

Brigitte NIXDORF

Brandenburgische Technische Universität Cottbus, Lehrstuhl Gewässerschutz

Measuring primary production in aquatic systems - new attempts to solve old problems

Why this workshop and why this journal? We all know that primary production is one of the most important process, not only in aquatic systems, but globally. There are many scientists (not only in Germany) who are interested in the development of and comparison of methods for measuring primary production in aquatic ecosystems. A platform for intensive discussions was provided by the two yearly meetings of primary production in the GDR prior to 1990 and the experimental orientated GAP workshops (last two in Breukelen/The Netherlands 1990 and Saskatoon/Canada 1993, next in Zürich/Switzerland in 1999). The idea for our little national GAP-workshop in Zingst was born after seminar discussions of current problems concerning primary production methods in Bad Saarow, a limnological research station of Technical University Cottbus in 1996 and 1997. Here we discussed how to measure photosynthesis, primary production and phytoplankton biomass by different methods, especially the modern fluorometric devices. Further current aspects of photosynthetic research were measurements of underwater light, modelling photosynthesis-light relations and laboratory scale simulation of natural conditions of shallow waters.

Although the general definition of primary production as the photo- and chemoautotrophic inorganic carbon fixation into biomass is widely accepted, there are a number of misunderstandings or misinterpretations between scientists when measuring this process by different methods. Measurements of chlorophyll fluorescence are an attractive alternative or supplement to conventional methods of photosynthesis. After initial use of

different fluorescence detectors to detect photosynthetic pigments, we wanted to know: Are the new advances in these methods really useful as alternatives for measuring primary production? Are we able to measure the same process by relatively different approaches like bottle methods, dilution techniques, fluorescence techniques; either *in situ* or in combination with incubation in an artificial light gradient as in a light pipette or photosynthetron? As a result of the Bad Saarow-seminars, the participants decided to meet at an experimental workshop. The staff of Hendrik Schubert organised this workshop at the Rostock University field station in Zingst from 6-10 October 1997, where we met to present, discuss and test our approaches and devices for measuring primary production in a mesocosm experiment. This workshop was very well organised and took place in a very constructive atmosphere. The organizer are thanked again by all participants!

The theme of the workshop was 'Estimation of primary production in aquatic systems - comparison and evaluation of instruments'. The main objectives were:

1. To assess the state of knowledge on the workshop theme, and to discuss new methods such as fluorescence and photoacoustics.
2. To perform joint field experiments using different techniques (e.g. conventional light and dark bottle techniques, in-situ and laboratory fluorescence methods) to test their comparability and reliability.
3. To define gaps and urgent research needs.

The main questions relating to our project concerned the wide diversity of approaches used to describe and measure primary production. The spectrum of methods applied at the workshop were as follows: 'Traditional' static fixed-depth *in situ* measurement of ^{14}C fixation in different bottle volumes to quantify bottle effects, oxygen concentration measurements in an open mesocosm; dynamic incubation of ^{14}C bottles to simulate different frequencies of mixing to indicate the importance of mixing especially in shallow eutrophic waters (brackish and shallow lakes); ^{14}C -fixation and O_2 -evolution under controlled irradiance conditions in a 'photosynthetron' and in a 'light pipette' respectively; fluorometric measurements by different types of modulated chlorophyll fluorometers. The 'true' nature of primary production is not only a question of a general accepted definition and further development of measuring devices. It also requires the careful analysis, integration and interpretation of results and application and testing of models.

Assuming that the energy source for primary production is light (phototroph) or chemical (chemotroph) energy, the electron donors are inorganic (lithotroph) compounds and that the carbon source for cell synthesis is carbon dioxide, we must be careful in interpretation and comparison of results obtained by the diverse methods tested at the workshop. We have to consider a complex of problems concerning the “old story” of what does each particular method really measure: net or gross production? Are we able to quantify losses like light and dark respiration or exudation? What about refixation of respired exudates, dark fixation or the kinetics of assimilation? How did the conditions and duration of incubation affect the result, and, of course, what was the production rate itself?

The most important aspect of the workshop was to compare the photosynthetic parameters resulting from different types of fluorometric measurements with conventional and modified conventional methods, to model a chlorophyll-specific production rate and to validate the models. I (as a representative of the more “matter” orientated scientists) wished to compare our primary production results in terms of $[gC\ m^{-2}\ d^{-1}]$. This meant that our energy orientated partners had to convert their fluorometric signals across a number of models into production values.

Despite the fact that some questions (as expected) remained open, I am certain that the workshop itself was helpful for all participants. And finally, the output of results of the individual experiments was greater than to be expected from such a short period as can be seen in chapter 3.

Because of this, we have decided to continue with this type of workshop in autumn 1998 in Büsum and we are all looking forward to meeting again there.

Author

Prof. Dr. rer. nat. habil Brigitte Nixdorf
Brandenburgische Technische Universität Cottbus
Lehrstuhl Gewässerschutz
Seestraße 45
D-15526 Cottbus