Hydromorphological restoration stimulates river ecosystem metabolism

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Supporting information

Appendix S1: Information about restoration activities and restored reaches

The restored reaches (R1 and R2) were compared to an upstream degraded "control-section". We selected the degraded reach (D) to be characteristic for the channelized state of the River Ruhr, and to reflect the conditions of the restored reaches prior to restoration (Fig. S1, S2). Accordingly, the hydromorphology of the degraded reach had been largely modified by channelization and bank fixation, resulting in lower physical stream quality (e.g. smaller wetted channel width, no islands and no accumulations of woody debris).

Restoration involved the widening of the riverbed and the reconnection of the river with its floodplain by creating a shallower river profile and by removing bank fixations. Furthermore, secondary channels and island were generated, instream structures - such as woody debris - were added and shallow habitats were created, potentially providing more space for autotrophs (Fig. S3, S4, S5, S6, S7, S8). The restored reaches differed in restoration effort (R1: moderate restoration effort and R2: high restoration effort). Briefly, R2 represented higher effort than R1 due to larger soil moving activities and higher costs for measures implemented (Table S1). Moreover, differences in restoration effort were obvious from measures implemented along the two reaches: In R1, removal of bank fixation and widening of the riverbed mainly focused on one (right) shoreline only, while the other (left) shoreline remained fixed due to railroad constrains (Fig. S7). On the contrary, R2 was substantially widened, bank fixation was removed at both shorelines and islands were created along the reach (Fig. S8). The differences between the restored reaches are further described by measurement results presented in our study (Table 2).

Table S1: Restoration costs and soil moving activities indicating differences in restoration effort between R1 and R2

Reach	Costs (€)	Soil excavation (m^3)	Soil shifting (m^3)
R1	1,400,000	44,000	15,000
R2	1,930,000	61,000	18,000

Fig. S1: Photo of the upstream degraded „control-section“ (D) (photo by A. Lorenz).

Fig. S2: Conditions of restored reaches prior to restoration (photo by A. Lorenz).

Fig. S3: Photo of the 1st restored reach (R1) (photo by B. Kupilas).

Fig. S4: Photo of the 1st restored reach (R1) (photo by B. Kupilas).

Fig. S5: Photo of the 2nd restored reach (R2) (photo by B. Kupilas).

Fig. S6: Photo of the 2nd restored reach (R2) (photo by B. Kupilas).

