

JSR

Journal of Sedimentary Research

An International Journal of SEPM

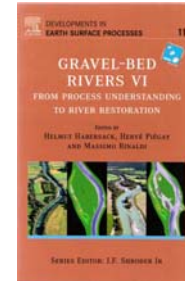
Paul McCarthy and Gene Rankey, Editors

A.J. (Tom) van Loon, Associate Editor for Book Reviews

Review accepted 6 April 2009



Gravel-Bed Rivers 6—From Process Understanding to River Restoration, edited by Helmut Habersack, Hervé Piegay & Massimo Rinaldi, 2008. Developments in Earth Surface Processes 11. Elsevier, P.O. Box 211, 1000 AE Amsterdam, The Netherlands. Hardcover, 836 pages. Price USD 185.00; GBP 115.00; EUR 155.00. ISBN 978-0-44-52861-2.



This book was published following the 6th International Gravel Bed Rivers workshop. It contains 30 chapters from 88 contributing authors and is organised into 6 sections following the key themes of the workshop. The first section of the book gives a general overview of spatial and temporal scales for the analysis of river processes. The following two sections collect together contributions on flow and sediment dynamics at small scales within river channels and then a series of chapters on sediment delivery and storage at larger scales. The fourth and fifth sections respectively address the issues of channel change and instability, and the interdisciplinary topics of ecohydrology and ecohydraulics. Finally there are a set of contributions that deal with the application of fluvial geomorphology to river management and restoration issues. The book follows the familiar format of previous Gravel-Bed Rivers workshop publications with most chapters being followed by discussion and reply comments from conference participants, who often answer questions that a reader finds himself asking at the end of a chapter.

“Scales of analysis for gravel-bed rivers” is the first theme addressed in the book, with three significant chapters presenting an overview of the importance of scale in terms of understanding river processes. Beginning with the broadest analysis of scale, the first chapter considers the spatial and temporal scales that characterise flow dynamics, roughness, sediment transport, channel morphology and pattern, and ecology. These concepts are usefully summarised by a diagram delimiting the boundaries of temporal and spatial scale behaviour. Considering a practical scale for modelling and measurement, the second chapter emphasises the importance of considering variability within reaches and therefore the limitations of the concept of stability inherent in regime theory. It then goes on to consider how new developments in observations and modelling may improve our understanding of the variability of rivers, but both approaches involve assumptions that need to be better understood. The third chapter considers scale in terms of hydrodynamics, and suggests that velocity spectra are composed of 4 scales. In addition, this chapter considers double averaging of the hydrodynamic equations, and demonstrates the importance of averaging across scales to represent complex flows.

“Analysis of processes at point and local scales,” the second theme, has contributions from physical models, field studies and numerical analyses of flow structure and sediment transport and their impacts on hydrodynamics and channel morphology. Interesting measurements and numerical simulations are presented in Chapters 4 and 5 of flow both within and above a gravel bed, providing a unique insight into the relationships between interstitial flow (measured using pressure sensors and inferred from thermal properties) and the turbulent boundary layer above. The next two chapters examine the dynamics of bifurcations. Chapter 6 highlights the intrinsic tendency for bifurcations to be unbalanced and sensitive to initial channel configuration, whilst numerical modelling of sediment transport, in Chapter 7, shows that when heterogeneous sediment mixtures are considered only less frequent flood discharges produce substantial changes

in bed topography. Following the theme of flood magnitude and frequency, Chapter 8 reviews the effects of large floods and identifies that the aggregate effect of large floods is greatest in headwater channels, whereas individual large floods are most significant in the middle portion of drainage basins. A review of bank erosion processes in Chapter 9 highlights the weakness that fluvial-erosion and mass-failure models have not been integrated and that feedback between these processes needs to be accounted for in future model developments. Detailed examination of the response of bed surface grain size distributions to cycled hydrographs is presented in Chapter 10. This yields the important result that bed samples easily obtained during low flow are representative of bed surfaces at higher flows when the sediment surface is not easily sampled, although this outcome is dependent on a constant sediment supply. Chapter 11 reviews the role of armour layers, sediment supply and bedload transport, highlighting improvements in understanding that enable well-defined trends to be identified, but that a “general equation” does not yet exist due to the problem’s complexity.

