



## **Sediment continuum, surplus and deficit - Scopes and Limits for spawning habitat restoration measures**

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Geomorphologic analysis plays an important role for spawning habitat research and spawning habitat restoration (SHR) of salmonids in describing the sedimentary conditions, and channel morphology requirements for productive fish populations. The size of sediments in which an adult salmonid can excavate redds is a crucial parameter at spawning sites. In general, salmonids prefer small gravel to cobble for spawning. Spawning redds of European salmonids feature burial depths of 10 - 15 cm for brown trout and at least 7 cm for grayling. Gravel bed rivers featuring riffle-pool morphology exhibit those bed-forming spawning materials independent of river size and slope, whereby especially riffle sections may be suitable for salmonid spawning. Plane bed rivers, however, are characterized by a lack of discrete bars, which is related to low width-depth ratios and by moderate to high slope reaches in relatively straight channels. Within plane river catchments, 66% - 79% of the wetted areas were classified as being unsuitable for spawning due to too coarse bed material, whereas 98% - 100% would theoretically be suitable if they featured riffle-pool morphology. Despite those natural constraints on salmonid spawning habitats check dams, torrent controls and lateral obstructions in general limit and/or cause a disturbed sediment continuum directly impacting the crucial replenishing of spawning gravel during high flows. Nevertheless, beside those deficits in bed load material surplus of fines due to intensified agricultural land use or draining of meandering brooks in crystalline catchments may additionally cause clogging of documented reproduction sites causing increased mortality before emergence. With respect to the importance of morphodynamics (e.g. turnover) at the spawning habitats, our study underlines the crucial importance of effective discharge and sediment continuum for suitable spawning substrate based on two-dimensional sediment transport modelling. This parameter can be applied to prevent clogging and to guarantee the sustainability of SHR-projects (analysis of sediment continuum). Thus, especially according to the aims of the European Water Framework Directive (WFD), the downstream transport of appropriate spawning gravel is one of the key issues to guarantee a healthy population structure of target fish species as well as good ecological status / potential.