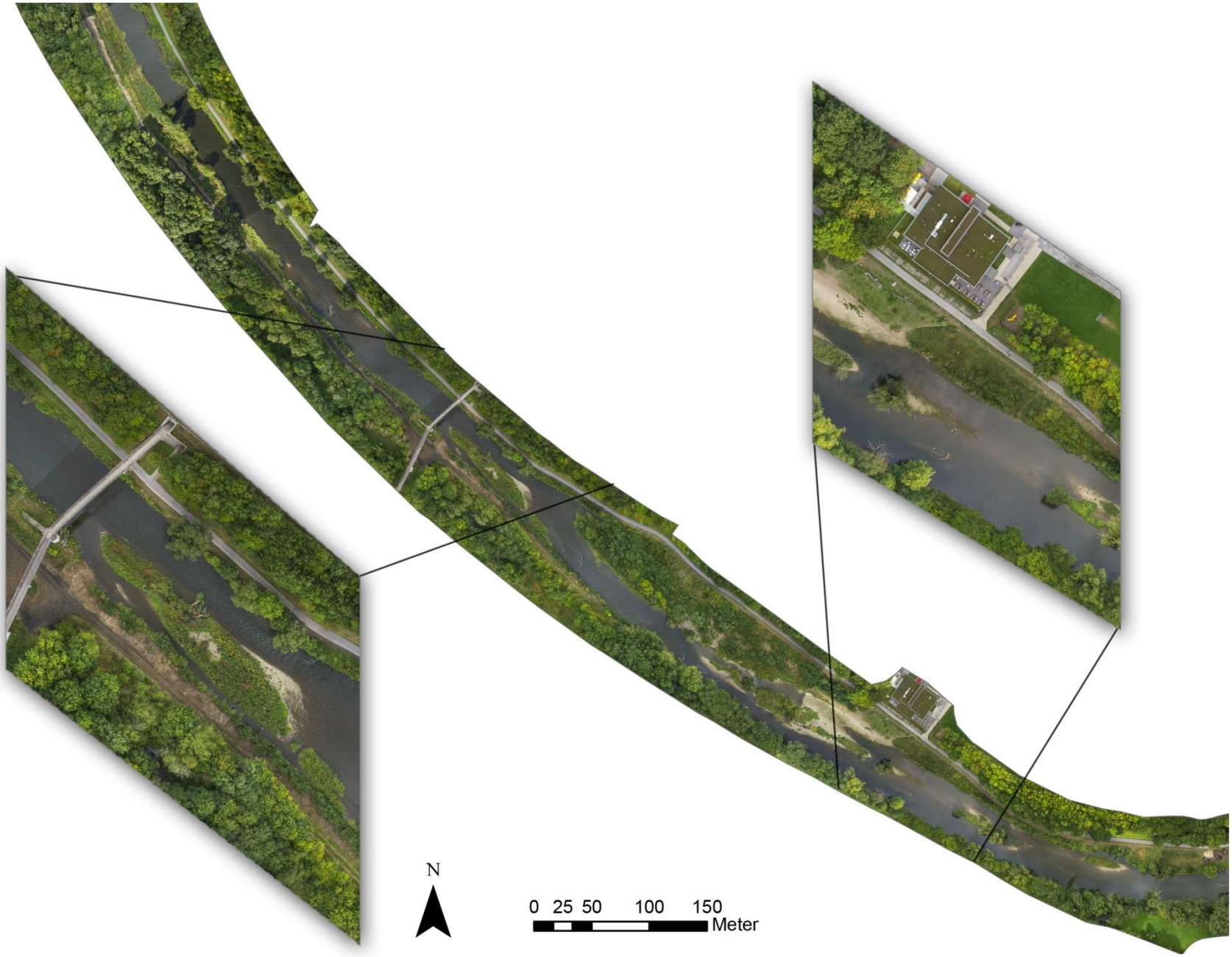

Fig. S7: 1st restored reach (R1) (photo by NZO GmbH, Germany).

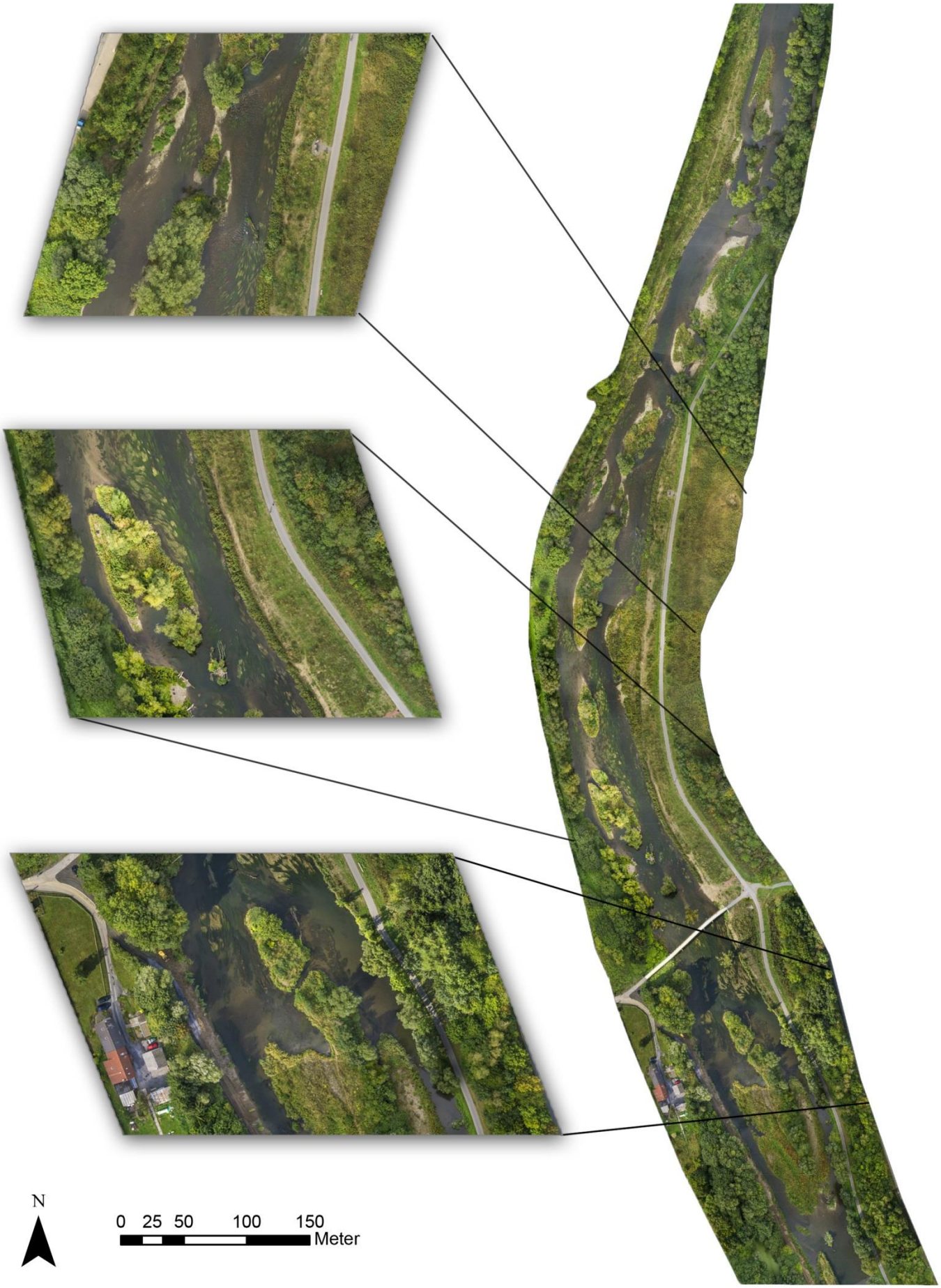

Fig. S8: 2nd restored reach (R2) (photo by NZO GmbH, Germany).