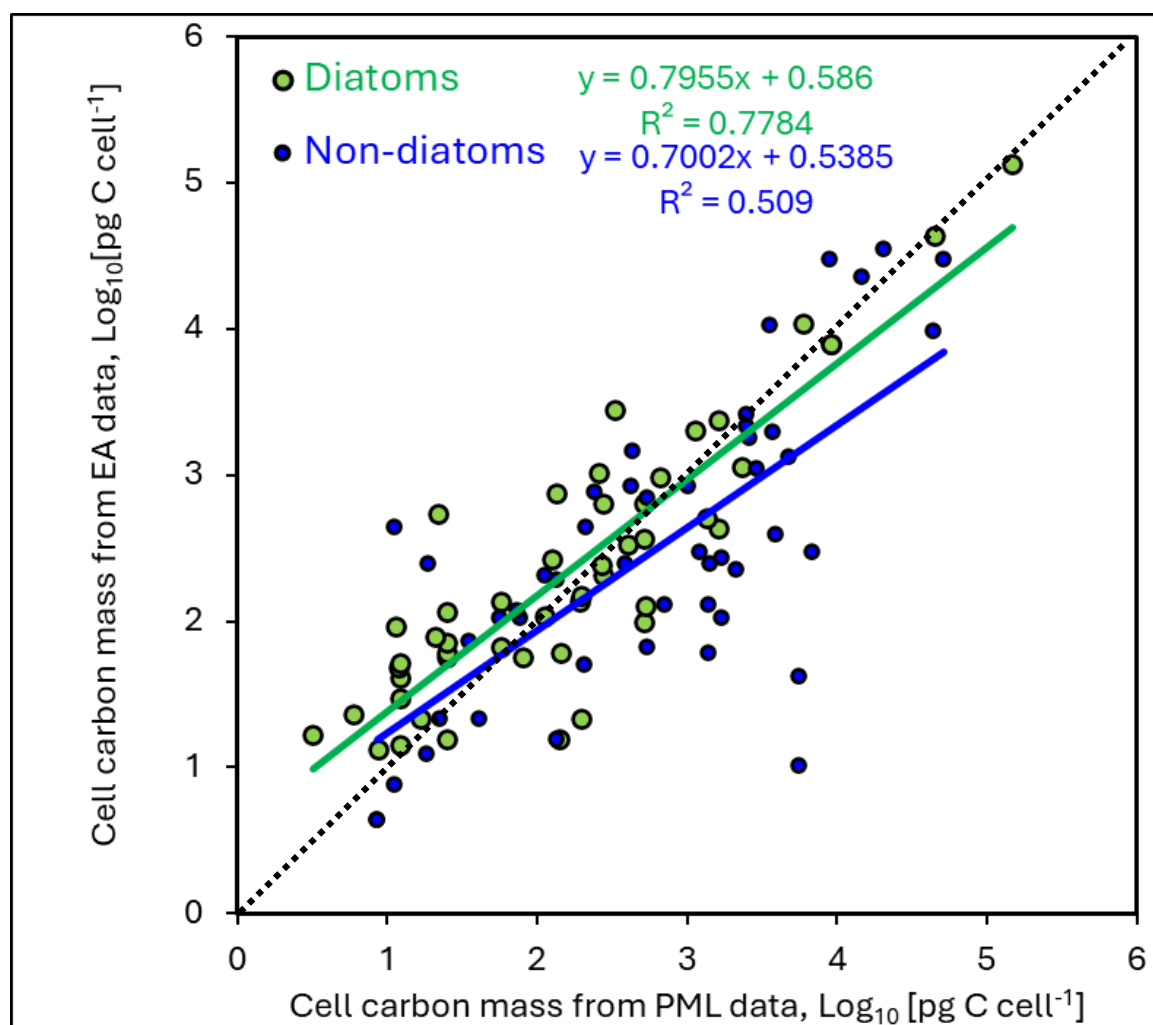


Fig. 1. Comparison of estimated carbon masses per cell, between PML (Plymouth Marine Laboratory) data and EA (Environment Agency) data for the 98 taxa common to both data sets. The dotted line marks the 1:1 line of equality. Note the logged scales.

Those using these data are asked to cite the data reference listed above if using both data sets, and to cite the original BODC data citation reference (Widdicombe and Harbour 2021)

or any subsequent updates if just using the L4 data. Users should be reminded that both the size and the content of these cells vary enormously through the year and according to nutrient status and these single fixed conversion factors will always be approximations. If these data are used to build larger trait databases, we urge those doing so to retain method traceability and credit for original data providers by maintaining the appropriate source data citations and encouraging users of data products to always cite the original, data source citations.

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