

FACTSHEET

2. Bedload tracing

Given the increased awareness of the importance of sediment supply for the success of river restoration measures, the processes determining the transfer of sediment are of great interest. Measures such as sediment replenishment are increasingly deployed to re-establish morphodynamics and to restore habitats in rivers, which are affected by sediment barriers and the related sediment deficits. The method of bedload tracing helps in gaining insights into the transport of injected or remobilised sediment. In HyMoCARES, bedload tracers were deployed to investigate the bedload transport after sediment replenishment and to derive a formula for the bedload transport velocity.

The effect and the lifetime of replenishments depend on the residence time of the sediment in the targeted river reaches. Sediment, which is remobilised upstream to supply downstream reaches (e.g. removal or redesign of check dams in tributaries), needs to be transported before it enters the reach of interest. Similarly, the effect of sediment barriers on downstream reaches is subject to a time-lag after construction, depending on the distance and on the travel velocity of the sediment. These circumstances complicate linking downstream morphological changes to measures implemented upstream. Bedload tracers (Figure 1 and Figure 2) help to gain insights on the sediment transfer in river catchments.

Figure 1. a) and b) Bedload tracers (active VHF transmitters) deployed in the Upper Drava valley, c) search of tracers with a mobile radio receiver and antenna from a boat.

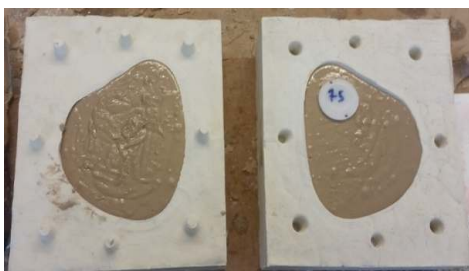


Figure 2. Moulds used to imitate the shape of an original stone and installed active UHF RFID transmitter, deployed in the Drac River (Brousse, 2020).



The tracer study in the Upper Drava valley revealed that sediment may be transferred rapidly in Alpine rivers (Figure 3). The results emphasize that the residence times even in partially restored river sections may be short and that the sediment regime would quickly respond to upstream alterations of sediment supply. In HyMoCARES, the results were used to derive a formula for bedload transport velocity. The method of Klösch and Habersack (2018) was improved to account for the downstream deceleration of tracers due to burial (Klösch et al., 2019).

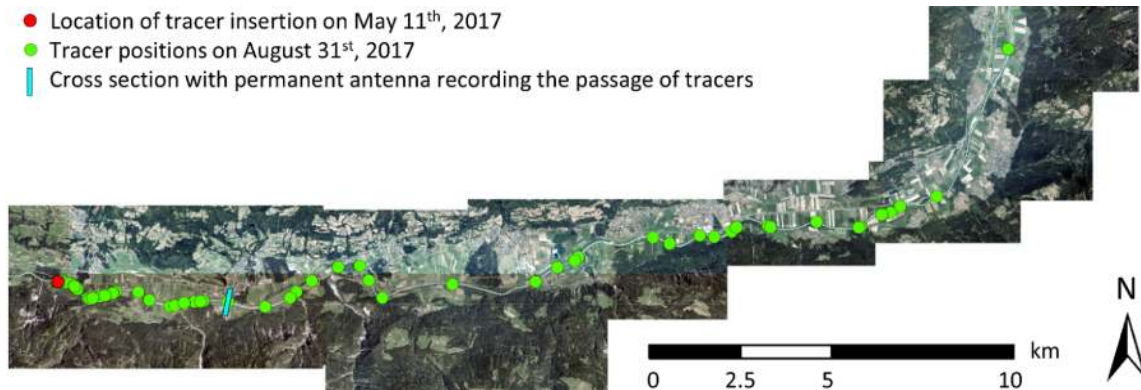


Figure 3. Study in the Upper Drava valley on the bedload velocity as basis for formula derivation; flow direction from left to right.

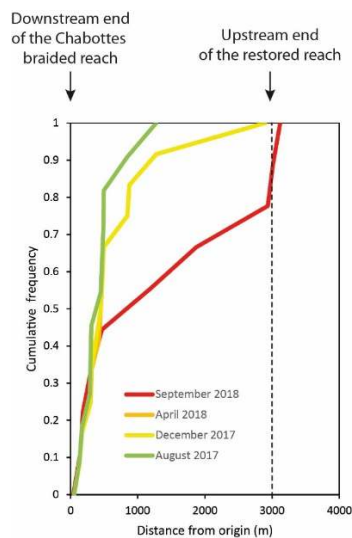


Figure 4. Propagation of bedload transport from the braided Chabottes plain (main sediment source) to the downstream restored reach, represented by the cumulative frequency of active RFID-tracers (Liébault et al., 2019).

At the Upper Drac River, bedload tracers (using active RFID technology) were deployed to investigate the sediment transfer from an upstream major sediment source to the downstream restored reach (Figure 4 and Figure 5). The bedload tracing program of the Upper Drac confirms a rapid transfer of gravels in this river, and favourable conditions of sediment connectivity between the main upstream sediment source and the restored reach. This is of uppermost importance for the persistence of braiding conditions in the near future along the restored reach.



Figure 5. Recovered morphology of the restored reach of the Upper Drac in 2018 after the sediment replenished upstream entered the reach (@SIGosphere)

Bedload velocities in alpine rivers can be high. This emphasizes the essential need for coupling sediment replenishment with widening (in case of channelization) to trigger deposition of the sediment in the target reaches and, importantly, recover the hydromorphology.

References

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- Liébault F. et al. (2019). Technical note on the evaluation of physical and ecological effects of river restoration works, Buëch and Upper Drac rivers. D.T3.3.1 HyMoCARES