Concepts in river ecology: pattern and process in the catchment hierarchy

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With 3 figures and 1 table in the text

Abstract

A sound conceptual framework is vital for river ecology, both to take the science forward and to guide effective management of our rivers. Our knowledge of whole river systems is fragmentary and more is known about small tributaries than large mainstems. One of our tasks is to evaluate the extent to which current concepts are appropriate to large river systems. I review and evaluate the diversity of concepts that have been proposed and argue that most are viable and can be meshed together into the broad spatiotemporal context of the catchment hierarchy of an entire river; this should be the unit of study for river ecologists. However, there are many gaps in our understanding of the workings of the catchment hierarchy. Thus, another task is to devise approaches and technologies to uncover new patterns and processes that are relevant at the larger scale.

Introduction

It is probably the case that the science that attracts us is a reflection of our mentality – those who crave order and certainty become physicists or chemists while those who wonder at variation and complexity become ecologists. River ecologists face one of the stiffest tests of all because of the extreme spatial and temporal complexity of each individual river and the profound variation among rivers.

Development of a sound conceptual framework, the basic goal of any scientific discipline, is vital to take the science of river ecology forward to a more mature state and to guide effective management of our river resources. In this paper, I review and evaluate the diversity of concepts that have been proposed so far. The subject has moved from a subjective stage in which organisms, populations and communities were related to zones presumed to correspond to meaningful ecological entities, through an objective phase correlating the biota with physicochemical environmental factors (in which critical factors were invariably overlooked) to a stage, beyond correlation, when process became the focus and explanations for patterns depended on carefully conceived causal pathways. A different thread, superimposed on these developments, has been the shift from a rather static and circumscribed view of river ecosystems that concentrated on spatial patterns in sections of river, to a view that emphasizes linkages at a variety of spatial and temporal scales. Conceptualisation of river ecosystems has taken various forms, differing in whether they are zonal or cli-