FACTSHEET

3. Sediment replenishment of highly altered alpine gravel bed rivers

Monitoring and assessment of morphological trajectories following artificial gravel replenishment in two degraded alpine rivers in France demonstrated that this kind of restoration project can improve hydromorphological conditions of starved river channels. In one case, sediment replenishment has stopped channel incision downstream of a dam, and in the other case, it has clearly contributed to the recovery of the braided morphological conditions.

The HyMoCARES project provided the opportunity to assess the morphological effects of two emblematic sediment replenishment operations in the Southern French Alps. In the Buëch River, 40 000 m^3 of gravels have been reinjected downstream from a dam (St Sauveur dam) to stop channel incision and to reactivate the altered braided morphology (Fig. 1A). In the Upper Drac River, 400 000 m^3 of gravels have been used to recreate a braided channel along a reach where gravel mining induced a dramatic channel incision into lacustrine clay deposits (Fig. 1B).

Figure 1.Emblematic recent sediment replenishment operations in French alpine gravel-bed rivers: (A) sediment replenishment downstream of the Saint-Sauveur dam in the Buëch River in 2016 (@EDF); (B) sediment replenishment of the incised Upper-Drac River in 2014 (@CLEDA)

In the Buëch River, it has been possible to document the formation and propagation of a coarse sediment wave induced by the scouring of artificial gravel berms deployed downstream from the dam, following a 5-yr frequency flood, which occurred few weeks after the restoration works (Fig. 2). The front of this gravel wave has been detected using data from sequential airborne LiDAR surveys, combined with observations from bedload tracers (active RFID technology). The front has been detected at 2.3 km down to the dam, attesting a rapid bedload dispersion along the restored reach, and a spatially extended morphological recovery of the altered channel.

The monitoring of the morphological restoration of the Upper Drac clearly reveals a very efficient spontaneous recovery of braiding conditions along the 3-km widened and replenished river reach. From a purely aesthetic point of view, this restoration is a real success, as today, the restored reach really looks like a "natural" braided river reach (Fig. 3). The evolution of the morphological signature of the restored reach confirms a rapid recovery to reference conditions (Fig. 4).

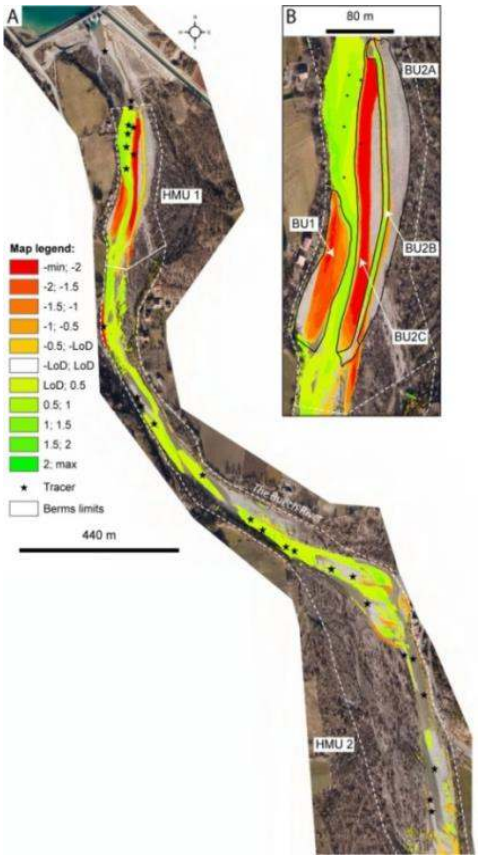

Figure 2. Propagation of the gravel wave induced by sediment replenishment downstream of the Saint-Sauveur dam, documented with topographic differencing and gravel tracing, Buëch River (Brousse et al., 2019)

Figure 3. Spontaneous recovery of braided pattern in the Upper Drac restored reach (@Sigosphere)

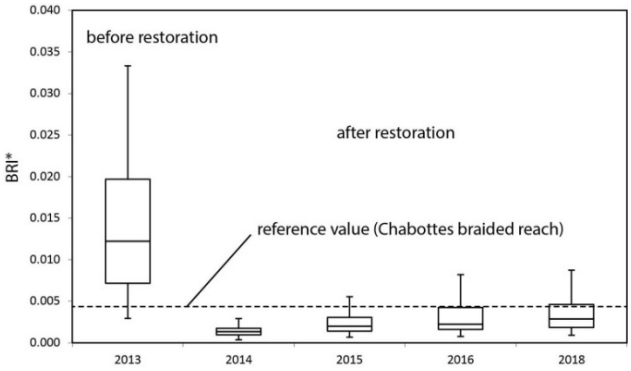

Figure 4. Bed Relief Index (BRI) evolution in the restored reach of the Upper Drac before and after restoration (Liébault et al., 2019)*

Key message: Sediment replenishment is a successfull solution to stop channel incision or to recreate braided morphology in highly altered alpine gravel bed rivers

References :

Brousse et al. (2019) 10.1002/rra.3527. Liébault F. et al. (2019). Technical note on the evaluation of physical and ecological effects of river restoration works, Buëch and Upper Drac rivers. DT331 HyMoCARES.