Phytoplankton data documentation and methods 1987-2006: Umweltbundesamt

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Data usage: Use by others is welcome, provided this source is acknowledged. Prior contact is recommended for discussion of conclusions and messages to be supported by these data.

- For features of Lake Tegel and for methods sampling, see the file "Lake Tegel – features and sampling".
- For physical and chemical data, see the excel spreadsheed "Tegeler See Station III"; for physical and chemical methods see the word file "Methods for Analyses_Tegel"

Lake Tegel phytoplankton data base 1984-2006

The data cover the years 1987-2006, sampled and evaluated by the Federal Environment Agency ("Umweltbundesamt"; UBA) and since 2007 by the Berlin-Brandenburg state laboratory (Landeslabor Berlin Brandenburg, LLBB). Phytoplankton was evaluated only at sampling station III, the deepest site of the main basin; however, the physico-chemical data show the main basin to be quite homogenous; thus these data are likely to represent the main basin quite closely.

Data agglomerated from 1987 to 2006 on the level of genera and size categories are given in the file "TegSee Phyto QUANT" which contains

1. a spreadsheet with biovolume per L for each taxon quantified, and for each phytoplankton class the sum of biovolumes with a figure showing the biovolumes of the taxa it contains,
2. a spreadsheet showing the results of the evaluation of net phytoplankton estimated in 3 frequency categories (0.1 = occasional; 1 = frequent; 10 = dominant)
3. for each class a spreadsheet with figures showing the data for 2.

The original data as digitised from counting records are given for each year in the files "Biovol_TS-….". These contain the following further information:

- biovolumes of species;
- mean cell volumes used to calculate biovolumes which can be gleaned from the equation behind each biovolume entry (from 1992 onward);
- differentiation of centric diatoms and *Cryptomonas* by size classes;
- differentiation of *Fragilaria/Synedra* as originally counted. Due to changes in taxonomy which, in retrospect, are difficult to re-allocate, we aggregated them in one group in "TegSee Phyto QUANT".

For any data evaluation by size, separation by groups is possible from these annual files.

Depth integrated samples

Sample depths representing the epilimnion differed between years as follows:

from 1987 – 1990 and in1995/1996 the choice of depths for integration was guided by temperature profiles, although identifying the appropriate depths proved difficult as – often in consequences of aeration – the metalimnion was not clear-cut.

In 1991 biovolume was not determined.

From 1992 – 1998, a sample from 2 m was taken as representative of the epilimnion, and this appears justified as depth profiles of temperature and chlorophyll-a indicate little difference between 0 to 5 m.

In 1995 and 1996 additional research programmes provided depth-integrated samples for the bulk of samples, while samples from the routine programme at 2 m depths are also available (marked in blue and italics in TegSee Phyto QUANT).

From 1999 onward, samples were integrated from 0 to 5 m sampled at equidistant intervals of 1 m).

Workers identifying taxa and counting

Taxonomic identification, counting and determination of cell volumes was conducted by an experienced technician, Katrina Laskus, up to 2003 when Astrid Baldus took over from her, with support and additional training by Wolfgang Arp. The additional depth-integrated samples in 1995 were contributed by Andrea Danowski in the context of her diploma thesis under the supervision of Katrina Laskus. The additional depth-integrated data for 1996 were contributed by Jutta Fastner; both worked in close collaboration with Katrina Laskus.

Species determination

Although species were determined from net samples before counting and during counting, when digitising the data years later in face of uncertainties in species identification (e.g. for Cryptophyceae and *Microcystis*) as well as changes in nomenclature over time (in particular among the diatoms and cyanobacteria) we chose genera or size classes (for centric diatoms, Cryptomonas and Fragilaria/Synedra) as level of resolution. These are differentiated in the files for the individual years but agglomerated in TegSee Phyto QUANT (due to shifts over time in some of the criteria for differentiaton). Chlorophyceae, Conjugatophyceae and Chrysophyceae were of minor quantitative relevance in Lake Tegel; thus efforts in species identification were limited. For *Planktothrix,* from habitat and colour we exclude *P. rubescens* and assume *P. agardhii*.

Unidentified flagellates and filaments were not allocated to any taxon, but included in total biovolume in the file TegSee Phyto QUANT and in the files for individual years in the class assumed to be most likely.

