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BOOK OF ABSTRACTS

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Assessing effects of nocturnal LED illumination on aquatic primary producers

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Rivers are increasingly illuminated at night, due to the continuous expansion of artificial lighting. As light-emitting diodes (LED) are increasingly used in outdoor illumination, rivers are more and more frequently illuminated by LEDs. Exposure to broad-band LED light at night is expected to increase ecological effects of nocturnal illumination. While LED was found to affect numerous organisms and processes in a range of ecosystems, its effects on aquatic ecosystems remain understudied.

In small and mid-sized rivers and streams, primary production is dominated by benthic primary producers in periphyton. Primary producers use light as a key source of energy for photosynthesis and a source of information to regulate their circadian rhythms. Light emitted by LED lamps has a significant amount of photosynthetically active radiation and typically a high content of blue light that is known to entrain circadian clock in almost all living beings, including primary producers. Nocturnal LED illumination is therefore likely to have complex impacts on the physiology of periphyton, and net effects are hard to predict.

We studied effects of nocturnal blue-rich white LED light on periphyton in field and laboratory experiments. In field experiments, we found that exposure to nocturnal LED light of an intensity commonly found in urban and suburban waters (20 lux) can decrease periphyton biomass and alter its community composition by changing relative proportions of diatoms and cyanobacteria. To identify critical thresholds of impacts, we performed controlled laboratory experiments where we exposed ALAN-naïve periphyton to a range of LED intensities as found in urban and suburban waters at night (from 1 to 40 lux) and assessed its effects on biomass and photosynthetic efficiency relative to communities that experienced no light at night.

Our results contribute to our understanding of ecological impacts of artificial illumination on aquatic ecosystems. As periphyton forms the base of the food web and plays an important role in nutrient and carbon cycling in aquatic ecosystems, the changes induced by nocturnal LED illumination may cascade to higher trophic levels and influence important ecosystem functions. Our results can help inform lighting policies to minimize ecological impacts of nocturnal illumination on riverine ecosystems.