The importance of sediment-continuum and self forming morphodynamic processes according to the aims of the European Waterframework Directive

The Danube partially features a totally disturbed system (e.g. the sediment balance is strongly altered). The sediment continuum is not given anymore (torrent control, hydrodams etc.), leading to a lack of bedload and suspended load in the downstream free flowing sections. For increasing navigation, flood protection and hydropower generation the Danube River has been narrowed, channelized, disrupted from the floodplains and morphologically degraded over long distances, thus leading to increased shear stresses, sediment transport capacities, lack of lateral sediment transport and reduced morphodynamics in the non-impounded sections. As a consequence of the sediment supply limitation and channelization the non-impounded sections are subject to river bed degradation. River bed degradation leads to a loss of instream structures, especially to a disappearance of gravel bars and changes of sand bars. With the lack of morphodynamics important river habitats, such as spawning and shelter places are disappearing, leading to a worsening of the ecological status.

It was found, that sediment-continuum and active sediment transport is crucial for most of the spawning habitats (of target fish species) in the Austrian Rivers (not only for the Danube). Due the mentioned degradation of spawning habitats (e.g. due to flood protection measures) artificial measures to enhance spawning conditions (e.g. gravel dumping) were implemented in river management strategies. However, when restoring spawning grounds, long-term morphological development is an important issue. The functionality of a restored spawning area (self-developing riffles without technical measures) has to be maintained for future generations of fish, which might undertake homing migrations to their place of birth. Generally, homing brings an individual fish back to an environment which is known to be suitable for reproduction. The ability to home to particular spawning locations is well

documented for salmonid species. Although evidence of homing during spawning migrations is sparse in non-salmonid species, studies recently carried out in Austria clearly supported homing migrations of barbels and nase.

The European Water Framework Directive aims to achieve a good ecological status for the rivers of Member States by 2015. This requires healthy fish population structures to guarantee sustainability for this part of the aquatic ecosystem. Various examples of river restoration in Austria (e.g. Sulm River, Drau River), however, clearly demonstrates that – apart from the short-term improvement in the aquatic ecology by such measures (artificial meander, river widenings) – long-term morphological developments can change the artificially created (restored) habitats. Further, full restoration according to the "natural conditions" is no longer possible. One clear problem is the urbanisation and settlements in the floodplains (decrease of inundation area); another issue is which time slot in history (specific situation of river morphology during morphodynamic and channel evolution processes) should be taken as a reference before systematic interference: the early 18th century or the early 20th century? Rivers have changed their appearance (confined, braided, meandering) depending on tectonic developments and on global climatic conditions over millions of years. The implementation of mid- to long-term monitoring programs of abiotic (hydraulics, morphology, sediment transport) and biotic data (benthic, fish, algae) would be the best way to understand river processes and to improve habitat structures under the prevailing circumstances. Integrative evaluation methods are especially suited to study the long-term developments that can be initiated by a rehabilitation measure, whereby habitat modelling can serve as an integrative tool. Understanding these processes can also promote restoration projects to achieve the good ecological status required by the European Water Framework Directive by 2015.

For benthic organisms active sediment transport and/or sediment continuum have to be seen crucial as well for achieving the aims of the WFD. Despite the fact, which in reaches with increased sediment load transport biomass and abundance of benthic invertebrates has been

reported as significant lower, the sediment continuum is important for the heterogeneity (patches) of habitats within a river. Hence, riffle-pool sequences should be mentioned. The sustainability of riffles only can be guaranteed due to downstream sediment transport. Within those riffle section benthic biomass production was documented for being three to four times higher than in associated pools. Therefore, those habitats (riffles) which are directly linked to the sediment continuum have to be seen as “key-habitats” for fulfilling the aims of the WFD (e.g. according to spawning and benthic biomass production).