In-Stream-Restoration

Gentle watercourse maintenance, weed clearance in the current channel, lowland waters, sand trap, gravel bank, natural dynamics

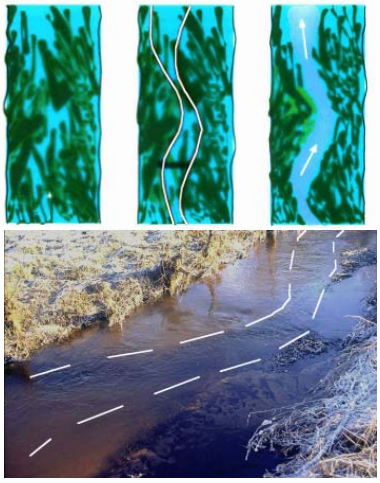
Water Maintenance

(1) Water starwort and a pool-riffle bring life back to a creek

Despite improvement of water quality components such as fish, there are still deficits in the biological quality of fish, invertebrates and aquatic plants within the creeks and rivers of the lowlands, preventing them from attaining good ecological status. The cause is the continuing intensive water maintenance as well as ***the input of harmful pollutants from agriculture****, both of which contribute to the deterioration of aquatic habitats. Often the physical conditions of a water body can be improved through small-scale measures, restoring habitats for local flora and fauna. „In-stream-restoration" refers to a principle where* ***gentle watercourse maintenance*** *and* ***adaptive land use management*** *play a major role.*

Reason / Cause

The presence of local fish, invertebrates, and aquatic flora are vital components of good ecological status for surface water in accordance with the Water Framework Directive. Morphological conditions of rivers contain a great deal of variation in depth and width, natural structure of the streambed, the riparian zone as well as the substrate. The categorization of a large number of small streams in the lowland as LAWA water type 14 „Small sand-dominated lowland rivers" is fundamentally false, since most small surface waters are actually ice-age stemming LAWA water type 16 „Small gravel-dominated lowland rivers". A large portion of the flowing water today is deeper and broader than its original morphology as a result of intensive maintenance. It lacks, above all, a close to natural riverbed with hard materials such as stones, dead wood and roots, which serve, for example, as hiding, spawning and feeding areas for lithophilic fish species (i.e. those spawning on gravel). Additionally, there is great sediment input by sometimes extremely high erosion levels from agriculture, which covers natural habitats with sand and which during floods acts like a „sandblast".



(2)+(3) The weed clearance should be placed windingly in the current channel, at best by hand

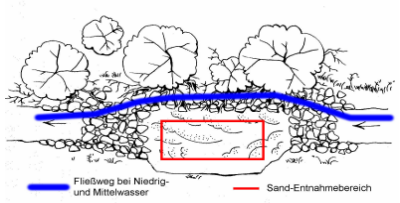
Measures

Often, small measures are sufficient to improve the physical condition of flowing waters, so that appropriate habitats for local flora and fauna can be established. The principle of „in-stream-restoration" usually allows for the low-cost improvement of a water body. Thereby **gentle watercourse maintenance** („just as much as necessary") and **appropriate, professional land usage** are given particular importance. Here some possible measures are presented:

- With **weed clearance**, best cut by hand with a scythe or string trimmer, a winding flow channel is built, which is at max of two thirds the width of the streambed. Local plants such as crowfoot and water starwort should be unaffected. The resulting turbulent flow whips fine deposited materials to the side and exposes existing gravel and stone. Additionally, alders on the water's edge constrict plant growth in the water and on the bank. The bank clearance can usually be limited or completely omitted. At high river discharge, water can simply flow freely over the vegetation. Risk of back up is not given.

(4) Intensive watercourse maintenance, land use up to the banks and lack of riparian vegetation lead to severe erosion and the build-up of sand

(5) A sand trap holds back eroded material, and alders shade the streambed, prevent mass growth of aquatic and marsh plants and protect the bank

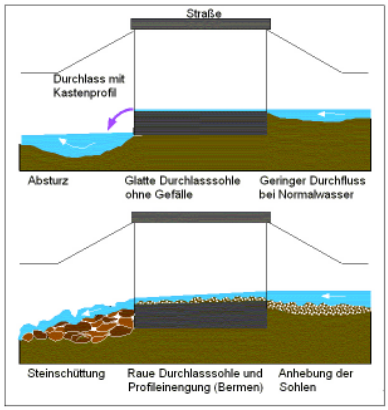


(6) Schematic of a sand trap
line = stream at medium and low water;
box = area of sand extraction

- **Sand trap**: Sand from agricultural erosion leads to high mortality in spawning pits and is a major factor that prevents trout and other gravel-breeding fish from having a self maintaining population through reproduction. Sand traps serve as a temporary solution to keep agricultural soil input from affecting the entire water body. Next to the sand trap, a rough stream of low and medium water must be created. Durin high water level, the sand trap is flooded and thus can catch eroded material. It is important that the trap is cleaned regularly, before it is completely filled. Otherwise the accumulated sediments are released concentrated to the tailwater.

- **Alternating narrowing overly wide creeks**: naturals streams often take the form of a double sine curve (S curve). Faciliation of the natural channel line through newly created turbulence often is enough to free the spawning gravel from sand and re-establish the habitats of local small organisms. Overly broad creeks are narrowed on alternating sides with triangular rocks, boulders and deadwood from the periphery. As a result, a narrower, winding channel is established, which keeps itself free of sand. Despite the resulting turbulence in the flow, these steps, if done correctly, prevent rather than create more erosion.
- **Creation of spawning grounds**: A more than 30 cm thick gravel bed across the whole streambed is required for spawning grounds. Waters which are too broad are narrowed with boulders, and a gravel bank is created between them.
- **Permeability of bridges**: Erosion washouts and low water hinder aquatic organisms' movement under bridges. Migrating land species such as amphibians and mammals need a dry path to keep them off the road, where they could be run over. A steep slope under the bridge should be smoothed by a riffle. In addition, berms made of wood or stone may be set on both sides under the bridge.

All maintenance activities shall be outside the closed and spawning seasons, in order to avoid interference. Self developed structures in the water, such as current channel, meandering, riffles, pools, bank overhang and washouts, or material deposits are to be sustained.



(7) Bio-permeability under a bridge (Schema)


(8) A rough gravel bed and berms on either side improve passage under a bridge

Results / Assessment

The condition of aquatic habitats and directly dependent terrestrial ecosystems can be improved quickly and effectively through **gentle maintenance** as „in-stream-restoration". Increased turbulence is associated with strong current variance. The erosion hazard at the banks is decreased. The once uniform sand bed is transformed into a variable stream bed with transverse and longitudinal profiles, where plants and invertebrates can find stable-dynamic habitats and lithophilic species can find spawning grounds.
The „in-stream-restoration" method works with the **natural dynamics of the water** and not against natural forces, so that excessive and unnecessary maintenance practices do not have to be performed. Thus, there is usually a good benefit cost ratio.


(9) Closer to the target: A trout spawning ground shows a successful gravel introduction

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Literature / Links

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