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Hydrologic and light variability as drivers of stream biofilm-invertebrate dynamics

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Among all abiotic controlling factors, hydrology and light availability are the key drivers that influence and affect space and time organization, structure and function of stream ecosystems.
To analyze from both an experimental and a modeling perspective the coupled effect of light and flow variability on the interactions between stream biofilm (i.e. the main component of benthic algae) and macroinvertebrates, a flume experiment and a modeling analysis have been carried out. In order to explore the impacts of flow alterations, two alternative discharge regimes have been performed, mainly a stochastic time-varying and a constant discharge sequence, reproducing the natural streamflow fluctuations of a river and an anthropogenic flow modification, respectively. In addition, given that light availability typically changes along the fluvial continuum as a function of the vegetation coverage and consequently affects biofilm primary production and macroinvertebrate foraging activity, four different light treatments characterized by 90%, 65%, 50% and 27% transmission of incident light radiation, have been introduced. Average grazing activity was significantly enhanced under variable flow conditions and highest at intermediate light availability. These results suggest that stochastic flow regime offers increased opportunity for grazing under favorable shear stress conditions, with implications for trophic carbon transfer in stream food webs. Alterations of natural streamflow regimes may have severe effects on the structure and function of stream ecosystems. Indeed future environmental impact criteria should include assessments of impacts on ecosystem processes. Our experimental evidence reveals hitherto unknown effects of flow regime changes on ecosystem functioning, and suggests that alterations simply maintaining minimum flowrates are inadequate to fully preserve ecosystem integrity.
In addition, the results of a modeling analysis of the observed biofilm-macroinvertebrate dynamics, as a function of discharge and light regimes, will be finally presented.