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Interactions between river channel processes and riparian vegetation – an example from the Lužnice River, Czech Republic

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Riparian vegetation responds to hydrogemorphic processes and environmental changes and also controls these processes. Our study focuses on the interactions between woody riparian vegetation (live and dead trees) and river channel morphology on the example of three 1 km long reaches of the Lužnice River in southern Czech Republic. Here, we propose that despite spatial proximity, identical hydrological and sedimentological controls, three river reaches have different geomorphology due to varying character of riparian woody vegetation and different character and abundance of large in-stream wood (LW). Upstream, middle and downstream reaches vary markedly in channel dimensions (width, depth) and the present day rate of lateral erosion. Three reaches also show the different in-stream wood loads which are dependent mainly on the character of the riparian vegetation, and on the lateral activity of the channel. The highest wood load was recorded at the downstream reach with 102,162 m3/ha, the lowest at the middle reach 37,041 m3/ha, the upstream reach has load 81,370 m3/ha. Upper reach woody vegetation is the mixture of willow, alder, chokecherry and oak. The reach is only slightly sinuous with the moderate rate of incision and lateral erosion. The channel width and depth are 13 m and 2,1 m respectively, the mean cross section area is 27,3 m2. Erosion in the reach is slightly enhanced by the river training works upstream (canalisation, weir construction). Middle reach woody vegetation mostly consist of willow. Tree-tops often incline into the channel, thus, dissipating effectively the energy of the river flow. The reach is moderately sinuous and rather laterally stable. The channel width and depth are 10 m and 2,5 m respectively, the mean cross section area is 25 m2. The reach approximates the natural condition of the pristine river. The impact of river training works is minor only with the road bridge upstream. This reach in the most natural condition shows the lowest in-stream wood load and lowest rate of the present day bank erosion. Downstream reach woody vegetation is discontinuous, alternating with pastures. Riparian trees are the mixture of poplar, willow, alder and oak. The reach is highly sinuous with distinct meanders and laterally very dynamic. The channel width and depth are 15 m and 3,7 m respectively, the mean cross section area is 55,5 m2. The highest bank erosion was noted at the locations with pastures. The specific feature of this reach are fossil oak logs, which are exhumed from the alluvial sediments by the rapid lateral erosion. The enhanced incision and lateral erosion is the combined effect of riparian forest clearance and river training works (canalisation) downstream. The planform changes of the river since 1952 have been studied by analysis of the aerial images. It was derived that floodplain area of 12 450 m2, 16 318 m2 and 20 687 m2 was eroded, of which 10 465 m2, 8496 m2 and 10 733 m2 was wooded land at the upstream, middle and downstream reaches. We estimated that this rate of bank erosion delivered 644, 510 and 628 trees to the river channel since 1952. These numbers represent 390%, 1130% and 285% of the present day number of LW pieces in the river channel. Approximate turnover rates of LW can be estimated from these data. Present day rate of bank erosion and LW input is monitored at selected concave banks by repeated geodetic surveying. The Lužnice River has a sandy bed and LW modifies bed and bank morphology profoundly. We found that 33%, 29% and 36% of LW pieces caused localized erosion (pool formation) and 37%, 24% and 21 % caused local deposition at upstream, middle and downstream river reaches.
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