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Approaches for developing a theoretical reference condition based on large river macroinvertebrate assemblages

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Reference aquatic communities reflect a state that is natural, or the least disturbed or best available conditions that are present in a watershed, drainage unit, or ecoregion. In highly altered large rivers such as the lower Missouri, reference conditions for aquatic communities are unknown or difficult to define, due to lack of historical data. However, a community of macroinvertebrate assemblages can be artificially constructed based on available knowledge of the fauna and the habitat and substrate affinities of the species present or expected. This theoretical or “virtual” reference consists of a list of actual species and associated relative abundances, both of which are designed to reflect the assemblage that should be expected in the system as a whole. The community is treated as its own site, and is assigned a score or rating in the same way as the test sites. It also defines expectations for indicator metrics, and the community is constructed so that it will achieve the best score for most metrics and a higher overall index score than any of the test sites. The theoretical reference is treated as the upper level of the best biological condition category, and provides the basis for the definition of category boundaries (i.e. good, fair, poor, or impaired vs. not impaired, etc.). Theoretical reference communities can be determined by back-calculation, habitat associations, structural and functional comparisons with other systems that are minimally disturbed, or models that use a combination of these approaches. This reference type may be useful in the lower Missouri River if a wide range in indicator response to future system changes cannot be adequately provided with an empirical or “best available” reference approach. Even though the theoretical reference provides a benchmark that is higher and potentially more stable than other approaches, it may not represent an attainable biological condition.