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The effect of flow reduction on microphytobenthos development in an alpine river stretch using novel fluorescence techniques

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Many European river systems are affected by flow alterations leading to significant differences of the pristine discharge regime at different temporal scales. Flow regulation measures and water abstraction are changing the extent and frequency of water level changes. In concert with river bed regulation this could affect the hydromorphological situation of river systems and key ecosystem functions.
Microphytobenthos is a major component in the physical, chemical and biochemical processes, which occur in river systems and the associated riparian zones. They are significant primary producers in rivers, because of their high turnover rate, rapid colonization along the aquatic-terrestrial boundary, transform nutrients and support via their biomass the food webs in the river and adjacent ecosystems. The developed structure and composition of microphytobenthos is controlled by the hydromorphological conditions and thus, indicates environmental changes. The guiding question for the presented research was to what extent changes in the variability of flow affect microphytobenthos development in a river stretch and to what extent the structure and composition of microphytobenthos changed at the micro scale.
To investigate these effects under natural conditions we compared a residual flow section impacted by a hydropower plant with one unaffected section of the River Ybbs, a tributary to the Danube River. The river stretch investigated was a 33 km long stretch between the villages Göstling and Opponitz in Lower Austria. The River Ybbs is draining a catchment of 1,300 km2 and has a mean discharge of 20 m3 s-1.The main benthic algal group are diatoms, which are typical for low order rivers in the Alpine area, characterized by low temperatures throughout the year.
We expected that flow velocity explain the extent of microphytobenthos development at the river stretch scale and especially low flow conditions affect the structure and composition of algal biomass at the micro scale.
The measurements included field surveys and two experimental settings. During May 2008 we conducted an in-situ experiment with artificial substrata to investigate the effect of flow velocity changes. We exposed glass slides in baskets along two transects in the River Ybbs at two sampling sites and eight different positions. After a period of about four weeks with weekly recurrent measurements including flow velocity, water depth, chlorophyll a content and electron transport rate (ETR) we started our experiment. Glass slides were taken from each position and were exposed in a flow reduced impounded area in the river Ybbs near Göstling. There low flow velocity was used to test the effect on microphytobenthos development. The next ten days daily measurements of flow velocity, water depth, chlorophyll-a content and electron transport rate (ETR) with the pulse amplitude modulated fluorescence method and microscopic analysis were undertaken. Based on these daily measurements under almost stable environmental conditions we could ascertain a shift in the benthic algae community. To assess the distribution along a river stretch we measured 70 sampling points at each sampling side.
To characterize the biomass and activity of the microphytobenthos we used Pulse Amplitude Modulated Fluorescence (PAM-Fluorescence). Using this technique allow to measure the biomass (Chlorophyll a) and the ETR (electron transport rate) simultaneously without destroying the structure. With this technique it is possible to The PAM technique measure directly the fluorescence of chlorophyll a in the photosystem two. The quantum yield you get is the probability that a photon can be used photochemically. The quantum yield offers the possibility to illustrate the fitness of algae. Based on these measurements short term responses can be measured and combined

with the results of field surveys.
These analytical results were used for a habitat modelling approach to describe the microphytobenthos development at 2 scales. First results of the research will be presented.