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Too much water? Challenging the wisdom that regulated rivers need higher minimum flows.

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In any regulated river system, the ultimate limit of the achievable ecological status of a water body is the amount of water available for release. It is not surprising that much ecohydrological research has focused upon the minimum instream flow required to sustain a given ecology. There has been much less attention given to three other critical dimensions of release from impoundments: (1) the maximum acceptable flow that can be released; (2) how to couple flow releases to within-year variation in the flow needs of particular organisms; and (3) the importance of morphological complexity in determining the habitat available in relation to a particular discharge release. In this paper we present results from a 6 year study of the hydrology, hydraulics and macroinvertebrate response to the redesign of releases from impoundments in order to enhance instream ecology. We were able to take a paired (adjacent) catchment approach based on millstone grit systems in South Yorkshire, U.K. For the first three years of the study, the catchments had very different flows per unit river width. For the second three years, the releases were adjusted to give equivalent flows per unit width. Hydraulic, macroinvertebrate and fish data were collected at regular time periods in each study year. A two-dimensional hydraulic model was used to provide additional data on how the patterns of habitat suitability changes as the impoundment releases were changed. In the river (A) with the lowest flow per unit width, we found that the system experienced greater hydrological variability as a result of the interaction of the lower flow release with non-regulated tributary inputs and impoundment overtopping. This translated into greater relative hydraulic complexity as a result of the coarse substrate, and the system had a more diverse macroinvertebrate population strongly associated with hydraulic variables. In the river (B) with the greater flow per unit width, hydrological variability was lower. Despite similar substrate characteristics to the first catchment, the hydraulic complexity was lower, as was the diversity

of macroinvertebrate populations, although this was balanced by a greater abundance. When the releases were changed to give a more equal flow per unit width, the primary change was a breakdown in the strong association between environmental variables and macroinvertebrate populations in river A and the introduction of weak association in river B. These results suggest that where the release from an impoundment is so great that it depresses hydrodynamic complexity, system diversity may be reduced, and too much water may be as much of an ecological problem as too little.