Estuarine, Coastal and Shelf Science 162 (2015) 143–150

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

Estimating time series phytoplankton carbon biomass: Inter-lab comparison of species identification and comparison of volume-to-carbon scaling ratios

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ARTICLE INFO

Article history:
Accepted 2 May 2015
Available online 13 May 2015

Keywords:
phytoplankton
carbon biomass time series
taxonomical inter-lab calibration
biovolume
biovolume-to-carbon conversion
comparison

ABSTRACT

An inter-calibration exercise was conducted to assess the performance of six phytoplankton taxonomists working within the Danish National Aquatic Monitoring and Assessment Program (DNAMAP). For species abundance and cell volume, a 2-fold difference was found among different estimates for subsamples from the same sample, which in turn cascaded into large differences in the species-specific carbon biomass contribution. The mean total carbon biomass estimated showed high variability (CV 43%) among the six taxonomists, but large variations were present within results produced by individual taxonomists (CV 8–50%), and one of the taxonomists produced significantly lower estimates than the others. Using data from phytoplankton time series samples, we also assessed the effect using a table of species-specific cell volumes versus cell volume measurements from a sample on carbon biomass values. For an example, the older cell-volume-to-carbon conversion method with fixed carbon-conversion constants was compared to the more recent approach of scaling biovolume to carbon biomass based on established regressions. We found that the regression between community biomass estimated by the old method versus the more recent equation yielded a slope close to 1, thus indicating general similar community biomass estimated between the methods. Type II regression suggested a high degree of variability in the estimates (17%). The highest degree of uncertainty was found by type II linear regression, when we compared the community biomass of diatoms estimated by cell sizes measured by sample to diatom community biomass estimated from cell sizes from a table of fixed cell sizes. In this analysis variation among methods for carbon estimation of individual samples was as high as 114%. Therefore, we recommend that, particularly for diatoms, cell volumes should be determined from the sample, or that table values be based on monthly estimates for at least the dominant diatom species for each study area.

1. Introduction

Performing taxonomical identification, cell volume measurements and cell carbon estimates are key components of phytoplankton monitoring programs. In particular, in light of ongoing and forecasted climate change, phytoplankton time series have become a valuable tool in understanding how marine foodwebs respond to climate drivers, underpinning the importance of precise and accurate cell volume and cell abundance estimates and of a reliable conversion of cell volume into species and community biomass. Identifying species is challenging and time consuming and the number of qualified taxonomists are decreasing globally. In this regard, active monitoring programs around the world are very important as they are the grounds for maintaining and educating future phytoplankton taxonomists with high level expertise. Within these programs, inter-calibration workshops are conducted to train taxonomists and compare their identification and counting performance. However, the outcomes of such workshops are often published in the grey literature in local languages and never reach a broader audience (Dürselen et al., 2014). So far, we have only been

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http://dx.doi.org/10.1016/j.ecss.2015.05.006
0272-7714/