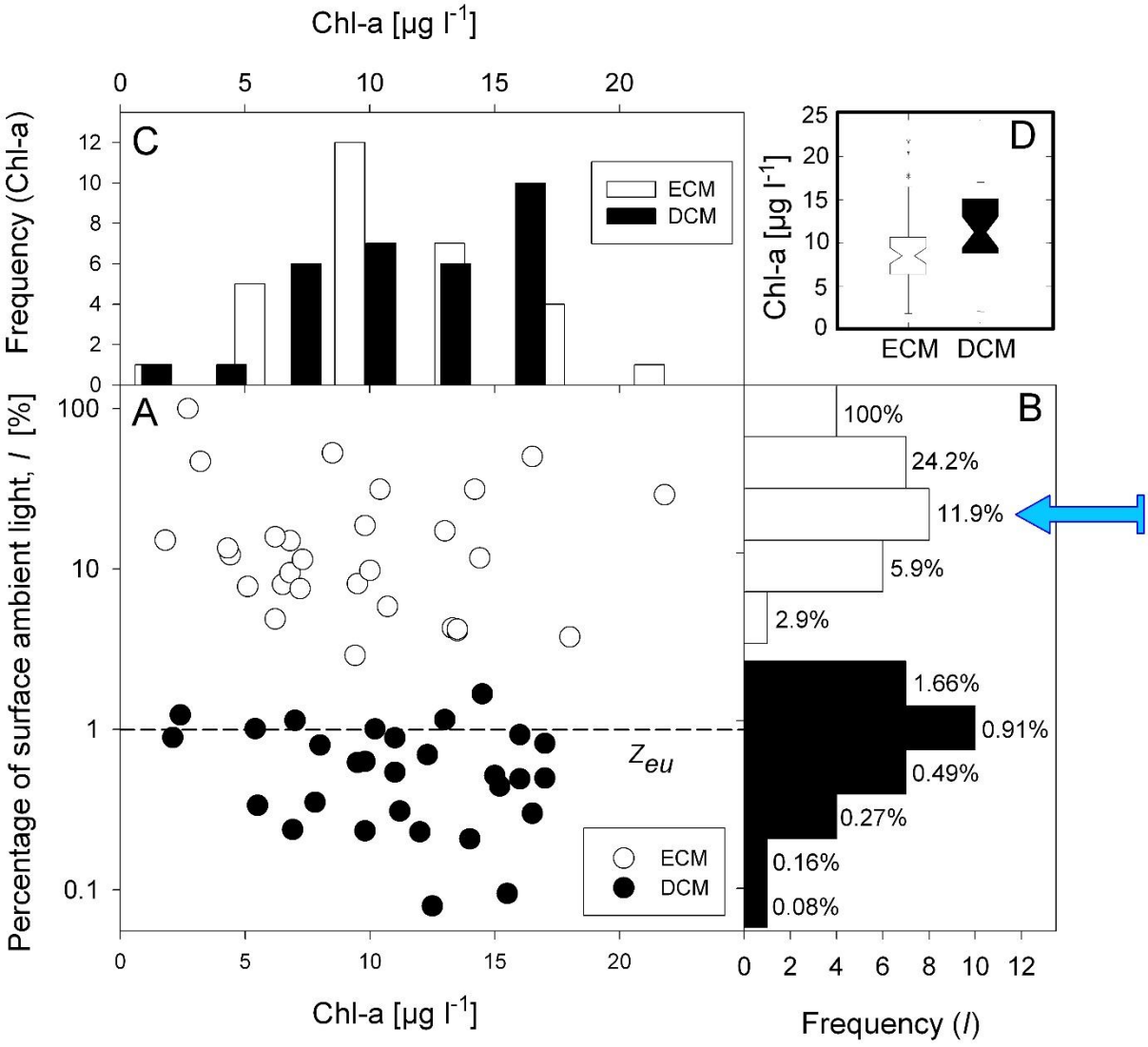
SUPPLEMENTARY MATERIAL_1

Exposure to 12% lake surface ambient light is assumed to indicate the lake depth at which underwater light availability is supportive for optimum growth ($z_{optimum}$) of primary producers



Supplementary Material_1, Figure_S1: ECM (Epilimnetic Chl-a Maximum) and DCM (Deep Chl-a Maximum in the metalimnion) along depth profile of underwater light intensity. A: Chl-a as concentration in µg L^{-1}, surface ambient light (*I*, in %) (=underwater light intensity of PAR in %); B: Frequency distribution of % surface ambient light for peak Chl-a concentrations at ECM and DCM, the blue arrow marks that about 12% surface ambient light is the most common light exposure at epilimnetic Chl-a peak; C: As B but for Chl-a; D: Chl-a concentration at ECM compared with DCM as notched box-whisker plot. Depth profile measurements refer to thermal summer stratification in Lake Ammersee, detail see method Supplementary Material 1, graph modified from Teubner et al. 2004.

METHOD

Phytoplankton biomass equivalent was measured with a "Haardt" BackScatter *in-situ* Fluorometer identifying Chl-a and Phycoerythrin/Phycocyanin concentrations to estimate biomass of phytoplankton

and specifically cyanobacteria along depth profiles, respectively. These depth profiles were used to identify the depth of maximum biomass development in the epilimnetic (ECM) and metalimnetic layer (DCM). Light profile measurements (surface photosynthetic available radiation, PAR) were applied to retrieve the underwater light attenuation from z_{eu} (in analogy of described methods of interrelating optical properties for the study about Alte Donau) identifying the underwater light intensity (% surface ambient light) at depth of peaking phytoplankton biomass, the ECM and DCM. Ammersee data refer to 28 depth profile measurements during thermal summer stratification from 1998 to 2001. Ammersee is a deep dimictic lake with a maximum depth of 81 m.

RESULTS and DISCUSSION

The Epilimnetic Chl-a Maximum (ECM) is most frequently observed at the depth of 11.9% light intensity, i.e., at depth of about 12% surface photosynthetic available radiation (see blue arrow in Supplementary Material_1, Fig._S1). This epilimnetic Chl-a peak mirrors the vertical migration of phytoplankton organisms towards optimal light exposure during calm days. 12% light intensity are thus assessed as optimal underwater light climate for planktonic primary producers. We thus define the lake depth exposed to at least 12% ambient light as $z_{optimum}$, which is also applicable for primary producers in other lakes, such as shallow Alte Donau. The relevance of $z_{optimum}$ not only for planktonic primary producers but also for the re-settlement of macrophytes is analysed in the main publication (e.g., see discussion "Underwater light climate: The achievement of optimum rather than minimum light requirement plays a role" for indicating a sustained growth of submerged macrophytes).

Furthermore, the Deep Chl-a Maximum (DCM) in the metalimnion of deep Lake Ammersee was most commonly found at 0.9% light (Supplementary Material_1, Fig._S1), which is slightly below the euphotic depth (z_{eu}). The euphotic depth refers to the minimum of 1% surface light exposure (1% PAR) in aquatic ecology (Kirk, 1994). The DCM is relevant for deep stratifying lakes only. Further details about Lake Ammersee are found in Teubner et al. (2004).

REFERENCES

Kirk, J. T. O. (1994). Light and Photosynthesis in Aquatic Ecosystems,Cambridge Univ. Press, New York

Teubner, K., Morscheid, H., Tolotti, M., Greisberger, S., Morscheid, H., and Kucklentz, V. (2004). Bedingungen für Auftreten Toxinbildender Blaualgen (Cyanobakterien) in bayerischen Seen und anderen stehenden Gewässern. (München: Bayerisches Landesamt für Wasserwirtschaft, Materialien 113), 1–105.