Sediment delivery and storage are the key themes in the third section of the book. Although the section title refers to the “basin scale,” the later chapters look at smaller scales. Results from the CAESER cellular model dealt with in Chapter 12 demonstrate the importance of antecedent conditions which result in non-linear relationships between water discharge and sediment yield. As identified in the subsequent discussion, this work demonstrates the uncertainties involved in sediment transport predictions. In contrast to the numerical model of the previous chapter, Chapter 13 uses data from different spatial and temporal scales to quantify changes in sediment supply and transfer and their relationship to changes in land use. Returning to modelling, Chapter 14 predicts changes in gravel-river beds under different climate change scenarios, and highlights the need to improve the parameterization of boundary conditions to produce “convincing” model predictions. Chapters 15 to 18 return to the theme of the last chapter in the previous section that existing bedload-transport theory does not adequately describe the complexity of gravel-bed rivers. These complexities include: differences in sediment supply not accounting for variability of sediment load (Chapter 15); the importance of geomorphic units, relative elevation and frequency of potential mobilization (Chapter 16); the role of sediment waves (Chapter 17); and the presence or absence of stabilizing bedforms associated with periods of low and high sediment supply respectively (Chapter 18).

The fourth section addresses channel change and instability. The focus of Chapters 19 and 20 is on anthropogenic modification of river systems that lead to changes in bed texture, and the resulting degradation of habitats (Chapter 19), and on significant channel incision resulting in increased flood risk and sediment-storage potential (Chapter 20). The most interesting chapter in this section (Chapter 21) highlights the role of riparian vegetation and demonstrates that the interaction between floods and vegetation growth may govern the development of single-thread or braided river channel planforms supporting the theoretical concept on vegetation growth damping the lateral erosion process. The final chapter in this section documents the impacts of large magnitude floods in Switzerland immediately prior to the workshop.

The two themes of ecohydrology and ecohydraulics are touched upon in several earlier chapters but are given greater attention in the fifth section. Many previous studies of reservoir operation have examined impacts within channels, but Chapter 23 broadens these studies to investigate possible approaches to restoring physical processes that support ecosystem functions throughout the floodplain. Perhaps the most interesting experimental study in this book is an investigation of macro-invertebrate behaviour in gravel beds (Chapter 24) under conditions of increasing velocities and turbulence. The outcome indicates that relative rather than absolute hydraulic forces dictate animal movements, and the study shows the potential for experimental approaches to ecological investigations. In contrast, Chapter 25 investigates ecology at a much broader scale using hydraulic geometry as a tool for predicting the ecological impact of stream restoration. Chapter 26 considers the importance of bar morphology and substrate particle size on the development of vegetation communities.

The final section of the book considers river management and restoration, starting with a broad overview of river restoration in the Alps (Chapter 27). The most significant conclusion from this chapter is that many rivers are close to a state where “natural” river restoration will be

impossible. The following chapter addresses the need to include uncertainty in river-restoration projects. Chapter 29 considers historical channel changes and assesses the potential for natural flood processes to restore the structure and function of the floodplain. The final chapter quantifies the ecological benefits of restoration and identifies both successes and limitations in a large-scale restoration project.

Overall, the standard of production and quality of editing is very high, which is a credit to the editors, and I would strongly recommend the book to those interested in gravel-bed rivers. The book would undoubtedly be an invaluable addition to the personal book collection of any fluvial geomorphologist or river engineer, but the cost means that it is most likely to be found on library shelves.

Stuart McLelland
Department of Geography
University of Hull
HULL HU6 7RX
United Kingdom
e-mail: S.J.McLelland@hull.ac.uk



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