The large and Great River "reference problem": Surmounting the obstacles

Ted Angradi, US EPA, Office of Research and Development, Duluth, MN

Great Rivers, which I define as rivers with a watershed area of at least 400,000 km^2 or a discharge at the mouth of at least 3000 m^3/s, are rare. There are only 14 Great Rivers in all of North America. Defining a reference condition for these rivers is not straightforward because the traditional empirical approach of using a regional reference condition based on the best streams in a regional population of streams is not applicable, and other data are limited. The most satisfactory approaches to a solution to the problem will require integration of multiple approaches to setting reference expectations. The main purposes for defining reference expectations in large rivers are 1) for setting threshold values (biocriteria) for bioassessment and Clean Water Act Reporting; 2) for setting ecological restoration and adaptive management goals; and 3) for assessing progress toward restoration or management goals. Approaches to reference can be classified into 4 categories: empirical, reconstructive, modeling, and hybrid approaches. The empirical approach involves the comparison of "test sites" to current least disturbed conditions elsewhere. This approach can be further divided into regional, internal, and ambient approaches. Regional approaches can be categorized by scale into ecoregional, state, continental/hemispherical and even global reference conditions. Representativeness decreases with increasing scale. Internal reference conditions are based on least disturbed conditions within the same river system including the lower reaches of the larger tributaries. In the ambient distribution approach, expectations are based on the sampled range of conditions in a population. Reconstructive approaches include using historical records to set expectations and using paleoecological methods to reconstruct pre-disturbance biotic assemblages (e.g., lakebed cores for diatoms) Historical data are often free, static (the past doesn't change), and are based on a more pristine past, but are very data limited. Modeling includes models (conceptual, simulation, and stress response) used to describe aspects of a river in a minimally disturbed condition, GIS-based models used as tools to find potential reference sites, and models used to score test sites. The hybrid or holistic approach to setting reference conditions integrates multiple approaches to reference. It is the most "evolved" approach, but presents challenges for incorporation into monitoring and assessment programs. This abstract does not necessarily reflect EPA Policy.

Dr. Angradi is research biologist with the EPA Mid-Continent Ecology Division Laboratory in Duluth, MN. He has been involved in large river research for about 18 years, and has worked on the Snake River in Idaho, the Colorado River in Arizona, and the Missouri River in North Dakota.