Scientists document aquatic species decline at dams and weirs

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Dams and weirs have a stronger impact on the ecosystem of watercourses than was previously realized. Species diversity in the dammed area upstream of weirs shows a significant decline: the diversity of fish species is one-quarter lower on average, and species diversity among invertebrates is up to 50 percent lower. The interruption of a river course thus has greater effects on the biodiversity than the geological origin of the river itself. Scientists from the Technische Universitaet Muenchen have demonstrated this on the basis of a survey of five rivers in the catchment areas of the Elbe, Rhine/Main, and Danube. Their analysis records, for the first time, both abiotic factors, for example chemical composition, current, and river bed substrate, and biotic factors, such as the number, size, and diversity of all important animal and plant groups on the two sides of weirs. The TUM researchers will present their findings, which have already been published online in the *Journal of Applied Ecology*, at the annual conference of the German Limnological Society, which takes place from September 12 to 16, 2011.

Whether it is done for the generation of electricity, for flood protection, or collection of drinking water, the damming of a river represents a drastic intervention in its ecosystem. Weirs and dams alter the chemical and physical characteristics of the water and the riverbed. Their construction is accompanied by a clear decline in upstream species diversity, and this is exacerbated by successive damming. This phenomenon, which is known as "serial discontinuity," has now been measured for all important animal and plant groups by system biologists from the TUM for the first time; the information available up to now

concerned only individual taxonomic groups or species. The scientists carried out a systematic survey of the aquatic organisms on both sides of the weirs in five rivers of different geological origins. Their survey revealed a significant reduction in the number, biomass and variety of periphyton, invertebrates, and fish species upstream of the weirs. Compared with downstream areas, the diversity of fish species measured upstream of weirs was 25 percent lower on average; a threefold decline in biomass was also observed.

Current-loving fish species, many of which are on the "Red List" of endangered species, are particularly severely affected. "Brown trout, grayling and Danube salmon are demanding fish species that require oxygen-rich water and spawn in coarse gravel areas. As typical residents of the upper reaches of rivers, they are unable to find suitable habitats in dammed areas," explains Juergen Geist, Professor of Aquatic Systems Biology at TUM. "These river sections are often dominated instead by bream, chub, and even carp – generalist species that are actually adapted to stagnant waters. The ecological impoverishment of rivers is particularly dramatic when series of dams prevent the sufficient interlinking of different habitat types," says Geist. According to the Bayerische Landesamt für Umwelt (Bavarian Environmental Agency) there are more than 10,000 weirs in Bavaria's rivers alone.

According to the researchers, the main reason for the species decline is not the impermeability of the barrier to migrating fish species. Instead, the deciding factor is the chemical and physical alteration of the river itself which leads to a reduction of biodiversity. If the current is decelerated or interrupted, the flow rate upstream of the weir declines, and this is accompanied by increased water depth. In all of the surveyed dammed areas, the TUM scientists also recorded major differences in the oxygen content and temperature of the water and the sediment in the river bed, which hinders reproduction in current-loving fish species. The situation is compounded by differences in the structure of the sediments.

The particles in the sediment found downstream of weirs are twice as large on average as those upstream, providing more and better quality spawning grounds.

River sections in the direct proximity of weirs should, therefore, be given greater consideration in ecological quality assessments, notes Prof. Geist: "During the evaluation of new weirs or modernization of hydroelectric power plants, attention should no longer be focused exclusively on the migration of fish species, but on the consequences of the structure and function for the river ecosystem as a whole." To ensure this, affected river sections must be covered by the relevant laws or regulations, such as the European Union Water Framework Directive. "A set of instruments for the quantification of the effects of weirs is now available, which records both the quality of the habitat and its biodiversity," says the TUM scientist.

More information: M. Mueller, J. Pander, J. Geist: The effects of weirs on structural stream habitat and biological communities, Journal of Applied Ecology (early online) onlinelibrary.wiley.com/doi/10 … 011.02035.x/abstract

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