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Sedimentological downstream effects of dam failure and the role of sediment connectivity: a case study from the Bohemian Massif, Austria

Maria-Theresia Wurster (1), Gabriele Weigelhofer (2), Christian Pichler-Scheder (3), Thomas Hein (2), and Ronald Pöppl (1)

(1) University of Vienna, Geography and Regional Research, Vienna, Austria (ronald.poeppl@univie.ac.at), (2) WasserCluster Lunz - Biologische Station GmbH, Lunz am See, Austria, (3) Blattfisch.at, Technisches Büro für Gewässerökologie, Wels, Austria

Sediment connectivity describes the potential for sediment transport through catchment systems, further defining locality and characteristics of sedimentation in river channels. Dams generally decrease sediment connectivity and act as temporary sediment sinks. When dams are removed these sediments are being reworked and released downstream. During dam restoration works along a small-sized stream in the Bohemian Massif of Austria in December 2015 a dam failure occurred which led to the entrainment of several tons of fine-grained reservoir sediments further entering and depositing in the downstream channel reaches, located in the Thayatal National Park. Aiming to remove these fine sediment deposits the National Park Authority decided to initiate a flushing event in April 2016. The main aim of the present study was to investigate the effects of dam failure-induced fine sediment release and reservoir flushing on downstream bed sediment characteristics by applying geomorphological mapping (incl. volumetric surveys) and sedimentological analyses (freeze-core sampling and granulometry), further discussing the role of in-channel sediment connectivity. The obtained results have shown that immediately after the dam failure event a total of ca. 18 m^3 of fine-grained sediments have accumulated as in-channel sediment bars which were primarily formed in zones of low longitudinal connectivity (e.g. in the backwater areas of woody debris jams, or at slip-off bank locations). The flushing event has been shown to have caused remobilization and downstream translocation of these deposits, further reducing their total volume by approx. 60%. The results of the granulometric analyses of the freeze-core samples have revealed fine sediment accumulation and storage in the upper parts of the channel bed, having further increased after the flushing event. Additionally, effects on chemical conditions and invertebrate community have been observed. These observations clearly indicate a significant influence of vertical connectivity conditions on in-channel fine sediment storage.