THESES

1.

The light saturation process of phytoplankton can be described by a queueing system.

1.1 The photosynthetic apparatus of phytoplankton is analogue to a multi-server queueing system where customers are served in pairs and the queue length cannot exceed 2. This system is $M/M^{(2)}/q/q+2$ type according to the classification of Kendall (1953), where q is the number of plastoquinone molecules in a photosynthetic unit.

1.2 The rate of photosynthesis in continuous light can be computed from the stationary probabilities of the Markov chain characterizing the queueing system.

1.3 The Markov chain has overlapping connection system because of the bulk service, so the stationary probabilities has to be computed by an iterative method based on their relative values.

1.4 The new model – contrary to the mechanistic methods used in limnology – can achieve better fit on measurement data than the so far most successful empirical models.

2.

Delayed fluorescence is an indicator of various photosynthetical parameters depending on the measurement light intensity.

2.1 The intensity of delayed fluorescence (DF) id a nonlinear function of the measurement light intensity.

2.2 On relatively low intensities, compared to the light saturation of phytoplankton, the initial intensity of DF (that is the spectrum amplitude) is proportional to the amount of light harvesting pigments, under high light it is proportional to the maximal rate of photosynthesis.

2.3 The integral of full DF kinetics is proportional to the number of photosynthetic units under high light intensity.

3.

The delayed fluorescence method, despite the general ignorance , is suitable for the automatic monitoring of population and photosynthesis dynamics of phytoplakton.

3.1 The automatic phytoplankton monitoring reveals the internal mechanisms of the ecosystem as never before. the biomass and composition of phytoplankton can be measured with the original DF spectroscope of Gerhardt and Bodemer (2000) on a daily scale, with the enhanced DF spectroscope in every 4-5 minutes.

3.2 The application of variable measurement light intensity allows the measurement of the dynamics of main photosynthetical parameters used in limnology.

4.

In the deconvolution of delayed fluorescence spectra, the error originating from the measurement noise has to be distinguished from the error arising from the use of improper calibration spectra.

4.1 The immense data created by the automatic monitoring (ten thousands of measurements with a single instrument) requires, that the examination of data quality and the analysis of data is prepared by automatic methods.

4.2 Contrary to the assumption of Gerhardt and Bodemer (2000), the error of the deconvolution process is not enough to fully characterize the quality and reliability of a delayed fluorescence spectrum.

4.3 With the introduction of relative noise ratio and adequacy, the two sources of error can be separated and an automatic process can filter the defective spectra and separate the good quality spectra deconvoluted with an inappropriate calibration set.

5.

By using online monitoring, the predictable and chaotic phases of phytoplankton population dynamics can be separated.

5.1 Based on datasets with higher temporal resolution than the doubling time of phytoplankton (that is at least daily resolution), phases with predictable biomass dynamics can be separated from the fluctuations caused by random disturbance events and autogenic processes.

6.

The seasonal dynamics of phytoplankton biomass can be successfully simulated with a threshold model that uses extreme simplifications to describe processes in the ground state of the community, which endures in most of the vegetative season.

6.1 The high resolution datasets obtained with online monitoring supported the fact, that the phytoplankton community in Lake Balaton spends most of the vegetative season in a ground state characterized by low biomass and high diversity.

6.2 These phases did not influence the buildup and collapse of biomass peaks which are of primary interest for human water use. The biomass peaks could be simulated with a simple threshold model based on logical conditions.