Hydromorphological restoration stimulates river ecosystem metabolism (Kupilas et al. 2017) [1]

Both ecosystem structure and functioning determine ecosystem status and are important for the provision of goods and services to society. However, there is a paucity of research that couples functional measures with assessments of ecosystem structure. In mid-sized and large rivers, effects of restoration on key ecosystem processes, such as ecosystem metabolism, have rarely been addressed and remain poorly understood. We compared three reaches of the third-order, gravel-bed river Ruhr in Germany: two reaches restored with moderate (R1) and substantial effort (R2) and one upstream degraded reach (D). Hydromorphology, habitat composition, and hydrodynamics were assessed. We estimated gross primary production (GPP) and ecosystem respiration (ER) using the one-station open-channel diel dissolved oxygen change method over a 50-day period at the end of each reach.

Moreover, we estimated metabolic rates of the combined restored reaches (R1 + R2) using the two-station open-channel method. Values for hydromorphological variables increased with restoration intensity (D < R1 < R2). Restored reaches had lower current velocity, higher longitudinal dispersion and larger transient storage zones. However, fractions of median travel time due to transient storage were highest in R1 and lowest in R2, with intermediate values in D. The share of macrophyte cover of total wetted area was highest in R2 and lowest in R1, with intermediate values in D. Station R2 had higher average GPP and ER than R1 and D. The combined restored reaches R1 + R2 also exhibited higher GPP and ER than the degraded upstream river (station D). Restoration increased river autotrophy, as indicated by elevated GPP : ER, and net ecosystem production (NEP) of restored reaches. Temporal patterns of ER closely mirrored those of GPP, pointing to the importance of autochthonous production for ecosystem functioning. In conclusion, high reach-scale restoration effort had considerable effects on river hydrodynamics and ecosystem functioning, which were mainly related to massive stands of macrophytes. High rates of metabolism and the occurrence of dense macrophyte stands may increase the assimilation of dissolved nutrients and the sedimentation of particulate nutrients, thereby positively affecting water quality.

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