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# ARENA

## EDITORIAL

# OVERCOMING THE LIMITS OF SCALES

The following Arena papers in this issue of River Research and Applications present the first of two sets of papers that address the current development status of Mesohabitat Simulation system (MesoHABSIM) and Target Fish Community approach. It includes a description of the methodology, results of testing and validation and example of application. I am excited to deliver this publication into the hands of scientists and practitioners in the hope that these useful methods will be applied more broadly. The presented methods are under constant improvement and with this publication I would like to open a discussion, which may help us to further enhance the methodology.

Contemporary river restoration and fisheries management seek quantitative planning models to assess and simulate biological response to environmental change at the catchment-scale. Without such tools river restoration efforts are often limited to replacement and mitigation actions of largely unknown improvement potential. Therefore, the emergence of the Target Fish Community approach, followed by the creation of the MesoHABSIM at the turn of this century, created considerable interest among resources managers in the northeastern United States. In the 5 years since their development, both techniques have become a part of State instream flow policies in the region.

The Target Fish Community approach is a tool used to define biological reference for river restoration by recreating the structure of the native fish community. The MesoHABSIM approach falls in the footsteps of the Instream Flow Incremental Methodology and Physical Habitat Simulation Model (PHABSIM), a technique designed to capture biological response to habitat modifications. MesoHABSIM enhances PHABSIM by providing options to simulate instream habitat for fish communities at the watershed scale.

A specific objective of MesoHABSIM development is to design an approach that will efficiently capture biophysical interactions at the biologically relevant scale and transfer it to the scale adequate to the management of a whole river. In addition to the entire process of ‘upscaling’ (Parasiewicz, 2003) it was necessary to develop metrics that would be valid across scales, independent of human-induced flow alteration. This required modification of some established conventions. For example most instream flow studies aim to answer the question of how much water (in volume per time) needs to flow through a spatially explicit river cross section in order to assure the habitat quantity sufficient for survival of target species. Applied units are $m^3\,s^{-1}$ (or $ft^3\,s^{-1}$). This metric is useful for the determination of water releases from one facility at a specific location, but it is less convenient if there is a need for multiple release points. To capture one moment in time along the river continuum we need to take into account the changes in river size. Obviously, as one moves downstream the river gets bigger and to create similar hydraulic conditions different volumes of water are necessary at different locations. Thus, the concept of flow per unit-catchment-area was introduced by the U.S. Fish and Wildlife Service at the early stage of development of instream flow methods (Robinson, 1969; Bayha, 1980). The units used $ft^3\,s^{-1}\,mi^{-2}$ are popularly called cfsm and are presently widely applied throughout the northeastern U.S. regulatory environment as a very intuitive metric of flow in the catchment (Reiser *et al*., 1989). The method has some limitations as it assumes the catchment runoff as a constant, that is that at the same point in time the same cfsm value is expected along the river. In reality, this relationship may vary seasonally and spatially. It is likely, though, that catchment specific correction factors could be established. Converting this unit into SI units is a little inconvenient as 1 cfsm equals $0.011\,m^3\,s^{-1}\,km^{-2}$ and may be an obstacle in the worldwide use of the metric.

There are a number of other ways to address this problem, such as, for example the use of Reynolds number (or discharge per unit width) as proposed by Lamouroux and Jowett (2005) or, widely used, flow duration statistics (Bayha, 1980). In comparison with the above, such metrics may be affected by human-induced alterations. Many rivers in the world have been dramatically modified by operations aiming to improve navigation and flood protection and are often much narrower and deeper than the natural form. For example the Mississippi River is now a fraction of its original width (Nestler and Sutton, 2000). Consequently, flow metrics based on presently occurring river morphometry and hydrology may be outside of the biologically relevant range, making the search for ecological thresholds very difficult. Similarly, flow metrics based on present flow statistics would limit our ability for comparing habitat time series. In addition, our experience with is cfsm is that it is a very intuitive metric that is easily applicable in a regulatory environment. Therefore, throughout this series of papers we use the $10^{-2}\,\mathrm{m}^3\,\mathrm{s}^{-1}\,\mathrm{km}^{-2}$ as a unit of flow and recommend its use across greater geographical areas.

## REFERENCES

Bayha K. 1980. Instream flow methodologies for regional and national assessments. Instream flow information paper, no. 7. Fort Collins, Colo: Western Energy and Land Use Team, Office of Biological Services, Fish and Wildlife Service, U.S. Dept. of the Interior. 98 pp.

Lamouroux N, Jowett IG. 2005. Generalised instream habitat models. *Canadian Journal of Fisheries and Aquatic Sciences* **62**: 7–14.

Nestler JM, Sutton VK. 2000. Describing scales of features in river channels using fractal geometry concepts. *Regulated Rivers: Research and Management* **16**: 1–22.

Parasiewicz P. 2003. Upscaling: integrating habitat model into river management. *Canadian Water Resources Journal* Special Issue: State-of-the-Art in Habitat Modelling and Conservation of Flows **28**(2): 283–300.

Reiser DW, Ramey MP, Wesche TA. 1989. Flushing Flows. In *Alternatives in Regulated River Management*. Gore JA and Petts GE (eds). CRC Press: Boca Raton; 91–135.

Robinson EH. 1969. A procedure for determining desirable stream flows for fisheries. U.S. Fish and Wildlife Service. Concord. New Hampshire. Mimeo. 12 pp.

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