Note that in records of the earlier years some taxa still appear as identified at the time, while in TegSee Phyto QUANT we list them under the current nomenclature:

- *Aulacoseira* as *Melosira*
- *Rhodomonas* as *Chroomonas*
- *Fragilaria* as *Synedra*
- *Chlorhomidium* as *Tribonema*

For taxonomic keys used for species identification, see the references at the end of this file.

Counting and biovolume determination:

Samples conserved with Lugol's iodine solution were sedimented in chambers of 2 – 10 mL depending on cell density (for more than 3 mL we used the HydroBios tubes that can be removed before counting, and some samples for Microcysts needed to be diluted to be

counted in the 2 mL chamber). Counting was done following the Utermöhl (1958 method) using an inverted microscope at 400-fold magnification (Zeiss; phase contrast). We counted at least two transects across the center of the chamber, and if numbers differed by more than 20%, we counted a further transect. Transect boundaries were defined by the border of the counting grid, and all cells partially within the grid on one side were included while all cells partially outside of the other side of the grid were excluded. In order to target a total of 400 units counted per sample, we counted at least 200 units of dominant taxa.

Mean cell volumes were determined for each sample by measuring linear dimensions at 400-fold magnification using an ocular micrometer with one unit corresponding to 2.55 µm (at 400-fold magnification). As a rule, we measured 20 cells per taxon counted, but if 10 measurements yielded almost identical results, we measured only 10 (this was typically the case for very small cells such as those of Microcystis or Rhodomonas, where almost all fall into the same category of – for example – 2.5 micrometer units).

Records of mean cell volumes were preserved in separate file only for some years. However, they can be gleaned from the original excel spreadsheets for individual years: the first row gives cell numbers, the one beneath gives the biovolume of the species, and either the spreadsheet still shows the equation behind the biovolume which includes the mean cell volume, or this can be back-calculated by dividing biovolume by cell number.

Counting and biovolume determination of Microcystis colonies:

Colonies were disintegrated through ultrasonication prior to sedimentation.

Counting and biovolume determination of filamentous forms:

(relevant for Dolichospermum (formerly *Anabaena), Aphanizomenon, Limnothrix, Planktothrix, Pseudanabaena, Aulacoseira/Melosira*, *Chlorhormidium/Tribonema*)

Instead of counting cells, we determined the length of filament within the transect (disregarding parts of filaments outside the transect boundaries) and added that up to the total mm/ml filament length in the sample. This we multiplied by the mean cross-section area of 10-20 filaments measured in the sample.

Aulacoseira was differentiated by diameter, resulting in differentiation by area of filament cross-sections (<20 and >20 µm²); see the original annual files for data.

Counting and biovolume determination of solitary centric diatoms (i.e. not including Melosira/ Aulacoseira):

Although our annual files still sometimes contain "*Stephanodiscus hantzschii*", we differentiated only by diameters, i.e. <8, 8-15 and >5 µm.

Counting and biovolume determination of the Fragilaria/Synedra complex

For the table encompassing all years we attempted to differentiate between large and smaller Fragilaria/Synedra, but this is not consistent even within years. The files for individual years show that in the mid 1990's we attempted to group by cells < 2300 µm³ and larger ones, but this differentiation did not work well for other years, for which differentiation according to species descriptions had been attempted.

In the 1980's differentiation was simply by Synedra acus and Fragilaria crotonensis. The large Synedra ulna rarely occurred.

Fragilaria ulna was differentiated between small and large cells, but boundaries for this differentiation varied over time. Smaller ones were sometimes counted as *Fragilaria crotonensis* (if in “combs”), *Synedra acus* or *Fragilaria acus*.

The differentiation between *F. crotonensis* and smaller *Fragilaria* was not upheld in all samples because of the assumption that single cells might be those lost from the “comb”, but looking at cell sizes suggests differentiation between taxa to have been somewhat arbitrariy. While the large *Fragilaria* might be more or less the same species, the small ones are probably a mixed bag.

Counting and biovolume determination of Cryptophytes

Although our records still sometimes contain “*Rhodomonas lens*”, we differentiated only by Chroomonas/Rhodomonas (including *Chroomonas nordstedtii*) and *Cryptomonas* spp., and within these groups only by size.

Original data sheets in files per year are partially in German. For translation:

- Summe = sum
- Gesamt = total
- Klein = small
- Groß = large
- Grundfläche = area of filament cross-section
- EZ (Einzelzelle) = single cell
- K (Kolonie) = colony
- <70Ts (<70 Teilstriche) = < 70 micrometer units (one unit correspond to 2.55 µm)
- Breite = width of a filament or cell

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